

# **Data-Over-Cable Service Interface Specifications DOCSIS 3.0**

## **Operations Support System Interface Specification**

**CM-SP-OSSIv3.0-I24-140729**

**ISSUED**

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# 1 SCOPE

## 1.1 Introduction and Purpose

This specification is part of the DOCSIS® family of specifications developed by Cable Television Laboratories (CableLabs). In particular, this specification is part of a series of specifications that define the third generation of high-speed data-over-cable systems. This specification was developed for the benefit of the cable industry, and includes contributions by operators and vendors from North America, Europe, and other regions.

## 1.2 Background

### 1.2.1 Broadband Access Network

A coaxial-based broadband access network is assumed. This may take the form of either an all-coax or hybrid-fiber/coax (HFC) network. The generic term "cable network" is used here to cover all cases.

A cable network uses a tree-and-branch architecture with analog transmission. The key functional characteristics assumed in this document are the following:

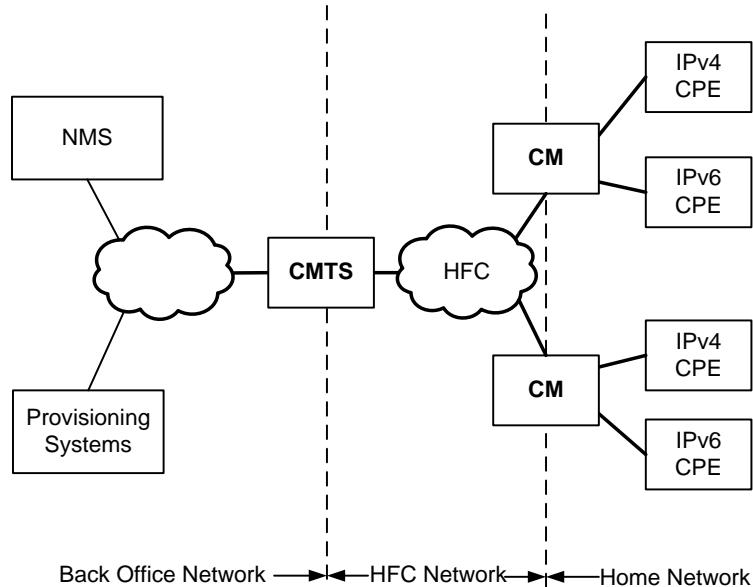
- Two-way transmission.
- A maximum optical/electrical spacing between the CMTS and the most distant CM of 100 miles in each direction, although typical maximum separation may be 10-15 miles.
- A maximum differential optical/electrical spacing between the CMTS and the closest and most distant modems of 100 miles in each direction, although this would typically be limited to 15 miles.

At a propagation velocity in fiber of approximately 1.5 ns/ft., 100 miles of fiber in each direction results in a round-trip delay of approximately 1.6 ms.

## 1.2.2 Network and System Architecture

### 1.2.2.1 The DOCSIS Network

The elements that participate in the provisioning of DOCSIS services are shown in Figure 1-1.



**Figure 1-1 - The DOCSIS Network**

The CM connects to the operator's HFC network and to a home network, bridging packets between them. Many CPEs devices can connect to the CMs' LAN interfaces CPE devices can be embedded with the CM in a single device, or they can be separate standalone devices (as shown in Figure 1-1). CPE devices may use IPv4, IPv6 or both forms of IP addressing. Examples of typical CPE devices are home routers, set-top devices, and personal computers.

The CMTS connects the operator's back office and core network with the HFC network. Its main function is to forward packets between these two domains, and optionally to forward packets between upstream and downstream channels on the HFC network. The CMTS performs this forwarding with any combination of link-layer (bridging) and network-layer (routing) semantics.<sup>1</sup>

Various applications are used to provide back office configuration and other support to the devices on the DOCSIS network. These applications use IPv4 and/or IPv6 as appropriate to the particular operator's deployment. The following applications include:

- Provisioning Systems<sup>2</sup>
  - The DHCP servers provide the CM with initial configuration information, including the device IP address(es), when the CM boots.
  - The Configuration File server is used to download configuration files to CMs when they boot. Configuration files are in binary format and permit the configuration of the CM's parameters.
    - The Software Download server is used to download software upgrades to the CM.
  - The Time Protocol server provides Time Protocol clients, typically CMs, with the current time of day.
  - Certificate Revocation server provides certificate status.

<sup>1</sup> Revised per OSSlv3.0-N-12-1058-3 on 7/24/12 by JS.

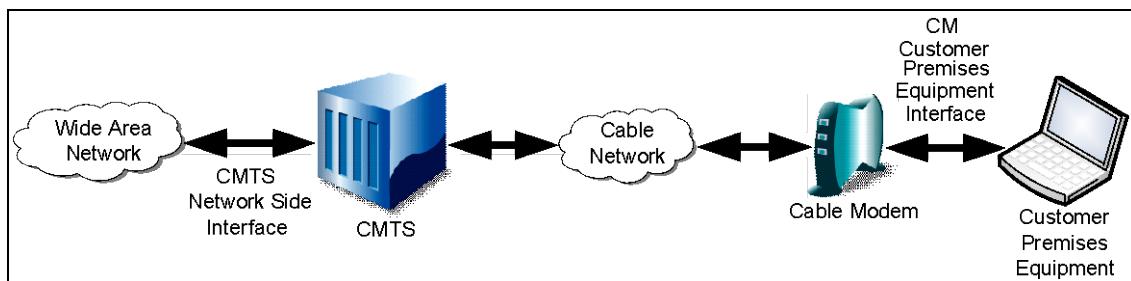
<sup>2</sup> Section modified per OSSlv3.0-N-07.0581 on 1/29/08 by KN.

- Network Management System (NMS)
  - The SNMP Manager allows the operator to configure and monitor SNMP Agents, typically the CM and the CMTS.
  - The syslog server collects messages pertaining to the operation of devices.
  - The IPDR Collector server allows the operator to collect bulk statistics in an efficient manner

### 1.2.3 Service Goals

As cable operators have widely deployed high-speed data services on cable television systems, the demand for bandwidth has increased. Additionally, networks have scaled to such a degree that IPv4 address constraints are becoming a burden on network operations. To this end, CableLabs' member companies have decided to add new features to the DOCSIS® specification for the purpose of increasing channel capacity, enhancing network security, expanding addressability of network elements, and deploying new service offerings.

The DOCSIS system allows transparent bi-directional transfer of Internet Protocol (IP) traffic, between the cable system head-end and customer locations, over an all-coaxial or hybrid-fiber/coax (HFC) cable network. This is shown in simplified form in Figure 1-2.



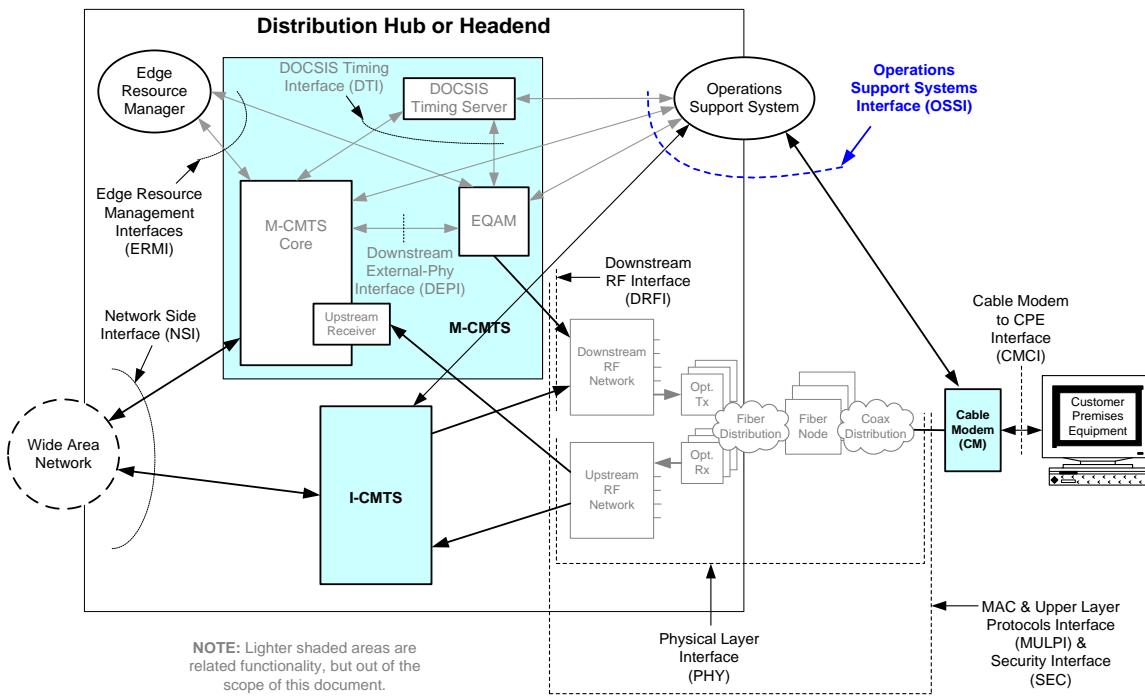
**Figure 1-2 - Transparent IP Traffic through the Data-Over-Cable System**

### 1.2.4 Statement of Compatibility<sup>3</sup>

This specification defines the DOCSIS 3.0 interface. Prior generations of DOCSIS were commonly referred to as DOCSIS 1.0, 1.1, and 2.0. DOCSIS 3.0 is backward-compatible with equipment built to the previous specifications with the optional exception for handling DOCSIS 1.0 CMs. DOCSIS 3.0-compliant CMs interoperate seamlessly with DOCSIS 2.0, DOCSIS 1.1, and DOCSIS 1.0 CMTSs. DOCSIS 3.0-compliant CMTSs seamlessly support DOCSIS 2.0, DOCSIS 1.1, and may optionally support DOCSIS 1.0 CMs (refer to Annex G of [MULPI]).

<sup>3</sup> Revised per OSSIV3.0-N-12-1040-3 on 7/24/12 by JS.

### 1.2.5 Reference Architecture



**Figure 1-3 - Data-over-Cable Reference Architecture**

The reference architecture for data-over-cable services and interfaces is shown in Figure 1-3.

### 1.2.6 DOCSIS 3.0 Documents

A list of the specifications in the DOCSIS 3.0 series is provided in Table 1-1. For further information, please refer to <http://www.cablemodem.com>.

**Table 1-1 - DOCSIS 3.0 Series of Specifications<sup>4</sup>**

Designation	Title
CM-SP-PHYv3.0	Physical Layer Specification
CM-SP-MULPIv3.0	Media Access Control and Upper Layer Protocols Interface Specification
CM-SP-OSSIV3.0	Operations Support System Interface Specification
CM-SP-SECv3.0	Security Specification
CM-SP-CMCIv3.0	Cable Modem CPE Interface Specification

This specification is defining the interface for the Operations Support Systems Interface (OSSI).

Related DOCSIS specifications are listed in Table 1-2.

<sup>4</sup> Revised per OSSIV3.0-N-08.0700-4 on 1/7/09 by JS.

**Table 1-2 - DOCSIS 3.0 Related Specifications<sup>5</sup>**

<b>Designation</b>	<b>Title</b>
CM-SP-eDOCSIS	eDOCSIS™ Specification
CM-SP-DRFI	Downstream Radio Frequency Interface Specification
CM-SP-DTI	DOCSIS Timing Interface Specification
CM-SP-DEPI	Downstream External PHY Interface Specification
CM-SP-DSG	DOCSIS Set-Top Gateway Interface Specification
CM-SP-ERMI	Edge Resource Manager Interface Specification
CM-SP-M-OSSI	M-CMTS Operations Support System Interface Specification
CM-SP-L2VPN	Layer 2 Virtual Private Networks Specification
CM-SP-TEI	TDM Emulation Interface Specification

### 1.3 Requirements

Throughout this document, 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 specification.
- "MUST NOT" This phrase means that the item is an absolute prohibition of this specification.
- "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.

This document defines many features and parameters, and a valid range for each parameter is usually specified. Equipment (CM and CMTS) requirements are always explicitly stated. Equipment must comply with all mandatory (MUST and MUST NOT) requirements to be considered compliant with this specification. Support of non-mandatory features and parameter values is optional.

### 1.4 Conventions

In this specification the following convention applies any time a bit field is displayed in a figure. The bit field should be interpreted by reading the figure from left to right, then from top to bottom, with the MSB being the first bit so read and the LSB being the last bit so read.

MIB syntax and XML Schema syntax is represented by this code sample font.

**Note:** Notices and/or Warnings are identified by this style font and label.

<sup>5</sup> Revised per OSSIV3.0-N-08.0700-4 on 1/7/09 by JS.

## 1.5 Organization of Document

Section 1 provides an overview of the DOCSIS 3.0 series of specifications including the DOCSIS reference architecture and statement of compatibility.

Section 2 includes a list of normative and informative references used within this specification.

Section 3 defines the terms used throughout this specification.

Section 4 defines the acronyms used throughout this specification.

Section 5 provides a technical overview and lists the DOCSIS 3.0 key features for the functional area of this specification.

Section 6 defines requirements for the OSS1 SNMP and IPDR management protocols.

Section 7 defines the requirements for the OSS1 management objects including SNMP MIBs and IPDR Service Definitions.

Section 8 defines the OSS1 requirements for the PHY, MAC and Network Layers.

Section 9 defines the OSS1 requirements for the Cable Modem to CPE Interface (CMCI).

Section 10 defines the OSS1 requirements for the Cable Model device including LED operations.

### 1.5.1 Annexes<sup>6</sup> (Normative)

Annex A includes a detailed list of MIB object requirements for the CM and CMTS.

Annex B defines the IPDR Service Definition and associated schema for Subscriber Account Management.

Annex C defines the IPDR Service Definition auxiliary schemas.

Annex D includes a detailed list of DOCSIS events and the associated formats.

Annex E defines the MGMD-STD-MIB requirements for DOCSIS 3.0 MGMD devices.

Annex F defines protocol filtering requirements.

Annex G defines the object model for the DOCSIS 3.0 Diagnostic Log feature.

Annex H defines the requirements for DOCS-IFEXT2-MIB.

Annex I defines the object model for the DOCSIS 3.0 Load Balancing requirements.

Annex J defines the object model for the DOCSIS 3.0 Enhanced Signal Quality Monitoring feature.

Annex K defines the DOCSIS 3.0 data type definitions.

Annex L defines the object model for the DOCSIS 3.0 Security requirements.

Annex M defines the object model for the DOCSIS 3.0 IP Multicast requirements.

Annex N defines the object model for the CM registration and upstream status requirements.

Annex O defines the object model for the MAC requirements.

Annex P defines the object model for the Subscriber Management requirements.

Annex Q defines the DOCSIS 3.0 MIB modules.

Annex R defines the DOCSIS 3.0 IPDR Service Definition schemas.

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<sup>6</sup> Revised per OSS1v3.0-N-07.0481-2 by ab on 7/17/07.

### 1.5.2 Appendices (Informative)

Appendix I identifies business process scenarios for Subscriber Account Management.

Appendix II provides a summary of Cable Modem authentication and code file authentication including areas of responsibility.

Appendix III includes example IPDR Instance Documents.

Appendix IV includes a list of IPDR/SP message encoding examples.

Appendix V identifies signal quality monitoring use cases for use as operational guideline examples.

Appendix VI provides an overview of the Object Model Notation using UML.

Appendix VII includes an RCC/RCP object diagram and corresponding XML Schema and Instance Documents.

Appendix VIII includes recommendations regarding CMTS exporter configuration.

Appendix IX includes acknowledgements and contains a list of contributors.

Appendix X includes engineering change revision history.

## 2 REFERENCES

### 2.1 Normative References<sup>7</sup>

In order to claim compliance with this specification, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights may be required to use or implement such normative references.

- [CMCI] DOCSIS Cable Modem to Customer Premise Equipment Interface Specification, CM-SP-CMCIV3.0-I02-140729, July 29, 2014, Cable Television Laboratories, Inc.
- [DPoE-MEFv1.0] DPoE-SP-MEFv1.0, DOCSIS Provisioning of EPON, Metro Ethernet Forum Specification, I03-120830, August 30, 2012, Cable Television Laboratories, Inc.
- [DSG] DOCSIS Set-Top Gateway (DSG) Interface Specification, CM-SP-DSG-I24-130808, August 2013, Cable Television Laboratories, Inc.
- [eDOCSIS] eDOCSISTM Specification, CM-SP-eDOCSIS-I27-140403, April 3, 2014, Cable Television Laboratories, Inc.
- [EQAM-PMI] Edge QAM Provisioning and Management Interface Specification, CM-SP-EQAM-PMI-I02-111117, November 17, 2011, Cable Television Laboratories, Inc.
- [IPDR/BSR] IPDR Business Solution Requirements - Network Data Management Usage (NDM-U), Version 3.7, TM Forum, October 2009.
- [IPDR/CAPAB] IPDR/Capability File Format, Version 3.9, TM Forum, October 2009.
- [IPDR/SP] IPDR Streaming Protocol (IPDR/SP) Specification, TMF8000-IPDR-IIS-PS, Version 2.7, TM Forum, November 2011.
- [IPDR/SSDG] IPDR Service Specification Design Guide, Version 3.8, TM Forum, October 2009.
- [IPDR/XDR] IPDR/XDR File Encoding Format, Version 3.5.1, TM Forum, October 2009.
- [M-OSSI] DOCSIS M-CMTS Operations Support System Interface Specification, CM-SP-M-OSSI-I08-081209, December 9, 2008, Cable Television Laboratories, Inc.
- [MULPIv3.0] DOCSIS MAC and Upper Layer Protocols Interface Specification, CM-SP-MULPIv3.0-I25-140729, July 29, 2014, Cable Television Laboratories, Inc.
- [PC EMv10] PacketCable 1.0 Event Messages Specification, PKT-SP-EM-C01-071129, November 29, 2007, Cable Television Laboratories, Inc.
- [PHYv3.0] DOCSIS Physical Layer Specification v3.0, CM-SP-PHYv3.0-I11-130808, August 8, 2013, Cable Television Laboratories, Inc.
- [RFC 1112] IETF RFC 1112, S. Deering, Host Extensions for IP Multicasting, August 1989.
- [RFC 2464] IETF RFC 2464, M. Crawford, Transmission of IPv6 Packets over Ethernet Networks, December 1998.
- [RFC 1157] IETF RFC 1157, J. D. Case, et al., A Simple Network Management Protocol (SNMP), May 1990.
- [RFC 1832] IETF RFC 1832, R. Srinivasan, XDR: External Data Representation Standard, August 1995.
- [RFC 1901] IETF RFC 1901, K. Norseth, Ed. and E. Bell, Ed., Introduction to Community-based SNMPv2, January 1996.
- [RFC 2578] IETF RFC 2578, K. McCloghrie, et al., Structure of Management Information Version 2 (SMIV2), April 1999.
- [RFC 2580] IETF RFC 2580, K. McCloghrie, et al., Conformance Statements for SMIV2, April 1999.

<sup>7</sup> Section revised per OSSIV3.0-N-07.0376-1 by ab on 5/3/07 and per OSSIV3.0-N-07.0402-1 on 5/7/07 by KN, and per OSSIV3.0-N-07.0480-3 by ab on 7/12/07. Revised per OSSIV3.0-N-07.0532-4 on 1/29/08 by KN. Revised per OSSIV3.0-N-09.0846-1 on 9/15/09 by JB. Revised per OSSIV3.0-N-10.0967-3 on 1/20/11 by JB; per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB, and per OSSIV3.0-12.1040-3 on 7/25/2012 by JS; per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO

- [RFC 2669] IETF RFC 2669, M. St. Johns, Ed., DOCSIS Cable Device MIB Cable Device Management Information Base for DOCSIS compliant Cable Modems and Cable Modem Termination Systems, August 1999.
- [RFC 2710] IETF RFC 2710, Multicast Listener Discovery (MLD) for IPv6, S. Deering, W. Fenner, B. Haberman, October 1999.
- [RFC 2786] IETF RFC 2786, M. St. Johns, Diffie-Helman [sic] USM Key Management Information Base and Textual Convention, March 2000.
- [RFC 2790] IETF RFC 2790, Waldbusser, P. Grillo, Host Resources MIB, March 2000.
- [RFC 2863] IETF RFC 2863, K. McCloghrie and F. Kastenholz, The Interfaces Group MIB, June 2000.
- [RFC 2933] IETF RFC 2933, K. McCloghrie et al., Internet Group Management Protocol MIB, October 2000.
- [RFC 3083] IETF RFC 3083, R. Woundy, Baseline Privacy Interface Management Information Base for DOCSIS Compliant Cable Modems and Cable Modem Termination Systems, March 2001.
- [RFC 3164] IETF RFC 3164, C. Lonvick, The BSD syslog Protocol, August 2001.
- [RFC 3376] IETF RFC 3376, Internet Group Management Protocol, Version 3, B. Cain, S. Deering, I. Kouvelas, B. Fenner, A. Thyagarajan, October 2002.
- [RFC 3410] IETF RFC 3410, J. Case, et al., Introduction and Applicability Statements for Internet-Standard Management Framework, December 2002.
- [RFC 3411] IETF RFC 3411/STD0062, D. Harrington, et al., An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks, December 2002.
- [RFC 3412] IETF RFC 3412, J. Case, et al., Message Processing and Dispatching for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3413] IETF RFC 3413/STD0062, D. Levi, et al., Simple Network Management Protocol (SNMP) Applications, December 2002.
- [RFC 3414] IETF RFC 3414/STD0062, U. Blumenthal and B. Wijnen, User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3), December 2002.
- [RFC 3415] IETF RFC 3415, B. Wijnen, et al., View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3416] IETF RFC 3416, R. Presuhn, Ed., Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3417] IETF RFC 3417, R. Presuhn, Ed., Transport Mappings for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3418] IETF RFC 3418, R. Presuhn, Ed., Management Information Base (MIB) for the Simple Network Management Protocol (SNMP), December 2002.
- [RFC 3419] IETF RFC 3419, M. Daniele, J. Schoenwaelder, Textual Conventions for Transport Addresses, December 2002.
- [RFC 3433] IETF RFC 3433, A. Bierman, D. Romascanu, K.C. Norseth, Entity Sensor Management Information Base, December 2002.
- [RFC 3584] IETF RFC 3584, R. Frye, et al., Coexistence between Version 1, Version 2, and Version 3 of the Internet-Standard and Network Management Framework, March 2000.
- [RFC 3635] IETF RFC 3635, J. Flick, Definitions of Managed Objects for the Ethernet-like Interface Types, September 2003.
- [RFC 3810] IETF RFC 3810, Multicast Listener Discovery Version 2 (MLDv2) for IPv6, R. Vida, Ed., L. Costa, Ed, June 2004.
- [RFC 3826] IETF RFC 3826, U. Blumenthal, *et al.*, The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model, June 2004.

- [RFC 3927] IETF RFC 3927, G. Klyne, et al., Dynamic Configuration of IPv4 Link-Local Addresses, May 2005.
- [RFC 4022] IETF RFC 4022, R. Raghunarayanan, Ed., Management Information Base for the Transmission Control Protocol (TCP), March 2005.
- [RFC 4036] IETF RFC 4036, W. Sawyer, Management Information Base for Data Over Cable Service Interface Specification (DOCSIS) Cable Modem Termination Systems for Subscriber Management, April 2005.
- [RFC 4113] IETF RFC 4113, B. Fenner and J. Flick, Management Information Base for the User Datagram Protocol (UDP), June 2005.
- [RFC 4131] IETF RFC 4131, S. Green et al., Management Information Base for Data Over Cable Service Interface Specification (DOCSIS) Cable Modems and Cable Modem Termination Systems for Baseline Privacy Plus, September 2005.
- [RFC 4133] IETF RFC 4133, A. Bierman, K. and McCloghrie, Entity MIB, August 2005.
- [RFC 4188] IETF RFC 4188, K. Norseth, Ed. and E. Bell, Ed., Definitions of Managed Objects for Bridges, September 2005.
- [RFC 4293] IETF RFC 4293, S. Routhier, Ed., Management Information Base for the Internet Protocol (IP), April 2006.
- [RFC 4506] IETF RFC 4506/STD0067, XDR: External Data Representation Standard. M. Eisler, Ed. May 2006.
- [RFC 4546] IETF RFC 4546, D. Raftus and E. Cardona, Radio Frequency (RF) Interface Management Information Base for DOCSIS 2.0 Compliant RF Interfaces, June 2006.
- [RFC 4601] IETF RFC 4601, Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised), B. Fenner, M. Handley, H. Holbrook, I. Kouvelas, August 2006.
- [RFC 4639] IETF RFC 4639, R. Woundy and K. Marez, Cable Device Management Information Base for Data-Over-Cable Service Interface Specification (DOCSIS) Compliant Cable Modems and Cable Modem Termination Systems, December 2006.
- [RFC 5132] IETF RFC 5132, IP Multicast MIB, D. McWalter, D. Thaler, A. Kessler. December 2007
- [RFC 5519] IETF RFC 5519, J. Chesterfield and B. Haberman, Multicast Group Membership Discovery MIB, April 2009.
- [SEC] DOCSIS Security Specification, CM-SP-SECv3.0-I15-130808, August 8, 2013, Cable Television Laboratories, Inc.
- [TEI] Business Services over DOCSIS™ TDM Emulation Interface Specification, CM-SP-TEI-I06-100611, June 11, 2010, Cable Television Laboratories, Inc.
- [USB] Universal Serial Bus Specification, Compaq, Hewlett-Packard, Intel, Lucent, Microsoft, NEC, Philips, Revision 2.0, April 27, 2000 (<http://www.usb.org>)
- [W3 XML1.0] Extensible Markup Language (XML) 1.0 (Third Edition), W3C Recommendation 04, February 2004.
- [W3 XSD1.0] XML Schema Part 1: Structures Second Edition, W3C Recommendation 28, October 2004.
- RFC 2236] IETF RFC 2236, Internet Group Management Protocol, Version 2, W. Fenner, November 1997.

## 2.2 Informative References<sup>8</sup>

This specification uses the following informative references.

- [DRFI] DOCSIS Downstream Radio Frequency Interface, CM-SP-DRFI-I14-131120, November 20, 2013, Cable Television Laboratories, Inc.
- [ISO 11404] BS ISO/IEC 11404:1996 Information technology--Programming languages, their environments and system software interfaces--Language-independent datatypes, January 2002.
- [ISO 19501] ISO/IEC 19501:2005 Information technology -- Open Distributed Processing -- Unified Modeling Language (UML) Version 1.4.2.
- [ITU-T M.3400] ITU-T Recommendation M.3400 (02/2000), TMN management functions.
- [ITU-T X.692] ITU-T Recommendation X.692 (03/2002), Information technology – ASN.1 encoding rules: Specification of Encoding Control Notation (ECN).
- [NSI] DOCSIS Cable Modem Termination System - Network Side Interface Specification, SP-CMTS-NSI-I01-960702, July 2, 1996, Cable Television Laboratories, Inc.
- [PKT-DQOS 1.5] PacketCable 1.5 Dynamic Quality-of-Service Specification, PKT-SP-DQOS1.5-I04-090624, June 24, 2009, Cable Television Laboratories, Inc.
- [PKT-PCMM] PacketCable Specification, Multimedia Specification, PKT-SP-MM-106-110629, June 29, 2011, Cable Television Laboratories, Inc.
- [RFC 1042] IETF RFC 1042, J. Postel and J.K. Reynolds. Standard for the transmission of IP datagrams over IEEE 80 networks, February 1988.
- [RFC 1213] IETF RFC 1213, K. McCloghrie and M. Rose, Management Information Base for Network Management of TCP/IP-base internets: MIB-II, March 1991.
- [RFC 2460] IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification. S. Deering and R. Hinden, December 1998.
- [RFC 2560] IETF RFC 2560, M. Myers, *et al.*, X.509 Internet Public Key Infrastructure Online Certificate Status Protocol – OCSP, June 1999.
- [RFC 2579] IETF RFC 2579, K. McCloghrie, *et al.*, Textual Conventions for SMIV2, April 1999.
- [RFC 2821] IETF RFC 2821, J. Klensin, Simple Mail Transfer Protocol, April 2001.
- [RFC 2856] IETF RFC 2856, A. Bierman, *et al.*, Textual Conventions for Additional High Capacity Data Types, June 2000.
- [RFC 3019] IETF RFC 3019, B. Haberman, R. and Worzella, IP Version 6 Management Information Base for The Multicast Listener Discovery Protocol, January 2001.
- [RFC 3168] IETF RFC 3168, K. Ramakrishnan *et al.*, The Addition of Explicit Congestion Notification.
- [RFC 3260] IETF RFC 3260, D. Grossman, New Terminology and Clarifications for Diffserv, April 2002.
- [RFC 3289] IETF RFC 3289, F. Baker, K. Chan, A. Smith, Management Information Base for the Differentiated Services Architecture, May 2002.
- [RFC 3306] IETF RFC 3306, B. Haberman, and D. Thaler, Unicast-Prefix-based IPv6 Multicast Addresses, August 2002.
- [RFC 3423] IETF RFC 3423, K. Zhang and E. Elkin, XACCT's Common Reliable Accounting for Network Element (CRANE), Protocol Specification Version 1.0, November 2002.
- [RFC 3569] IETF RFC 3569, S. Bhattacharyya, Ed., An Overview of Source-Specific Multicast (SSM), July 2003.
- [RFC 4001] IETF RFC 4001, M. Daniele, *et al.*, Textual Conventions for Internet Network Addresses, February 2005.

<sup>8</sup> Revised per OSSIV3.0-N-07.0395-3 by ab on 5/4/07, OSSIV3.0-N-07.0473-3 by ab on 7/12/07, and per OSSIV3.0-12.1040-3 on 7/25/2012 by JS.

[RFC 4181]	IETF RFC 4181, C. Heard, Ed. Guidelines for Authors and Reviewers of MIB Documents, September 2005.
[RFC 4291]	IETF RFC 4291, R. Hinden and S. Deering, Internet Protocol Version 6 (IPv6) Addressing Architecture, February 2006.
[RFC 4323]	IETF RFC 4323, M. Patrick and W. Murwin, Data Over Cable System Interface Specification Quality of Service Management Information Base (DOCSIS-QOS MIB), January 2006.
[RFC 4604]	IETF RFC 4604, H. Holbrook <i>et al.</i> , Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast, August 2006.
[RFC 791]	IETF RFC 791, J. Postel. Internet Protocol, September 1981.

## 2.3 Reference Acquisition

CableLabs Specifications:

- Cable Television Laboratories, Inc., 858 Coal Creek Circle, Louisville, CO 80027; Phone +1-303-661-9100, Fax +1-303-661-9199; <http://www.cablelabs.com>

ANSI Specifications:

- American National Standards Institute, Inc. 1819 L Street, NW, 6th floor Washington, DC 20036; Phone +1-202-293-8020; Fax +1-202-293-9287; <http://www.ansi.org>

IETF Specifications:

- Internet Engineering Task Force (IETF) Secretariat, 48377 Fremont Blvd., Suite 117, Fremont, California 94538, USA; Phone: +1-510-492-4080, Fax: +1-510-492-4001.

IPDR Specifications:

- 240 Headquarters Plaza, East Tower, 10th Floor, Morristown, NJ 07960; Phone +1-973-944-5100; Fax +1-973-944-5110; <http://www.tmforum.org>

ISO Specifications:

- International Organization for Standardization (ISO), 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland; Phone +41 22 749 01 11, Fax +41 22 733 34 30; <http://www.iso.org>

ITU Recommendations:

- International Telecommunication Union, Place des Nations, CH-1211, Geneva 20, Switzerland; Phone +41-22-730-51-11; Fax +41-22-733-7256; <http://www.itu.int>

World Wide Web Consortium (W3C)

- Massachusetts Institute of Technology, 32 Vassar Street, Room 32-G515, Cambridge, MA 02139; Phone +1-617-253-2613, Fax +1-617-258-5999; <http://www.w3.org/Consortium/>

### 3 TERMS AND DEFINITIONS<sup>9</sup>

This specification uses the following terms:

<b>Allocation</b>	A group of contiguous mini-slots in a MAP which constitute a single transmit opportunity.
<b>Bridging CMTS</b>	A CMTS that makes traffic forwarding decisions between its Network Systems Interfaces and MAC Domain Interfaces based upon the Layer 2 Ethernet MAC address of a data frame.
<b>Burst</b>	A single continuous RF signal from the upstream transmitter, from transmitter on to transmitter off.
<b>Cable Modem (CM)</b>	A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.
<b>Cable Modem Termination System (CMTS)</b>	Cable modem termination system, located at the cable television system head-end or distribution hub, which provides complementary functionality to the cable modems to enable data connectivity to a wide-area network.
<b>Cable Modem Termination System - Network Side Interface (CMTS-NSI)</b>	The interface, defined in [NSI], between a CMTS and the equipment on its network side.
<b>Cable Modem to CPE Interface (CMCI)</b>	The interface, defined in [CMCI], between a CM and CPE.
<b>Carrier-to-Noise plus Interference Ratio (CNIR)</b>	The ratio of the expected commanded received signal power at the CMTS input to the noise plus interference in the channel.
<b>Channel</b>	The frequency spectrum occupied by a signal. Usually specified by center frequency and bandwidth parameters.
<b>Chip</b>	Each of the 128 bits comprising the S-CDMA spreading codes.
<b>Classifier</b>	A set of criteria used for packet matching according to TCP, UDP, IP, LLC, and/or 802.1P/Q packet fields. A classifier maps each packet to a Service Flow. A Downstream Classifier is used by the CMTS to assign packets to downstream service flows. An Upstream Classifier is used by the CM to assign packets to upstream service flows.
<b>Customer</b>	See End User.
<b>Customer Premises Equipment (CPE)</b>	Equipment at the end user's premises; may be provided by the end user or the service provider.
<b>Downstream (DS)</b>	In cable television, the direction of transmission from the head-end to the subscriber.
<b>End User</b>	A human being, organization, or telecommunications system that accesses the network in order to communicate via the services provided by the network.
<b>FCAPS</b>	A set of principles for managing networks and systems, wherein each letter represents one principle. F is for Fault, C is for Configuration, A is for Accounting, P is for Performance, S is for Security.
<b>Fiber Node</b>	A point of interface between a fiber trunk and the coaxial distribution.
<b>Hybrid Fiber/Coax (HFC) System</b>	A broadband bidirectional shared-media transmission system using fiber trunks between the head-end and the fiber nodes, and coaxial distribution from the fiber nodes to the customer locations.

<sup>9</sup> Section revised per OSSIV3.0-07.0403-1 on 5/8/07 and per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

<b>Inform</b>	A confirmed SNMP message for asynchronous notification of events from an SNMP entity.
<b>International Organization for Standardization (ISO)</b>	An international standards body, commonly known as the International Standards Organization.
<b>IPDRDoc</b>	Master IPDR Schema Document [IPDR/BSR]
<b>Local Log</b>	A volatile or non-volatile log stored within a network element.
<b>Logical Upstream Channel</b>	A MAC entity identified by a unique channel ID and for which bandwidth is allocated by an associated MAP message. A physical upstream channel may support multiple logical upstream channels. The associated UCD and MAP messages completely describe the logical channel.
<b>Media Access Control (MAC) address</b>	The "built-in" hardware address of a device connected to a shared medium.
<b>MAC Domain</b>	A subcomponent of the CMTS that provides data forwarding services to a set of downstream and upstream channels.
<b>MAC Domain Cable Modem Service Group</b>	The subset of a Cable Modem Service Group which is confined to the Downstream Channels and Upstream Channels of a single MAC domain. Differs from a CM-SG only if multiple MAC domains are assigned to the same CM-SGs.
<b>MAC Domain Downstream Service Group</b>	The subset of a Downstream Service Group (DS-SG) which is confined to the Downstream Channels of a single MAC domain. An MD-DS-SG differs from a DS-SG only when multiple MAC domains are configured per CM-SG.
<b>MAC Domain Upstream Service Group</b>	The subset of an Upstream Service Group (US-SG) which is confined to the Upstream Channels of a single MAC Domain. An MD-US-SG differs from a US-SG only when multiple MAC domains are defined per CM-SG.
<b>Micro-reflections</b>	Echoes in the forward or reverse transmission path due to impedance mismatches between the physical plant components. Micro-reflections are distinguished from discrete echoes by having a time difference (between the main signal and the echo) on the order of 1 microsecond. Micro-reflections cause departures from ideal amplitude and phase characteristics for the transmission channel.
<b>Mini-Slot</b>	A "mini-slot" is an integer multiple of 6.25-microsecond increments.
<b>Network Management</b>	The functions related to the management of data link layer and physical layer resources and their stations across the data network supported by the hybrid fiber/coax system.
<b>Network Management System (NMS)</b>	The hardware and software components used by the Network Provider to manage its networks as a whole. The Network Management System provides an end-to-end network view of the entire network enabling management of the network elements contained in the network.
<b>Notification</b>	Information emitted by a managed object relating to an event that has occurred within the managed object.
<b>Open Systems Interconnection (OSI)</b>	A framework of ISO standards for communication between different systems made by different vendors, in which the communications process is organized into seven different categories that are placed in a layered sequence based on their relationship to the user. Each layer uses the layer immediately below it and provides a service to the layer above. Layers 7 through 4 deal with end-to-end communication between the message source and destination, and layers 3 through 1 deal with network functions.
<b>Physical (PHY) Layer</b>	Layer 1 in the Open System Interconnection (OSI) architecture; the layer that provides services to transmit bits or groups of bits over a transmission link between open systems and which entails electrical, mechanical and handshaking procedures.
<b>Pre-3.0 DOCSIS</b>	Versions of CableLabs Data-Over-Cable-Service-Interface-Specifications (DOCSIS) prior to the DOCSIS 3.0 suite of specifications.

<b>Primary Service Flow</b>	All CMs have a Primary Upstream Service Flow and a Primary Downstream Service Flow. They ensure that the CM is always manageable and they provide a default path for forwarded packets that are not classified to any other Service Flow.
<b>QoS Parameter Set</b>	The set of Service Flow Encodings that describe the Quality of Service attributes of a Service Flow or a Service Class.
<b>Routing CMTS</b>	A CMTS that makes traffic forwarding decisions between its Network System Interfaces and MAC Domain Interfaces based upon the Layer 3 (network) address of a packet.
<b>Service Class</b>	A set of queuing and scheduling attributes that is named and that is configured at the CMTS. A Service Class is identified by a Service Class Name. A Service Class has an associated QoS Parameter Set.
<b>Service Class Name</b>	An ASCII string by which a Service Class may be referenced in modem configuration files and protocol exchanges.
<b>Service Flow</b>	A MAC-layer transport service which provides unidirectional transport of packets from the upper layer service entity to the RF and shapes, polices, and prioritizes traffic according to QoS traffic parameters defined for the Flow.
<b>Service Flow Identifier (SFID)</b>	An identifier assigned to a service flow by the CMTS [32 bits].
<b>Service Identifier (SID)</b>	An Identifier assigned by the CMTS to an Active or Admitted Upstream Service Flow [14 bits].
<b>Simple Network Management Protocol (SNMP)</b>	A network management protocol of the IETF.
<b>SNMP Agent</b>	The term "agent" is used throughout this section to refer to 1) a SNMPv1/v2 agent or 2) a SNMPv3 entity [RFC 3411] which contains command responder and notification originator applications.
<b>SNMP Manager</b>	The term "manager" is used throughout this section to refer to 1) a SNMPv1/v2 manager or 2) a SNMPv3 entity [RFC 3411] which contains command generator and/or notification receiver applications.
<b>Subscriber</b>	See End User.
<b>Syslog</b>	A protocol that provides the transport of event notifications messages across IP networks.
<b>Trap</b>	An unconfirmed SNMP message for asynchronous notification of events from an SNMP entity.
<b>Upstream (US)</b>	The direction from the subscriber location toward the head-end.

## 4 ABBREVIATIONS AND ACRONYMS<sup>10</sup>

This specification uses the following abbreviations:

<b>ACK</b>	Acknowledge
<b>ANSI</b>	American National Standards Institute
<b>ARP</b>	Address Resolution Protocol
<b>ASCII</b>	American Standard Code for Information Interchange
<b>ASM</b>	Any Source Multicast
<b>ASN.1</b>	Abstract Syntax Notation 1
<b>BOOTR</b>	Boot ROM
<b>BPI</b>	Baseline Privacy Interface
<b>BPI+</b>	Baseline Privacy Interface Plus
<b>BPKM</b>	Baseline Privacy Key Management
<b>BSR</b>	Business Solution Requirements
<b>BSS</b>	Business Support System
<b>CA</b>	Certificate Authority
<b>CableLabs</b>	Cable Television Laboratories
<b>CATV</b>	Community Access Television, Cable Television
<b>CDC</b>	Communications Device Class
<b>CLI</b>	Command Line Interface
<b>CM</b>	Cable Modem
<b>CMCI</b>	Cable Modem to CPE Interface
<b>CMIM</b>	Cable Modem Interface Mask
<b>CM-SG</b>	Cable Modem Service Group
<b>CMTS</b>	Cable Modem Termination System
<b>CNIR</b>	Carrier-to-Noise plus Interference Ratio
<b>CoS</b>	Class of Service
<b>CPE</b>	Customer Premises Equipment
<b>CPU</b>	Central Processing Unit
<b>CRANE</b>	Common Reliable Accounting for Network Elements
<b>CRL</b>	Certificate Revocation List
<b>CSA</b>	Code Signing Agent
<b>CSR</b>	Customer Service Representative
<b>CVC</b>	Code Verification Certificate
<b>dB</b>	Decibel
<b>DBC</b>	Dynamic Bonding Change
<b>DBG</b>	Downstream Bonding Group
<b>DCC</b>	Dynamic Channel Change
<b>DCID</b>	Downstream Channel Identifier

<sup>10</sup> Section revised per OSSIV3.0-07.0403-1 on 5/8/07 by KN.

<b>DCS</b>	Downstream Channel Set
<b>DEPI</b>	Downstream External Physical layer Interface
<b>DES</b>	Digital Encryption Standard
<b>DH</b>	Diffie-Hellman
<b>DHCP</b>	Dynamic Host Configuration Protocol
<b>DNS</b>	Domain Name Service
<b>DOCSIS®</b>	Data-Over-Cable Service Interface Specifications
<b>DoS</b>	Denial of Service
<b>DS</b>	Downstream
<b>DSAP</b>	Destination Service Access Point
<b>DSCP</b>	Differentiated Services Code Point
<b>DSID</b>	Downstream Service Identifier
<b>EAE</b>	Early Authentication and Encryption
<b>ERMI</b>	Edge Resource Manager Interface
<b>eSAFE</b>	Embedded Service/Application Functional Entity
<b>EUI-64</b>	64-bit Extended Unique Identifier
<b>FC</b>	Frame Control
<b>FCAPS</b>	Fault, Configuration, Accounting, Performance, Security
<b>FEC</b>	Forward Error Correction
<b>FQDN</b>	Fully Qualified Domain Name
<b>FSM</b>	Finite State Machine
<b>GC</b>	Group Configuration
<b>GCR</b>	Group Classifier Rule
<b>GMAC</b>	Group Media Access Control
<b>GMT</b>	Greenwich Mean Time
<b>GQC</b>	Group Quality of Service Configuration
<b>GSF</b>	Group Service Flow
<b>HFC</b>	Hybrid Fiber/Coax (HFC) System
<b>HMAC</b>	Keyed-Hash Message Authentication Code
<b>IANA</b>	Internet Assigned Numbers Authority
<b>ICMP</b>	Internet Control Message Protocol
<b>ID</b>	Identifier
<b>IDL</b>	Interactive Data Language
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>IETF</b>	Internet Engineering Task Force
<b>IGMP</b>	Internet Group Management Protocol
<b>INIT</b>	Initialize or Initialization
<b>IP</b>	Internet Protocol
<b>IPv4</b>	Internet Protocol version 4
<b>IPv6</b>	Internet Protocol version 6
<b>IPCDN</b>	Internet Protocol over Cable Data Network (IETF working group)

<b>IPDR</b>	Internet Protocol Detail Record
<b>IR</b>	Internet Protocol Detail Record Recorder
<b>ISO</b>	International Standards Organization
<b>ITU</b>	International Telecommunications Union
<b>ITU-T</b>	Telecommunication Standardization Sector of the International Telecommunication Union
<b>LAN</b>	Local Area Network
<b>LED</b>	Light Emitting Diode
<b>LLC</b>	Logical Link Control
<b>LSB</b>	Least Significant Bit
<b>MAC</b>	Media Access Control
<b>MAP</b>	Bandwidth Allocation Map
<b>M-CMTS</b>	Modular Cable Modem Termination System
<b>MD-CM-SG</b>	Media Access Control Domain Cable Modem Service Group
<b>MDD</b>	MAC Domain Descriptor
<b>MD-DS-SG</b>	MAC Domain Downstream Service Group
<b>MD-US-SG</b>	MAC Domain Upstream Service Group
<b>MDF</b>	Multicast DSID Forwarding
<b>MER</b>	Modulation Error Ratio
<b>MGCP</b>	Media Gateway Control Protocol
<b>MGMD</b>	Multicast Group Membership Discovery
<b>MIB</b>	Management Information Base
<b>MLD</b>	Multicast Listener Discovery
<b>MP</b>	Multipart
<b>MSB</b>	Most Significant Bit
<b>MSO</b>	Multiple Systems Operator
<b>MTA</b>	Multimedia Terminal Adapter
<b>MTC</b>	Multiple Transmit Channel
<b>NACO</b>	Network Access Control Object
<b>NE</b>	Network Element
<b>NMS</b>	Network Management System
<b>NSI</b>	Network Side Interface
<b>OCSP</b>	Online Certificate Status Protocol
<b>OID</b>	Object Identifier
<b>OM</b>	Object Model
<b>OSI</b>	Open Systems Interconnection
<b>OSS</b>	Operations Support System
<b>OSSI</b>	Operations Support System Interface
<b>PC</b>	Personal Computer
<b>PCMM</b>	PacketCable™ Multimedia
<b>PDU</b>	Protocol Data Unit
<b>PHY</b>	Physical Layer

<b>PS</b>	CableHome Portal Services
<b>QAM</b>	Quadrature Amplitude Modulation
<b>QoS</b>	Quality of Service
<b>PHS</b>	Payload Header Suppression
<b>QPSK</b>	Quadrature Phase-Shift Keying
<b>RCC</b>	Receive Channel Configuration
<b>RCP</b>	Receive Channel Profile
<b>RCP-ID</b>	Receive Channel Profile Identifier
<b>RCS</b>	Receive Channel Set
<b>REG</b>	Registration
<b>RFC</b>	Request for Comments
<b>RF</b>	Radio Frequency
<b>RFI</b>	Radio Frequency Interface
<b>RNG</b>	Range or Ranging
<b>ROM</b>	Read Only Memory
<b>SA</b>	Security Association or Source Address
<b>SAID</b>	Security Association Identifier
<b>SAMIS</b>	Subscriber Accounting Management Interface Specification
<b>SAV</b>	Source Address Verification
<b>SC</b>	Service Consumer
<b>S-CDMA</b>	Synchronous Code Division Multiple Access
<b>SCN</b>	Service Class Name
<b>SE</b>	Service Element
<b>SF</b>	Service Flow
<b>SFID</b>	Service Flow Identifier
<b>SG</b>	Service Group
<b>SID</b>	Service Identifier
<b>SIP</b>	Session Initiation Protocol
<b>SLA</b>	Service Level Agreement
<b>SMI</b>	Structure of Management Information
<b>SMIv1</b>	Structure of Management Information Version 1
<b>SMIv2</b>	Structure of Management Information Version 2
<b>SNAP</b>	Sub-network Access Protocol
<b>SNMP</b>	Simple Network Management Protocol
<b>SNMPv1</b>	Version 1 of the Simple Network Management Protocol
<b>SNMPv2c</b>	Version 2C of the Simple Network Management Protocol
<b>SNMPv3</b>	Version 3 of the Simple Network Management Protocol
<b>SNR</b>	Signal to Noise Ratio
<b>SOHO</b>	Small Office – Home Office
<b>SP</b>	Streaming Protocol
<b>SRT</b>	Source Routing Transparent

<b>SSD</b>	Secure Software Download
<b>SSM</b>	Source Specific Multicast
<b>STB</b>	Set-top Box
<b>STP</b>	Spanning Tree Protocol
<b>SW</b>	Software
<b>SYNC</b>	Synchronize or Synchronization
<b>TBD</b>	To Be Determined (or To Be Deferred)
<b>TEK</b>	Traffic Encryption Key
<b>TLV</b>	Type/Length/Value
<b>TCP</b>	Transmission Control Protocol
<b>TCS</b>	Transmit Channel Set
<b>TFTP</b>	Trivial File Transfer Protocol
<b>TOD</b>	Time Of Day
<b>TOS</b>	Type of Service
<b>UBG</b>	Upstream Bonding Group
<b>UCC</b>	Upstream Channel Change
<b>UCD</b>	Upstream Channel Descriptor
<b>UCID</b>	Upstream Channel Identifier
<b>UDC</b>	Upstream Drop Classifier
<b>UDP</b>	User Datagram Protocol
<b>UML</b>	Unified Modeling Language
<b>URL</b>	Uniform Resource Locator
<b>US</b>	Upstream
<b>USB</b>	Universal Serial Bus
<b>USM</b>	User-based Security Model
<b>UTC</b>	Coordinated Universal Time
<b>UUID</b>	Universally Unique Identifier
<b>VACM</b>	View-based Access Control Model
<b>VLAN</b>	Virtual Local Area Network
<b>VPN</b>	Virtual Private Network
<b>XDR</b>	External Data Representation
<b>XML</b>	Extensible Markup Language
<b>XSD</b>	XML Schema Definition

## 4.1 XML Namespaces

This specification uses the following XML namespace prefixes to indicate the corresponding public XML namespaces.

**Table 4-1 - Public XML Namespaces**

Prefix	XML Namespace	Specification Reference
xsd	http://www.w3.org/2001/XMLSchema	[W3 XSD1.0]
xsi	http://www.w3.org/2001/XMLSchema-instance	[W3 XSD1.0]
ipdr	http://www.ipdr.org/namespaces/ipdr	[IPDR/SSDG]

This specification defines the following XML namespaces for DOCSIS IPDR Service Definitions.

**Table 4-2 - IPDR Service Definition Namespaces<sup>11</sup>**

Prefix	XML Namespace
DOCSIS-SAMIS-TYPE-1	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-1
DOCSIS-SAMIS-TYPE-2	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-2
DOCSIS-CMTS-CM-US-STATS-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US-STATS-TYPE
DOCSIS-CMTS-CM-REG-STATUS-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-REG-STATUS-TYPE
DOCSIS-CMTS-TOPOLOGY-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-TOPOLOGY-TYPE
DOCSIS-SPECTRUM-MEASUREMENT-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM-MEASUREMENT-TYPE
DOCSIS-CPE-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE-TYPE
DOCSIS-DIAG-LOG-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-TYPE
DOCSIS-DIAG-LOG-EVENT-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-EVENT-TYPE
DOCSIS-DIAG-LOG-DETAIL-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL-TYPE
DOCSIS-CMTS-US-UTIL-STATS-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL-STATS-TYPE
DOCSIS-CMTS-DS-UTIL-STATS-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL-STATS-TYPE
DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE
DOCSIS-IP-MULTICAST-STATS-TYPE	http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST-STATS-TYPE

<sup>11</sup> Table revised per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN; per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB; per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

This specification defines the following XML namespaces for DOCSIS auxiliary schemas.

**Table 4-3 - Auxiliary Schema Namespaces<sup>12</sup>**

Prefix	XML Namespace
DOCSIS-CMTS	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS</a>
DOCSIS-CM	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM</a>
DOCSIS-CPE	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE</a>
DOCSIS-QOS	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS</a>
DOCSIS-REC	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC</a>
DOCSIS-CMTS-CM-US	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US</a>
DOCSIS-CMTS-CM-NODE-CH	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH</a>
DOCSIS-MD-NODE	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE</a>
DOCSIS-SPECTRUM	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM</a>
DOCSIS-DIAG-LOG	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG</a>
DOCSIS-DIAG-LOG-DETAIL	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL</a>
DOCSIS-CMTS-US-UTIL	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL</a>
DOCSIS-CMTS-DS-UTIL	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL</a>
DOCSIS-SERVICE-FLOW	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SERVICE-FLOW">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SERVICE-FLOW</a>
DOCSIS-IP-MULTICAST	<a href="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST">http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST</a>

<sup>12</sup> Table revised per OSSIV3.0-N-08.0642-3 on 4/25/08 by K; N per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB; per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

## 5 OVERVIEW

This section provides a brief description of the key management features introduced in DOCSIS 3.0. These features are categorized according to the five conceptual categories of management developed as part of ITU Recommendation [ITU-T M.3400]. This set of management categories is referred to as the FCAPS model, represented by the individual management categories of Fault, Configuration, Accounting, Performance and Security.

In addition to the description of features, the rationale behind the introduction of object models is presented. Section 5.1 discusses the requirements introduced in this specification for DOCSIS 3.0. Section 5.2 is a technical introduction to the detailed models in support of the user requirements.

### 5.1 DOCSIS 3.0 OSSI Key Features

DOCSIS 3.0 introduces a number of features that build upon features introduced in previous versions of DOCSIS. This specification includes the key new features for the Operations Support System Interface (OSSI) based on the requirements established with both the introduction of new DOCSIS 3.0 features and enhancements to management capabilities that are designed to improve operational efficiencies for the MSO.

Table 5-1 summarizes the new requirements that support new 3.0 features and the enhancements to existing management features. The table shows the management features along with the traditional Network Management Functional areas (Fault, Configuration, Accounting, Performance and Security) for the Network Elements (NE) Cable Modem (CM), Cable Modem Termination System (CMTS) and the corresponding OSI layer where those features operate.

**Table 5-1 - Management Features Requirements for DOCSIS 3.0**

Features	Management Functional Area	OSI layer	NE	Description
Multiple Upstream Channels per port	Configuration	PHY	CMTS	Provisioning physical upstream ports that support multiple upstream receivers according to their capabilities.
Plant Topology		PHY, MAC (Data Link)	CMTS	Provisioning flexible arrangements of US/DS channels for channel bonding configuration to reflect HFC plant topology.
Enhanced Diagnostics	Fault	PHY, MAC, Network	CMTS	Detailed log of different conditions associated with the CM registration state and operation that may indicate plant problems affecting service availability.
Enhanced Performance Data Collection	Performance	PHY, MAC, Network	CMTS	IPDR streaming of large statistical data sets such as CMTS CM Status information with less performance impact on the CMTS resources.
Enhanced Signal Quality Monitoring		PHY	CMTS	To gather information on narrow band ingress and distortion affecting the quality of the RF signals.
Usage Based Billing	Accounting	PHY, MAC, Network	CMTS	Update SAMIS to 3.0 specification requirements.

Features	Management Functional Area	OSI layer	NE	Description
Enhanced Security	Configuration, Fault, Performance, Security	MAC, Network	CM/CMTS	Updates to management models to support The DOCSIS 3.0 security features.
IPv6	Configuration, Fault, Performance	Network	CM/CMTS	Updates to management models to support IPv6 provisioning, CM IP stack management, CMTS and CM IP Filtering requirements.
Channel Bonding	Configuration, Fault, Performance	PHY, MAC	CM/CMTS	Update existing management models and include new events to support DS and US channel bonding.
IP Multicast	Configuration, Fault, Performance	MAC, Network	CM/CMTS	Update existing management modes to support new multicast capabilities such as SSM, IGMP v3, MLD v1 and v2.

It needs to be noted that pre-3.0 DOCSIS Network Management models used IETF RFCs that were defined to use only IPv4. After the introduction of IPv6, IETF IPv6 compliant MIBs are not backward compatible with IPv4 based MIBs required by pre-3.0 DOCSIS. In contrast, provisioning system backward compatibility is a key requirement for management. To accommodate these two conflicting requirements (backwards compatibility and IPv6 support using combined v4/v6 MIBs), DOCSIS 3.0 requires maintaining backward compatibility for provisioning but not monitoring. This approach minimizes the additional costs that will be required if both versions of MIBs are required in the CM and CMTSs for provisioning and monitoring purposes.

It is important to emphasize that DOCSIS 3.0 Network Management requirements accentuate the need for proactive maintenance, traffic analysis and dimensioning of services (see Section 5.1.3 on Performance Management Features) in an effort to minimize critical fault conditions and the occurrence of failures.

### 5.1.1 Fault Management Features

The DOCSIS 3.0 fault management requirements include:

- Extended lists of detailed events related to the new set of DOCSIS 3.0 features.
- A new diagnostic tool that enables the detection of unstable CM operation, such as:
  - CM repeat registration attempts
  - Station maintenance retry sequences

### 5.1.2 Configuration Management Features

The Configuration of the DOCSIS protocols for CM/CMTS interactions for configuring features in support of PHY MAC/QoS and Security (BPI) uses the CM configuration file and CMTS policies via MAC messages exchange. The reporting of configuration state information is done via SNMP MIB objects. This model provides a CM standard configuration with minimal operator intervention.

The DOCSIS 3.0 configuration requirements include:

- Updates to CM configuration parameters to support IPv6 and channel bonding, enhanced security and IP multicast.
- Updates to CMTS configuration in support of multiple upstream channels per port, HFC plant topology, channel bonding, security, IPv6, and IP multicast.
- Security enhancements for the CM provisioning process, such as TFTP proxy, configuration file learning, certificate revocation list, etc.

### 5.1.3 Performance Management Features

The DOCSIS 3.0 performance management requirements include:

- DOCSIS 3.0 requires an efficient mechanism for collecting large data sets as described above. The identified data sets are:
  - The CMTS resident CM status information
  - Additional granularity of QoS statistics for bonded and non bonded channels to aid in network capacity planning and dimensioning
  - Enhanced signal quality monitoring for granular plant status
- Minimizing redundant information collection associated with differing services provided by the CMTS (statistics for PacketCable voice may incorporate large data sets for DOCSIS PHY and MAC)
- Support for CM and CMTS host resource statistics, such as memory and CPU utilization

### 5.1.4 Security Management Features

Security Management includes both security of management information (e.g., SNMP access control) and management of network security related to authentication, authorization and privacy of data plane communications.

DOCSIS 3.0 includes new features to strengthen the confidentiality of user data over the HFC network and the authenticity of CMs for features such as software upgrades. Both features improve the protection of the DOCSIS network against theft of service and denial of service attacks.

SNMPv1, v2c management of 3.0 CMs is essential due to the extensive deployment of SNMP frameworks utilizing NmAccess configuration. The NmAccess approach has been deprecated by the IETF.

In order to address the enhancements and comply with the IETF decision, the DOCSIS 3.0 security management requirements include:

- Extensions are required in the management models of CM and CMTS to report configuration status, error conditions and statistics of the new security features
- Replacement of NmAccess is required using a method compatible with the SNMPv3 framework to configure SNMP v1 and v2c access controls

**Note:** The management of security models such as PKI (Public Key Infrastructure) for the management of cable modem X.509 certificates are outside the scope of DOCSIS 3.0 Network Management Requirements.

### 5.1.5 Accounting Management Features <sup>13</sup>

The CMTS supports collection of usage information for use in a billing interface known as SAMIS (Subscriber Accounting Management Interface Specification). SAMIS uses the business model originally defined by IPDR.org and IPDR streaming protocol [IPDR/SP] (now both managed by the TM Forum) for the reliable and resource efficient transmission of accounting data. There are no accounting requirements for the CM. Refer to Section 8.3 for further details.

## 5.2 Technical Overview

The technical overview presented in this section details functional areas of the FCAPS management model addressed by DOCSIS.

### 5.2.1 Architectural Overview

This section defines the functional areas of network management in terms of FCAPS (Fault, Configuration, Accounting, Performance and Security) as applied to the management of a DOCSIS network.

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<sup>13</sup> Revised per OSSIV3.0-N-10.0971-2 on 4/26/11 by JB. Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

The requirements in the previous section were grouped both according to the management functional area and the relevant DOCSIS layer (using the OSI reference model) where they apply. This section provides an overview of the functions supported by each area. Even though specific functions are described for each area, there are interdependencies amongst all these functions to achieve the overall objective of efficient and proactive management of the DOCSIS network.

Fault management seeks to identify, isolate, correct and record system faults. Configuration management modifies system configuration variables and collects configuration information. Accounting management collects usage statistics for subscribers, sets usage quotas and bills users according to their use of the system. Performance management focuses on the collection of performance metrics, analysis of these metrics and the setting of thresholds and rate limits. Security management encompasses identification and authorization of users and equipment, provides audit logs and alerting functions, as well as providing vulnerability assessment.

### **5.2.1.1 Fault Management**

The goals of fault management are to provide failure detection, diagnosis, and perform or indicate necessary fault correction. Fault identification relies on the ability to monitor and detect problems, such as error-detection events. Fault resolution relies on the ability to diagnose and correct problems, such as executing a sequence of diagnostic test scripts, and correcting equipment or configuration faults. DOCSIS supports Event Reporting using Local Log, syslog and SNMP notifications.

For the CMTS, syslog messages or SNMP notifications are used to deliver the critical events that cause service interruption and need immediate response. Examples of these events are interface state up/down, and threshold events when the total number of CMs in a fault condition exceeds a configured threshold.

### **5.2.1.2 Configuration Management**

Configuration management is concerned with adding, initializing, maintaining and updating network elements. In a DOCSIS environment, network elements include CMs and CMTSs.

Configuration management is primarily concerned with network control via modifying operating parameters on network elements such as the CM and CMTS. Configuration parameters could include both physical resources (for example, an Ethernet interface) and logical objects (for example, QoS parameters for a given service flow).

While the network is in operation, configuration management is responsible for monitoring the configuration state and making changes in response to commands by a management system or some other network management function.

For example, a performance management function may detect that response time is degrading due to a high number of uncorrected frames, and may issue a configuration management change to modify the modulation type from 16-QAM to QPSK. A fault management function may detect and isolate a fault and may issue a configuration change to mitigate or correct that fault.

### **5.2.1.3 Accounting Management**

Accounting management, in general, includes collection of usage data and permits billing the customer based on the subscriber's use of network resources. The CMTS is the network element that is responsible for providing the usage statistics to support billing. Billing is outside the scope of this specification.

Subscriber Account Management Interface Specification (SAMIS) is defined to enable prospective vendors of Cable Modems and Cable Modem Termination Systems to address the operational requirements of subscriber account management in a uniform and consistent manner. It is the intention that this would enable operators and other interested parties to define, design and develop Operations and Business Support Systems necessary for the commercial deployment of different classes of service over cable networks, with accompanying usage-based billing of services for each individual subscriber.

### 5.2.1.4 Performance Management

Performance management functions include collecting statistics of parameters such as number of frames lost at the MAC layer and number of codeword errors at the PHY layer. These monitoring functions are used to determine the health of the network and whether the offered Quality of Service (QoS) to the subscriber is met. The quality of signal at the PHY layer is an indication of plant conditions.

The previous versions of DOCSIS OSSI specification defines SNMP polling as the collection mechanism for CM and CMTS statistics for performance management. SNMP polling of CMs is scalable and widely deployed with specialized engines that minimize the upstream bandwidth allocated to management during the polling intervals. In contrast, the CMTS SNMP polling is not scalable since it addresses large data sets comprised of data from thousands of CMs connected to the same CMTS.

To overcome the existing CMTS limitations, this specification includes the IPDR Streaming Protocol [IPDR/SP] which provides reliable streaming of subscriber usage data and other statistics. In addition, the IPDR streaming process enables pro-active maintenance by management systems in collecting large data sets from the CMTS.

### 5.2.1.5 Security Management

Security management is concerned with both security of management information to protect the MSOs operations systems as well as managing the security information. The latter is used to authenticate and secure the traffic on the HFC. Security of the management interface is required to prevent end users from accessing and initiating configuration changes that may provide them with services for which they are not entitled or could result in the degradation or denial of services for other subscribers.

## 5.2.2 Management Protocols

As noted earlier in this section, DOCSIS OSSI specification uses the Simple Network Management Protocol (SNMP) versions 1, 2c and 3 to define the management information for DOCSIS network elements in support of the functional areas mentioned in the previous section. SNMP is primarily a polling based protocol where the management system retrieves data such as counter values and state information. There are events defined as a notification that are used to inform the management systems of fault conditions and security violations. The support for SNMP versions is continued in DOCSIS 3.

The SNMP polling mechanism was not considered to be the appropriate long term approach to obtaining increasingly large and detailed usage information from the CMTS. A streaming protocol developed by the IPDR organization was introduced to offer an efficient mechanism for CMTSs to transfer statistics to a collector over connection oriented (TCP) continuous stream. The processing of the data is outside the scope of the CMTS and delegated to the IPDR collector and management systems to perform. DOCSIS 3.0 OSSI specification expands the use of the IPDR protocol to other management areas in order to optimize timeliness and resource efficiency in the transfer of large amounts of performance metrics to the management systems.

### 5.2.3 Object Models<sup>14</sup>

Prior versions of the DOCSIS OSSI specifications developed management information models, suitable for use with Simple Network Management Protocol. For the subscriber usage data using Internet Protocol Data Records (IPDR), XML schema definitions were included in the specification. DOCSIS 3.0 OSSI introduces an expanded IPDR paradigm where XDR-encoded records (conformant to these XML schema) are streamed to a collector for all categories of statistical data pertinent to the FCAPs management model.

The management models when using SNMP are described using the Structure of Management Information Version 2 (SMIV2) [RFC 2578] and the design of these models is determined by the capabilities of the protocol. With the introduction of IPDR for other management areas beyond accounting management, this specification introduces a new approach for representing managed objects.

The approach is based on an object oriented modeling approach well known in the industry for capturing requirements and analyzing the data in a protocol independent representation. This approach defines requirements with use cases to describe the interactions between the operations support systems and the network element. The

<sup>14</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

management information is represented in terms of objects along with their attributes and the interactions between these encapsulated objects (or also referred to as entities in some representations). With the introduction of several new, complex features in DOCSIS 3.0 and the operator needs for a more proactive and efficient approach to management information, object modeling methodologies offer the ability to reuse the same definitions when new protocols are introduced in the future.

Refer to Annex A for object modeling concepts used throughout this specification.

## 6 OSS MANAGEMENT PROTOCOLS

### 6.1 SNMP Protocol <sup>15</sup>

The SNMP protocol has been selected as the communication protocol for management of data-over-cable services.

CM MUST implement SNMPv3 protocol.

CMTS SHOULD implement SNMPv3 protocol.

Although SNMPv3 offers certain security advantages over previous SNMP versions, many existing management systems do not fully support SNMPv3; necessitating support of the theoretically less secure but more ubiquitous SNMPv1 and SNMPv2c protocols.

CM MUST implement SNMPv1 and SNMPv2c protocol.

CMTS MUST implement SNMPv1 and SNMPv2c protocol.

The IETF SNMP-related RFCs listed in Table 6-1 are supported by the CM and CMTS.

**Table 6-1 - IETF SNMP-related RFCs**

[RFC 3410]	Introduction and Applicability Statements for Internet Standard Management Framework
[RFC 3411]	An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
[RFC 3412]	Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)
[RFC 3413]	Simple Network Management Protocol (SNMP) Applications
[RFC 3414]	User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
[RFC 3415]	View-based Access Control Model (VACM) for the simple Network Management Protocol (SNMP)
[RFC 3416]	Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)
[RFC 3417]	Transport Mappings for the Simple Network Management Protocol (SNMP)
[RFC 3418]	Management Information Base for the Simple Network Management Protocol (SNMP)
[RFC 3419]	Textual Conventions for Transport Addresses
[RFC 3584]	Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework
[RFC 3826]	The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model
[RFC 1901]	Introduction to Community-based SNMPv2 (Informational)
[RFC 1157]	A Simple Network Management Protocol

For support of SMIv2, Table 6-2 lists the IETF SNMP-related RFCs which are supported by the CM and CMTS.

**Table 6-2 - SMIv2 IETF SNMP-related RFCs**

[RFC 2578]	Structure of Management Information Version 2 (SMIv2)
[RFC 2579]	Textual Conventions for SMIv2
[RFC 2580]	Conformance Statements for SMIv2

<sup>15</sup> Revised per OSSIV3.0-N-10.0958-2 on 1/20/11 by JB.

For support of Diffie-Helman Key exchange for the User Based Security Model, Table 6-3 lists the IETF SNMP-related RFC which is supported by the CM and CMTS.

**Table 6-3 - Diffie-Helman IETF SNMP-related RFC**

[RFC 2786]	Diffie-Helman USM Key Management Information Base and Textual Convention
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### 6.1.1 Requirements for IPv6

Several transport domains were initially defined for SNMP (see [RFC 3417]). To support IPv6, [RFC 3419] adds a new set of transport domains not only for SNMP but for any application protocol.

The CM MUST support the recommendations of [RFC 3419] to support SNMP over IPv6.

The CMTS MUST support the recommendations of [RFC 3419] to support SNMP over IPv6.

## 6.2 IPDR Protocol

### 6.2.1 Introduction<sup>16</sup>

This section defines the IPDR Streaming Protocol [IPDR/SP] requirements for the CMTS. Unless otherwise indicated, the term "IPDR Exporter" refers to the CMTS. A collector system is often referred to as an "IPDR Collector" and conforms to [IPDR/BSR] and in particular to [IPDR/SP] specification. IPDR collector management requirements are outside the scope of this specification. See Section 6.2.3 for a brief overview of the IPDR Standard.

[IPDR/SP] provides scalable solutions for the collection of high volume management data related to performance, usage, and operational status of the cable networks. The [IPDR/SP] scalability benefits are for both the CMTS and the data collection systems. The CMTS gains in reduced computing resources, compared with other management protocols, such as SNMP, when generating comparable data sets. The collector systems benefit from [IPDR/SP] by reducing the costs associated with reliable data collection, scalable growth in number of records, and multiple types of data sets over the same collection platform. See [IPDR/SP] for additional information about the streaming protocol design considerations.

**Note:** [IPDR/SP] applied to SAMIS is already supported by DOCSIS 2.0 OSSI specification. This specification updates the SAMIS Service Definition to support the DOCSIS 3.0 feature sets.

[IPDR/SP] is not required for CMs.

The IPDR-related standards listed in Table 6-4 are supported by CMTS.

**Table 6-4 - IPDR-related Standards**

[IPDR/SP]	IPDR/SP Protocol Specification
[IPDR/BSR]	IPDR Business Solution Requirements - Network Data Management Usage (NDM-U)
[IPDR/SSDG]	IPDR Service Specification Design Guide
[IPDR/XDR]	IPDR/XDR Encoding Format
[IPDR/CAPAB]	IPDR/Capability File Format

### 6.2.2 CMTS Usage of IPDR Standards

This specification defines new IPDR Service Definitions for performance and monitoring management applications beyond DOCSIS 2.0 SAMIS. The list of DOCSIS 3.0 IPDR Service Definitions is listed in Section 7.1.3.28.

<sup>16</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

### 6.2.3 IP Detail Record (IPDR) Standard<sup>17</sup>

[IPDR/SSDG] defines a generic model for using XML Schema in IP Detail Recording applications. [IPDR/XDR] defines the compact binary representation of corresponding IP Detail Records. This specification extends IPDR applications as described in Section 6.2.2. The following subsections describe the IPDR standard and its application.

#### 6.2.3.1 IPDR Network Model

The IPDR Network Model is given in the [IPDR/BSR] specification and is portrayed in Figure 6-1. In this network model, the Service Consumer (SC) is the Cable Data Service Subscriber identified by their Cable Modem MAC address, current CM IP address, and current CPE IP addresses. The Service Element (SE) is the CMTS identified by its host name, IP address, and current value of its sysUpTime object. The IPDR Recorder (IR) is the record formatter and exporter function that creates the data record compliant to [IPDR/BSR] based on the DOCSIS schemas. The IPDR Store (IS) and the IPDR Transmitter (IT) are two kinds of collector functions that receive IPDR XDR records from the IR exporter function as specified in Section 6.2.4. The CMTS implements the IPDR Recorder (IR) functions and is often referred to as the "Exporter". The IT/IS collector functions receive IDPR XDR records on a collection cycle determined by the IR exporter function.

The A-interface is not specified by the [IPDR/BSR] specification because it is an internal interface between the SE and the IR exporter components. The B-interface between the IR exporter and the IT/IS collector components is specified by the IPDR Streaming Protocol [IPDR/SP] and the considerations of Appendix IV of this specification. The CMTS supports the B-interface.

**Note:** The highlighted blocks and interfaces depicted in Figure 6-1 are the only ones defined in this specification. The A, C, D, E, and F interfaces are beyond the scope of this specification.

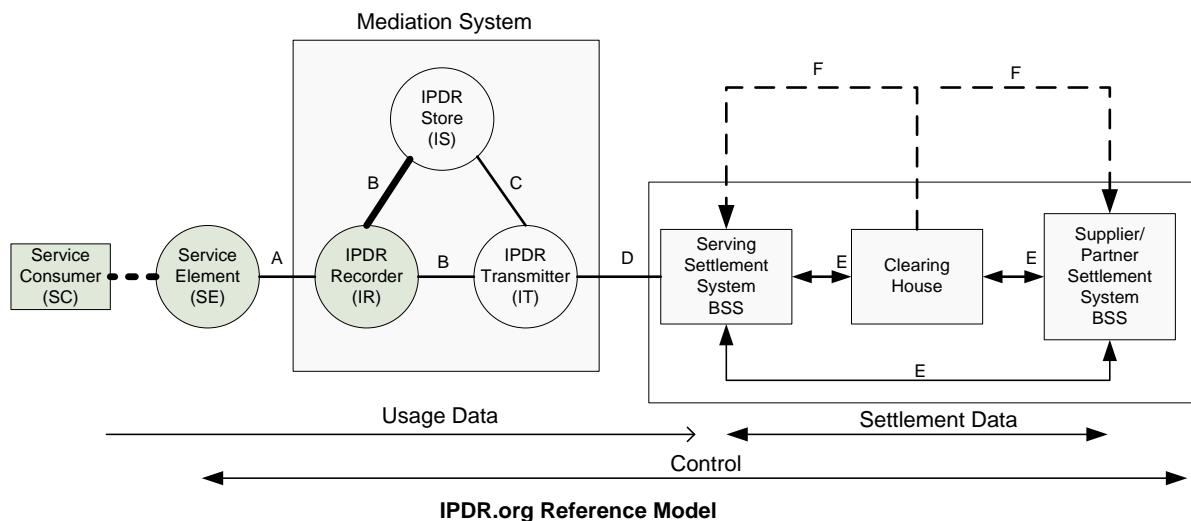


Figure 6-1 - Basic Network Model (ref. [IPDR/BSR])

#### 6.2.3.2 IPDR Transport High Level Protocol Requirements<sup>18</sup>

To facilitate processing of the DOCSIS IPDR Service Definitions by a large number of mediation systems, an Extensible Markup Language (XML) [W3 XML1.0] format is required. Specifically, the IP Detail Record (IPDR) standard as described in [IPDR/BSR] is used to model the DOCSIS IPDR Service Definitions outlined in Section 6.2.2.

<sup>17</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

<sup>18</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

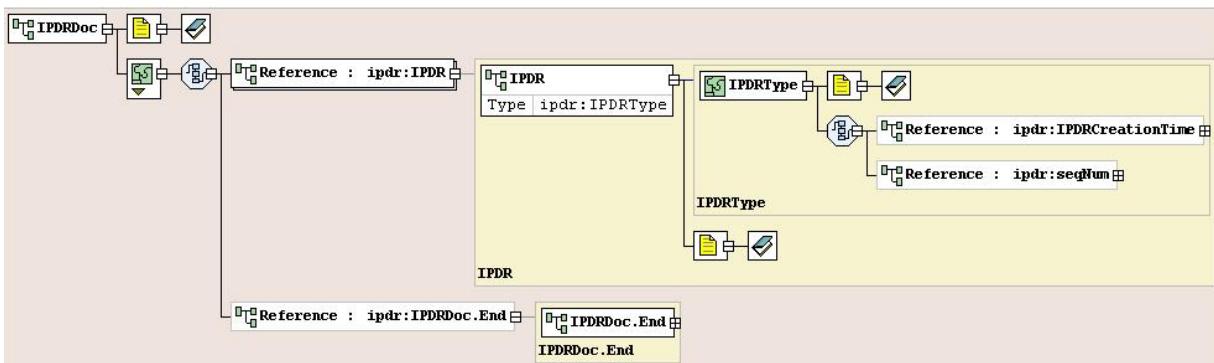
To improve the performance of storage and transmission of the BSR XML records, a compression mechanism is required. [IPDR/XDR] describes a compact encoding of IPDR Docs, based on the IETF XDR specification language [RFC 1832].

To improve the network performance of the data collection activity, a reliable high-throughput TCP stream is used to transfer data records between the record formatter and the collection system. Furthermore, at the application layer the streaming protocol [IPDR/SP] described in Section 6.2.4 is implemented to scale the collection of data in a reliable manner for both Exporters and Collectors.

To ensure the end-to-end privacy and integrity of the billing records, while either stored or in transit, an authentication and encryption mechanism between the record formatter and the collection system is desirable. The security model is detailed in Section 8.5.4.9.

### 6.2.3.3 IPDR Record Structure

The Master IPDR Schema Document (IPDRDoc) [IPDR/BSR] defines the generic structure of any IPDR document regardless of application. The IPDRDoc defines the hierarchy of elements within an IPDR instance document that are supported by the CMTS as shown in Figure 6-2 below.



**Figure 6-2 - IPDRDoc 3.5.1 Master Schema**

### 6.2.3.4 Service Definition Schemas

Service definition schemas are defined based on the guidelines listed in [IPDR/SSDG]. Refer to the applicable Annex as defined in Table 7-7 for each service definition schema.

### 6.2.3.5 Service Definition Instance Documents<sup>19</sup>

To complete the definition of an application specific IPDR record structure, an application instance schema needs to be provided that imports the basic IPDRDoc master schema (see [IPDR/SSDG]). The IPDRDoc records may be constructed by the Collector for the purpose of storing. The Collector takes the data records and may use the session ID to construct a docId, it depends upon the collector storing IPDR records as IPDR documents, or simulating a docId for the purpose of acknowledging each record as part of a reliable collection process labeled with a docId (accounting of total number of records). Some ways to mark docId could be session start/stop boundaries, but it is Collector implementation specific (see Section 6.2.4.6).

1. The IPDRDoc element is the outermost element that describes the IPDR file itself. It defines the XML namespace, the identity of the XML schema document, the version of the specification, the timestamp for the file, a unique document identifier, and the identity of the IPDR recorder. An IPDRDoc is composed of multiple IPDR records.

The attributes for the IPDRDoc element are defined as follows:

- a) xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"

<sup>19</sup> Section modified per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN. Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

Constant: the IPDR XML namespace identifier.

b) xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

Constant: the XML Schema Instance Namespace identifier. Defined by the W3C Consortium.

c) xmlns= "http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr"

Constant: the DOCSIS XML namespace identifier. Defined by CableLabs.

d) xsi:schemaLocation="\*.xsd"

Constant: the name of the DOCSIS service definition schema file. Refer to Table 7-7 for a list of the DOCSIS service definition schema files.

e) version="<IPDR BSR version>-A.n"

Constant: the version of the IPDR document. Defined by Cable Television Laboratories, Inc. This specification follows the convention of <IPDR BSR version>-A.n where n is a sequence number for versioning starting at 1. For example, the first version of a DOCSIS IPDRDoc instance document in compliance with version 3.5.1 of [IPDR/BSR] is defined as "3.5.1-A.1".

f) creationTime ="yyyy-mm-ddThh:mm:ssZ"

UTC time stamp at the time the IPDR Record is created (in ISO format). For example: creationTime="2002-06-12T21:11:21Z". Note that IPDR timestamps are always specified in UTC/GMT (Z). The compact representation of this element is the 32-bit unsignedLong value since EPOCH [IPDR/XDR].

g) docId="<32-bit UTC timestamp>-0000-0000-0000-<48-bit MAC address>"

The unique document identifier. The DOCSIS docId is in a simplified format that is compatible with the Universally Unique Identifier (UUID) format required by the IPDR [IPDR/BSR] specification.

- The docId attribute consists of the following:<sup>20</sup>
- The 32-bit UTC timestamp contains the IPDRDoc creationTime in seconds since the epoch 1 Jan 1970 UTC formatted as eight hex digits.
- The 48-bit MAC address component is the Ethernet address of the CMTS management interface formatted as 12 hex digits.
- All other components are set to zero.

In the context of the minimum 15-minute IPDR billing file collection cycle specified in this document, this simplified UUID is guaranteed to be unique across all CMTSs and for the foreseeable future.

h) IPDRRecorderInfo="hostname.mso.com"

IPDRRecorderInfo identifies the IPDR Recorder (IR) from the network model in Figure 6-1. Since the CMTS includes the IPDR Recorder function, the CMTS MUST populate the IPDRRecorderInfo attribute with its fully qualified hostname. If a hostname is not available, then the CMTS MUST populate the IPDRRecorderInfo attribute with its IPv4 address formatted in dotted decimal notation.

2. An IPDR element describes a single DOCSIS service application specific record. The IPDR record is further structured into DOCSIS specific sub elements that describe the details of the CMTS, the subscriber (CM and CPE), and the service application itself. The attributes for the IPDR element are:

xsi:type="\*-TYPE"

Constant: identifies the DOCSIS application specific type of the IPDR record. Examples of types based on the DOCSIS Service Definitions listed in Table 7-7.

In addition to the DOCSIS service specific sub-elements, the following sub-elements for the IPDR element are:

a) IPDRCreationTime

<sup>20</sup> Text revised per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN.

The IPDRCreationTime element identifies the time associated with the counters for this record. The IPDRCreationTime element uses the same format as the IPDRDoc creationTime attribute (see 1f. above). The CMTS MUST NOT support IPDRCreationTime element.

**Note:** This sub element is optional in the basic IPDR 3.5.1 schema, and is required by previous DOCSIS specifications. This specification deprecates that requirement and prohibits usage of IPDRCreationTime.

- b) seqNum

The CMTS MUST NOT support seqNum elements of the basic IPDR 3.5.1 schema.

**Note:** There is no ordering implied in DOCSIS IPDRs within an IPDRDoc.

3. IPDRDoc.End is the last element inside IPDRDoc. It defines the count of IPDRs that are contained in the file and the ending timestamp for the file creation. The attributes of IPDRDoc.End are:

- a) count="nnnn"

Where "nnnn" is the decimal count of the number of IPDR records in this IPDRDoc.

- b) endTime ="yyyy-mm-ddThh:mm:ssZ"

Where endTime is the UTC time stamp at the time the file is completed (see 1f. above).

For [IPDR/SP] protocol, it is left to the collector to generate IPDRDoc.End based on SessionStop message for a specific docId, see Section 6.2.5. In addition, IPDRDoc.End is an [IPDR/BSR] optional field and it is included in this section for information purposes with no requirements for CMTS Exporter.

#### 6.2.4 IPDR Streaming Model

DOCSIS IPDR Service records are built by the record formatter on the CMTS and are then transmitted to the collection system using the IPDR Streaming Protocol [IPDR/SP].

The [IPDR/SP] Protocol is an application running over a reliable, connection oriented transport layer protocol such as TCP. It allows exporting high volume of Data Records from a Service Element with an efficient use of network, storage, and processing resources. There are also bi-directional control message exchanges, though they only comprise a small portion of the traffic.

The [IPDR/SP] was built upon two existing specifications, namely IPDR's [IPDR/BSR] [IPDR/XDR] file format and Common Reliable Accounting for Network Elements (CRANE) [RFC 3423].

It enables efficient and reliable delivery of any data, mainly Data Records from Service Elements (the record formatters that are denoted as the "Exporters") to any collection systems (that are denoted as the "Collectors"), such as mediation systems and BSS/OSS.

**Note:** The term "Exporter" corresponds to the CMTS, unless otherwise specified.

Since the IPDR Streaming Protocol could run over different transport layers in future versions, a transport neutral version negotiation is needed. [IPDR/SP] supports a negotiation mechanism running over UDP. Either the Exporter or the Collector could inquire about the Streaming Protocol version and transport layer support by sending a UDP packet on a configured UDP port.

#### 6.2.4.1 Sessions and Collector Priorities

A Session is a logical connection between an Exporter and one or more Collectors for the purpose of delivering Data Records. For any given Session, a single active Collector will be targeted with those Data Records. Multiple Sessions may be maintained concurrently in an Exporter or Collector, in which case they are distinguished by Session IDs. For a complete specification of the Sessions, see [IPDR/SP].

A Collector is assigned a Priority value. Data Records need to be delivered to the Collector with the highest Priority value (the primary Collector) within a Session. The Collector Priority reflects the Exporter's preference regarding which Collector will receive Data Records. The assignment of the Collector Priority needs to consider factors such as geographical distance, communication cost, and Collector loading, etc. It is also possible for several Collectors to have the same priority. In this case, the selection method is vendor-specific.

#### 6.2.4.2 Documents and Collection Methodologies<sup>21</sup>

The IPDR/SP Protocol provides for open-ended streaming of data records as they are created, or as an option, logical boundaries may also be placed between groups of data records as well. A logical range of data records is called a document. For more information on this topic see [IPDR/SP]. Even though [IPDR/SP] supports the IPDRDoc instance documents requirements, the IPDRDoc is handled by the collector and not by the exporter. The collector can, for example, create IPDRDoc based on sessions start/stop sequence sent by the exporter, or based on number of records received.

In this specification, an IPDR document is defined as a series of records that were generated during the interval an IPDR session lasted or during a time interval called collection interval. Each DOCSIS IPDR Service Definition has its own requirements in terms of how IPDR documents are generated. For example, [IPDR/SP] sessions are created on a schedule basis, an open-ended session or a per-request session. Below is a list of collection methodologies:

**Time Interval Session:** The exporter follows a schedule based session to stream data on a periodic time interval. The collector creates the IPDRDoc within those demarcation points. Note that the Time Interval Session is managed by the exporter as being delimited by session start/stop messages. A collector initiated flow operation is possible as well; the collector issues Flow Stop messages to stop the exporter streaming. Finally, it is possible to control the Time Interval Session at either end-points. A Time Interval Session may close immediately after the exporter streams the records or remain open until the end of the time interval in which case, the exporter stops the session and starts a new session for the next time interval.

**Event Based Session:** It consists of an open-ended session or a Time Interval Session. During the time the IPDR session is open the exporter can stream records at any time, thus the name "Event Based Session". In the case of an open-ended session, the collector could create documents based on size, number of records received, timestamps (to simulate Time Interval Sessions), or never creates an IPDRDoc.

**Ad-hoc Session:** Per request (from a Collector), the Exporter creates a session and closes it when either the data is streamed or a closing command is generated. Once Collector starts flow CMTS Exporter SHOULD start session, stream data and stop session. The CMTS Exporter can optionally support additional management interface triggers for starting the session.

Some variations of the collection methodologies above include the possibility that an open-ended session demarcated by the collector as IPDR document by time where the records are received.

In cases where periodic records exporting applies (Time Interval Session), the DOCSIS IPDR Service Definition needs to specify the handling of records deleted in the exporter before the scheduled time for data streaming. That is accomplished either with an immediate record if exporter does not want to retain such record in memory, or wait until the next periodic interval to report that data. It is also required to distinguish between the record being a periodically exported record or a final record. This specification defines a periodic record as an "interim" record and a final record as a "stop" record.

<sup>21</sup> Revised per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

#### **6.2.4.3 Data Types and Message Format**

[IPDR/SP] describes its message format using an augmented form of [RFC 1832], External Data Representation (XDR) [IPDR/XDR]. Two augmentations of XDR used by [IPDR/XDR] that enable a more concise and formal C style syntax for describing protocol message formats, are as follows:

- Support for indefinite length specification. This allows for stream based encoding of information without knowing or calculating the entire length of a message or document in advance. The value of -1 in a length field indicates that, based on Template information, a decoder be able to determine where a message completes.
- No 32-bit alignment padding. Beginning in IPDR 3.5.1, both [IPDR/XDR] and [IPDR/SP] remove the padding constraint specified by XDR. This allows for specification to the byte level of structures. This augmentation is described in [RFC 1832], "Areas for Future Enhancement".

For a complete specification of the [IPDR/SP] message format see the Message Format section of that specification.

The type IDs for the base types and the derived types used in the protocol, the data structure as well as the data representation are described in the Data Types section of [IPDR/SP] specification.

#### **6.2.4.4 Templates and Service Definitions**

The IPDR/SP Protocol utilizes the concept of Templates in order to eliminate the transmission of redundant information such as field identifiers and typing information on a per data record basis.

A Template is an ordered list of Field Identifiers. A Field Identifier is the specification of a Field in the Template. A Template references an IPDR Service Definition. It specifies a data item that a Service Element (e.g., CMTS) may export. Each Field specifies the Type of the Field. [IPDR/SP] specifies that Templates may be optionally negotiated upon setup of the communication between the Exporter and the Collector. This allows the Exporter to avoid sending Fields that the Collector is not interested in. Several Templates can be used concurrently (for different types of records). Fields contained in a Template could be enabled or disabled. An enabled Field implies that the outgoing data record will contain the data item specified by the key. A disabled Field implies that the outgoing record will omit the specified data item. The enabling/disabling mechanism further reduces bandwidth requirements; it could also reduce processing in Service Elements, as only needed data items are produced. For a complete specification of the IPDR streaming Templates, refer to the Templates section of [IPDR/SP].

The IPDR/SP Protocol incorporates IPDR/Service Definitions [IPDR/SSDG], based on XML-Schema, by reference.

A Template references an IPDR Service Definition document, where a more complete definition of the Template is included. IPDR Service Definitions describe in detail the properties of the various data records and their fields (see Service Specification Design Guide 3.5.1 [IPDR/SSDG].)

#### **6.2.4.5 Flow Control and Data Reliability**

Flow control mechanisms are employed to ensure that data is sent from an Exporter to a Collector only if it is ready to receive data. Four messages are employed to support flow control:

- FlowStart and FlowStop are sent by the Collector to indicate whether it is ready or not ready to receive data.
- SessionStart and SessionStop messages are sent by the Exporter to designate the associated Collector the active/inactive Collector and to provide information about the IPDR document being transmitted within the Session.

Flow control mechanisms are likewise used to indicate to the Collector whether the Exporter considers the Collector to be a primary or backup Collector. The Flow control also provides information on the data sequence numbers and document Id so that the Collectors can collectively guarantee that no Data Records are lost. For the complete specification of the IPDR flow control mechanism refer to the Flow Control section of [IPDR/SP].

To further reduce the likelihood of data loss IPDR/SP Messages are acknowledged after they have been processed and the record information has been placed in persistent storage. Refer to the Data Transfer section of [IPDR/SP].

#### 6.2.4.5.1 DOCSIS IPDR/SP Flow Diagrams

Figure 6-3 illustrates the Streaming Protocol flow diagram based on the DOCSIS default Streaming Flow (the Time Interval based Session Streaming) set of requirements.

Figure 6-4 illustrates the Streaming Protocol flow for Event Based Session.

Figure 6-5 illustrates the Streaming Protocol flow for the ad-hoc Session. The Ad-hoc Streaming flow diagram shown is one of the types. The Time Interval based Session Streaming can also be treated as an Ad-hoc streaming flow. Neither these diagrams nor the explanations provided in limit the ability of a Collector or Exporter (CMTS) to be fully compliant with the IPDR Streaming Protocol flow diagram [IPDR/SP]. Note that these figure models a DocId boundary (established by the IPDR Streaming Session Start/Stop messages) that is used to identify the records created during a collection interval (see Section 6.2.4.2). A single continuously open session/document will span a single collection interval and will be closed at the end of the interval. Figure 6-3 represents a complete IPDR session/document and assumes the model of periodic data streaming with interim and stop records. Each entity instance of the DOCSIS IPDR Service will include one or more Interim records and one Stop record when the entity in the DOCSIS IPDR service is deleted. If a Service entity instance is both created and deleted within the same collection interval, then only a single Stop record is exported.

Since the collection interval may be up to 24 hours long, it is likely that Keep-Alive messages will be sent periodically to indicate that the session/document is still open but there are no Stop records to export at the moment. Later, at the end of the collection interval, the current session/document is terminated with a SessionStop message, a new DocId is created, and the next session/document is started with a SessionStart message.

**Note:** The sequence diagram shown in Figure 6-3, Figure 6-4 and Figure 6-5 does not include optional Template Negotiation and the mandatory KeepAlive messages.

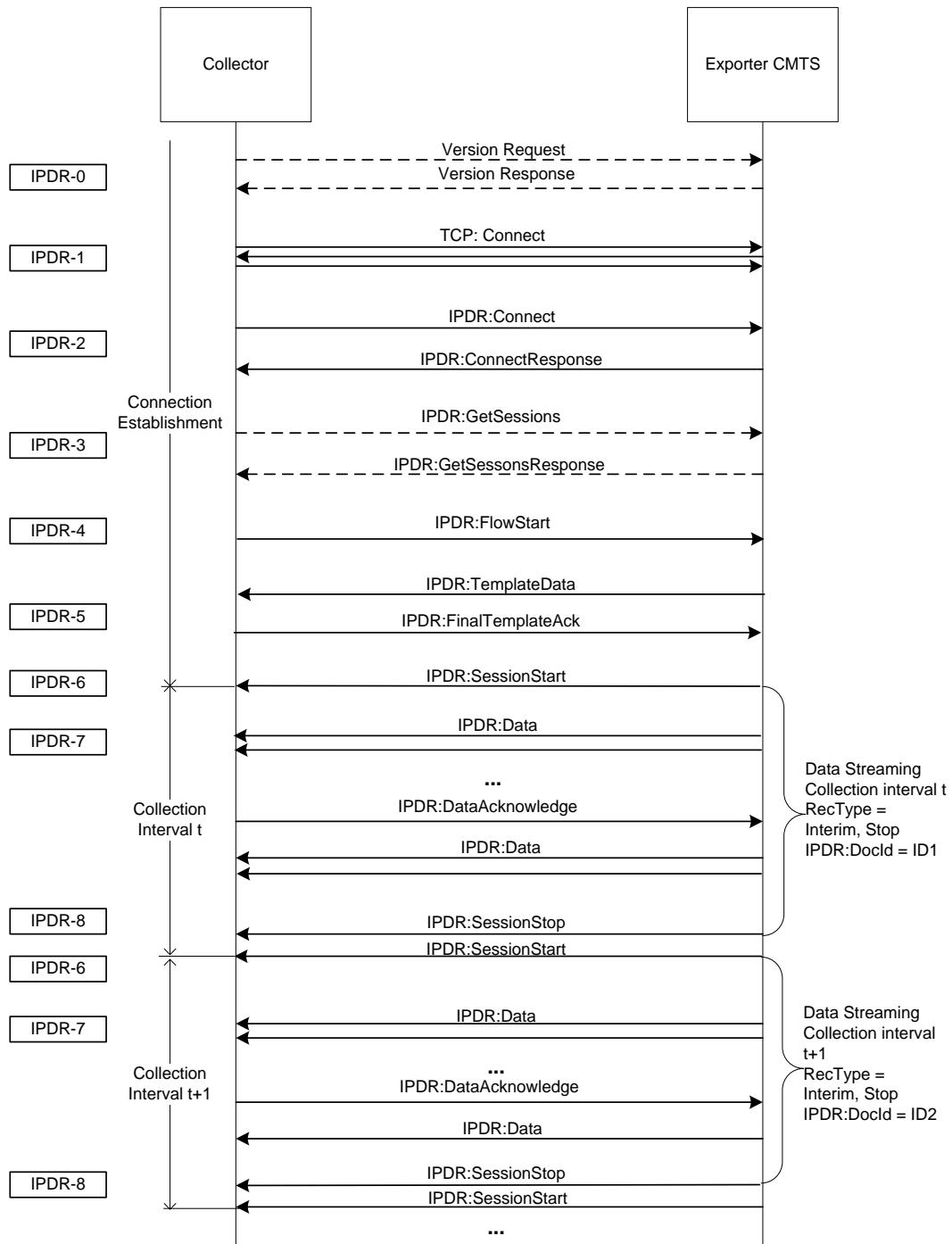
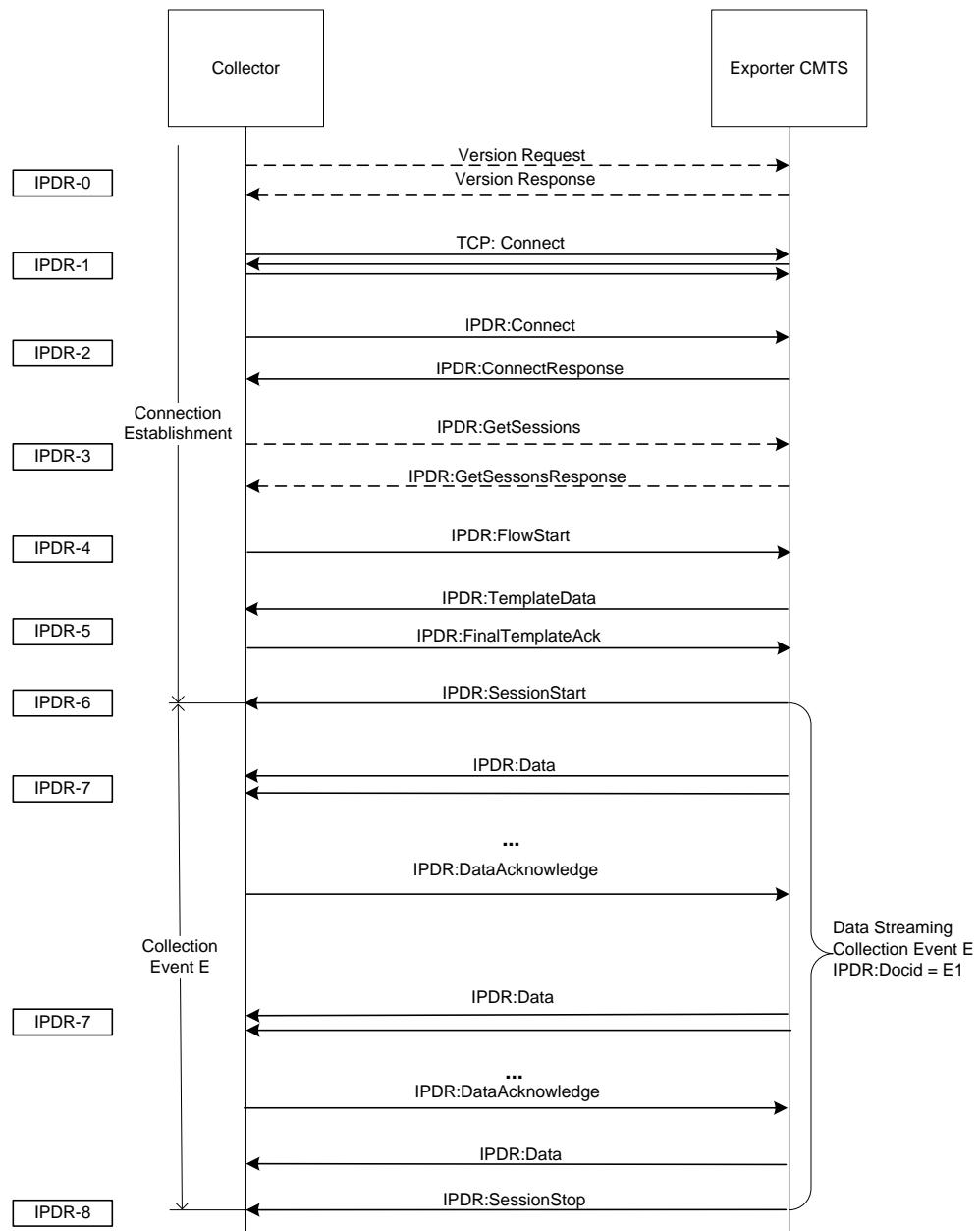
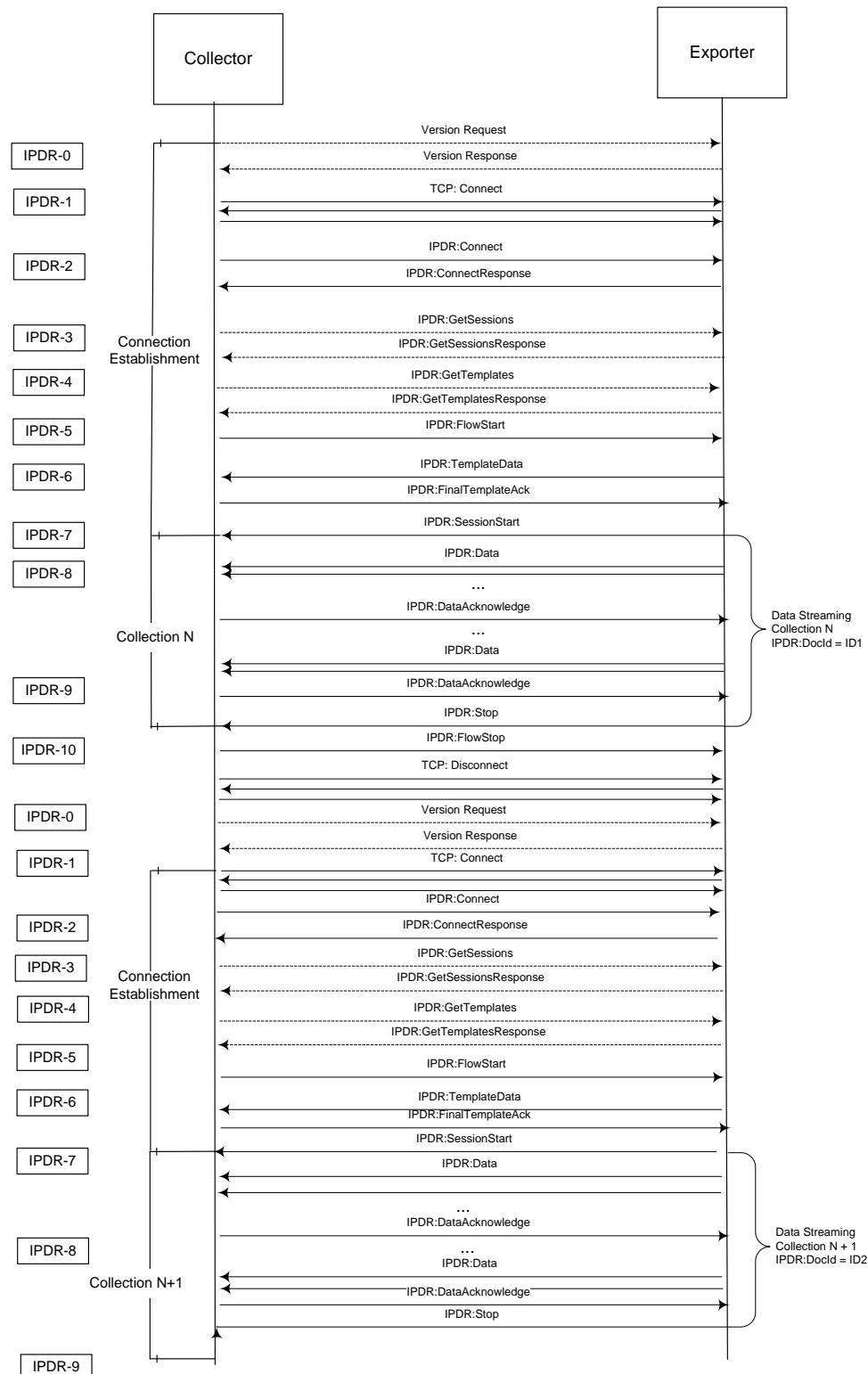


Figure 6-3 - Sequence Diagram for DOCSIS Time Interval Session Streaming Requirements



**Figure 6-4 - Sequence Diagram for DOCSIS Event Based Session Streaming Requirement**



**Figure 6-5 - Sequence Diagram for DOCSIS Ad-hoc Based Session Streaming Requirement**<sup>22</sup>

<sup>22</sup> Figure replaced per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

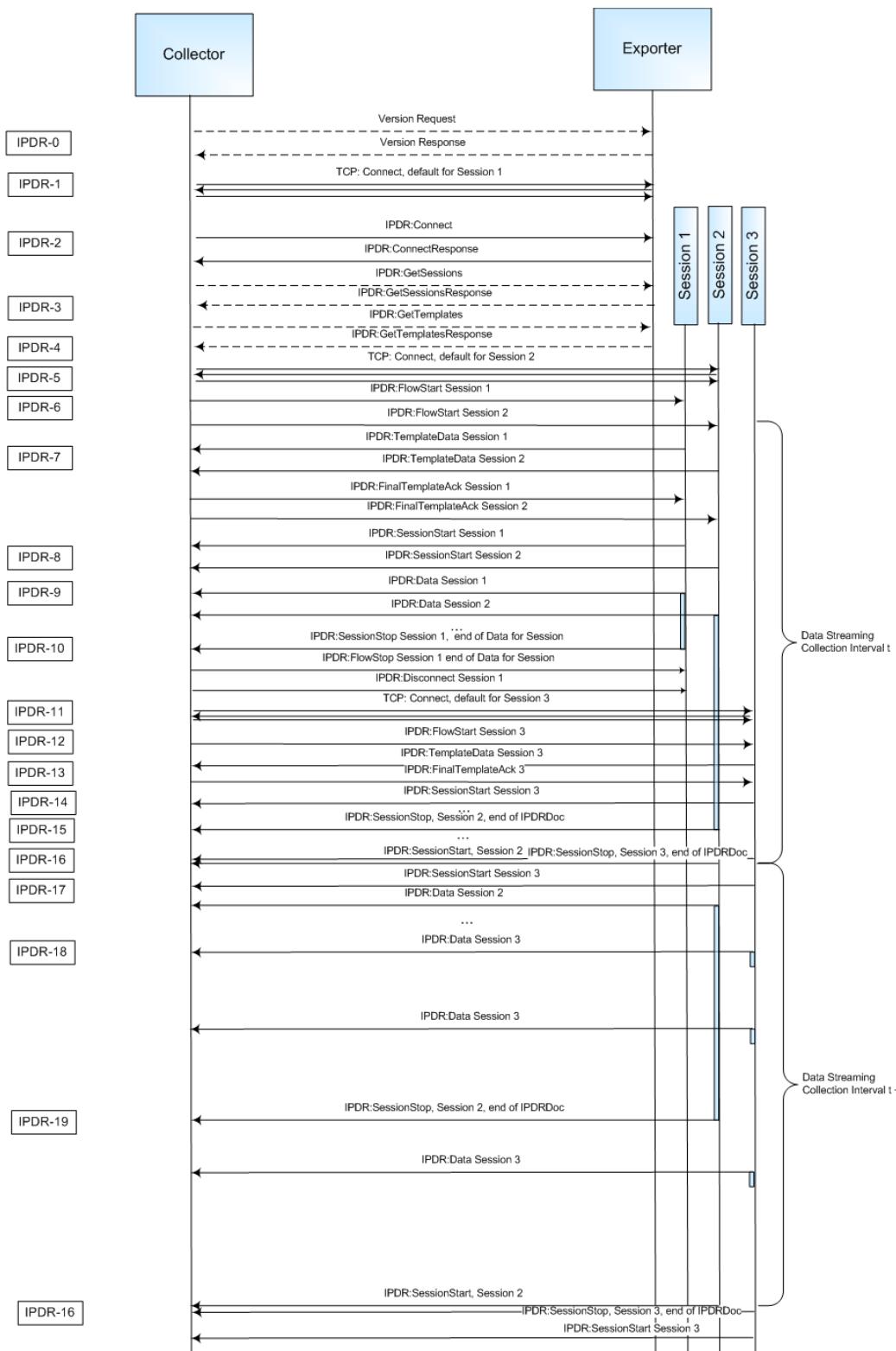
**Table 6-5 - DOCSIS IPDR Collection Methodologies Sequence Diagram Details**

<b>Identifier</b>	<b>Streaming Sequence Diagram Description</b>
IPDR-0	Prior to Streaming Connection, Collector may query Exporter for version request (discovery).
IPDR-1	Collector initiates the TCP connection: Port 4737
IPDR-2	Collector sends IPDR Connect message, sets capabilities flags and KeepAlive value Exporter (CMTS) replies with IPDR ConnectResponse message, see Appendix IV.
IPDR-3	Collector may request Sessions description to know what session ID and associated templates to use for streaming by GetSessions message request. Exporter (CMTS) reply with the GetSessionsResponse message.
IPDR-4	Following the GetSessionsResponse message the Collector may request template descriptions for the Session ID of interest by sending a GetTemplates message Exporter (CMTS) replies with the GetTemplatesResponse message.
IPDR-5	Collector is ready to start receiving data. Sends IPDR FlowStart message.
IPDR-6	Exporter (CMTS) sends a TemplateData message, see Appendix IV. Collector responds with FinalTemplateData message, see Appendix IV.
IPDR-7	Exporter (CMTS) starts the Session by sending IPDR SessionStart message. See Appendix IV.
IPDR-8	Data is streamed by Exporter (CMTS) and acknowledged by Collector IPDR DataAcknowledge messages.
IPDR-9	Exporter (CMTS) closes the IPDR Session with a SessionStop.
IPDR-10	Collector sends a IPDR FlowStop message to indicate that it is no longer able to participate in a particular session.
	Repeat Steps IPDR-6 through IPDR-9 based on the provisioned collection interval.

Figure 6-6 shows typical interaction between Collector and Exporter when multiple sessions are used. In this particular example Collector uses ad-hoc and event based session ("Session 1" and "Session 3" respectively) to retrieve initial state and subsequent changes of CMTS-TOPLOGY. Another time interval based session ("Session 2") is used for SAMIS-TYPE-2 service. This example has the following assumptions:<sup>23</sup>

- The event session is a time interval session
- The CMTS time interval is in sync with the wall clock. Sessions 2 and 3 have the same time interval t
- Keep Alive, Data Ack and other messages are omitted for clarity the example.
- Each IPDR session is carried in a separated IPDR connection.

<sup>23</sup> Table and text changes per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

**Figure 6-6 - Sequence Diagram for a Multisession streaming example<sup>24</sup>**<sup>24</sup> Figure added per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

**Table 6-6 - Multisession Streaming Example Sequence Diagram Details<sup>25</sup>**

Identifier	Streaming Sequence Diagram Description
IPDR-0	Prior to Streaming Connection, Collector may query Exporter (CMTS) for version request (discovery).
IPDR-1	Collector initiates the TCP connection: Port 4737. This connection will carry session 1.
IPDR-2	Collector sends IPDR Connect message, sets capabilities flags and KeepAlive value. Exporter (CMTS) replies with IPDR ConnectResponse message. See Appendix IV.
IPDR-3	Collector may request Sessions description to know what session ID and associated templates to use for streaming by GetSessions message request. Exporter (CMTS) replies with the GetSessionsResponse message.
IPDR-4	Collector requests templates to make sure they match expected configuration. Exporter (CMTS) replies with the GetTemplatesResponse message.
IPDR-5	Collector initiates the second TCP connection: Port 4737 for session 2.
IPDR-6	Collector is ready to start receiving data. Collector sends IPDR FlowStart messages for sessions 1 and 2.
IPDR-7	Exporter (CMTS) sends a TemplateData messages for sessions 1 and 2. See Appendix IV. Collector responds with FinalTemplateData message. See Appendix IV.
IPDR-8	Exporter (CMTS) starts the Sessions 1 and 2 by sending IPDR SessionStart message. See Appendix IV.
IPDR-9	Exporter (CMTS) sends data for Sessions 1 and 2.
IPDR-10	Exporter (CMTS) closes the IPDR Session 1 with a SessionStop and reasonCode 'end of data for session'. Subsequently the Exporter sends FlowStop and Disconnect message.
IPDR-11	Collector initiates the TCP connection: Port 4737 for session 3
IPDR-12	Collector previously knew the IPDR Service Definition sessions and the associated templates. Therefore, the Collector is ready to start receiving data and sends IPDR FlowStart message for session 3.
IPDR-13	Exporter (CMTS) sends a TemplateData messages for session 3. See Appendix IV. Collector responds with FinalTemplateData message. See Appendix IV
IPDR-14	Exporter (CMTS) starts the Session 3 by sending IPDR SessionStart message. See Appendix IV.
IPDR-15	When there is no more data for the Exporter (CMTS) to send for session 2, the Exporter sends a SessionStop message with reasonCode 'end of IPDRDoc'. The Exporter maintains the connection waiting for the next time interval for Session 2.
IPDR-16	At the time of the expire of the time interval session 3 is terminated with message SessionStop and reasonCode 'end of IPDRDoc'. Around the same time new IPDR SessionStart messages for sessions 2,3 and sent by the Exporter.
IPDR-17	Exporter (CMTS) sends data for Session 2.
IPDR-18	When available, IPDR data for session 3 is sent by the Exporter (CMTS).
IPDR-19	When there is no more data for the Exporter (CMTS) to send for session 2, the Exporter sends a SessionStop message with reasonCode 'end of IPDRDoc'. The Exporter maintains the connection waiting for the next time interval for Session 2.
IPDR-20	The process continues on IPDR-16 for the closure of session data for the expiring interface and initiate the next cycle.

#### 6.2.4.6 IPDRDoc Mapping for DOCSIS IPDR Streaming<sup>26</sup>

The IPDRDoc records may be constructed by the Collector for the purpose of storing or to be communicated to other instances through the Collector's D-interface mentioned in Section 6.2.3.1. The IPDRDoc is identified by a docId that is used to tag all of the IPDR records contained within the document. To do so, IPDRDoc in [IPDR/SP] is scoped to the IPDR/SP Session boundary as described in Section 6.2.4.5.1 and the IPDR/SP transport elements listed in Table 6-7 below.

<sup>25</sup> Table added per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

<sup>26</sup> Section inserted (and subsequent section renumbered) per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN.

**Table 6-7 - IPDRDoc Element/Attribute Mapping**

<b>Element or Attribute of IPDRDoc</b>	<b>IPDR/SP Mapping</b>
docId	IPDR:SP:SessionStart:documentId (see Section 6.2.3.5, item 1.g)
version	3.5.1-A.1; In general this field contains the version content of the schemaName of the first TemplateBlock within a negotiated Template after FinalTemplateDataAck
creationTime	IPDR:SP:SessionStartExporterBootTime
IPDRRecorderInfo	reverse DNS lookup of Exporter IP
IPDRTypE	Refer to the Data Type section of [IPDR/SP]
ipdr:IPDRCreationTime	Not supported (see Section 6.2.3.5)
ipdr:seqNum	Not supported (see Section 6.2.3.5) IPDR reliable transport is handled via IPDR:SP:DataSequenceNum
IPDRDoc.End (optional)	
Count	reflect number of records After closing the Session (Session Stop): IPDR:SP:DataAcknowledge:SequenceNumber - IPDR:SP:SessionStart:FirstRecordSequenceNumber
endTime	Time since epoch time when SessionStop was received

#### **6.2.4.7 Message Detail and IDL Definition<sup>27</sup>**

The complete message set defined for IPDR/SP and the normative IDL specification for constructing IPDR/SP messages are defined in [IPDR/SP].<sup>28</sup>

#### **6.2.5 CMTS IPDR Specifications Support<sup>29</sup>**

The CMTS MUST support [IPDR/SP] as the transport mechanism for all DOCSIS Service Definitions.

The CMTS MUST support data records encoded in IPDR/XDR Encoding Format, per the [IPDR/XDR] specification.

The CMTS MAY support the UDP-based Service Discovery Protocol described in the IPDR Streaming Protocol section in [IPDR/SP].

The CMTS MAY support the advertisement upon request of IPDR capabilities as described in [IPDR/CAPAB]. The retrieval of this file is vendor dependent. The same information is available by the Service Discovery described above.

##### **6.2.5.1 IPDR Streaming Protocol**

The CMTS MUST support the minimum conformance feature set for the IPDR Streaming Protocol as follows:

###### **6.2.5.1.1 IPDR/SP Transport Protocol**

The CMTS MUST support IPDR Streaming Protocol [IPDR/SP] over TCP.

###### **6.2.5.1.2 Streaming Flow Control and Messaging<sup>30</sup>**

[IPDR/SP] defines three main states in its model: 1) Connection, 2) Flow and 3) Session. Connections are initiated by either Collectors or Exporters. Flows are initiated by Collectors only and Sessions are initiated by Exporters (CMTSs) only. See Table 1 of [IPDR/SP] for details.<sup>31</sup>

<sup>27</sup> Section renumbered as result of new Section 6.2.4.6.

<sup>28</sup> Section below this deleted (and subsequent sections renumbered) per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN.

<sup>29</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

<sup>30</sup> Revised per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

<sup>31</sup> Revised per OSSIV3.0-07.0442-3 on 5/9/07 by PO.

#### 6.2.5.1.2.1 Streaming Flow Connection and Messaging<sup>32</sup>

The CMTS MUST support a minimum of two IPDR streaming connections.

IPDR streaming includes Template Negotiation allowing Collectors to adjust the data streams to include only the information that is relevant to their systems. The CMTS SHOULD support Template Negotiation; the support of the IPDR/SP message MODIFY TEMPLATE RESPONSE is recommended. If the CMTS implements Template Negotiation capability, then all messages within the Template Negotiation phase MUST be supported as described in the Protocol Sequence section of [IPDR/SP]. If the CMTS does not implement Template Negotiation, a Collector MODIFY TEMPLATE message MUST be replied to with a MODIFY TEMPLATE RESPONSE having a preconfigured Template Set as described in Appendix IV.

The CMTS MAY support IPDR Capability File Negotiation. If the CMTS supports IPDR Capability File Negotiation, then Communication Negotiation MUST be supported. Communication Negotiation allows the Exporter and the Collector to negotiate communication parameters. The Communication Negotiation allows both the Collector and the Exporter to acknowledge that they are capable of participating in the exchange of records via IPDR Streaming as and identify their ability to support optional protocol capabilities.

#### 6.2.5.1.2.2 Streaming Flow Sessions<sup>33</sup>

The CMTS MUST support a minimum of one Data Streaming Session per connection.

The CMTS MUST handle a minimum of one Template per Session, which is transmitted to the Collector via the TEMPLATE DATA message as described in [IPDR/SP]. See Appendix IV for details of CMTS default TEMPLATE DATA message requirements.

See Section 6.2.4.2 for the definition of the relationship between IPDR/SP Sessions, [IPDR/XDR] documents, and collection intervals.

#### 6.2.5.1.2.3 Records Collection<sup>34</sup>

A particular Service Definition supports ad-hoc, and event or time interval based data collection in order for the Collector to retrieve initial state through the ad-hoc session followed by subsequent updates through the event or time interval based session

A typical scenario is for example the IPDR Service Definition CMTS-TOPLOGY-TYPE that supports ad-hoc and event based sessions. The ad-hoc session allows the Collector to obtain initial topology, and the event based session to obtain subsequent topology updates. To allow a Collector to perform timely synchronous processing of SAMIS flow records (e.g., SAMIS-TYPE-2) along with corresponding topology records, the CMTS SHOULD use the same time base and interval for both a topology event session and a SAMIS interval session. The only difference to open ended event sessions is that Exporter inserts start/stop session messages at regular time intervals while the content of data records is the same. This allows Collector to easily detect when Exporter is done sending flow information and topology (e.g., CMTS-TOPLOGY-TYPE, CMTS-CM-REG-STATUS-TYPE and CPE-TYPE) for specific interval.

Unless otherwise specified, for an IPDR Service Definition that supports ad-hoc, and time interval and/or event based collection mechanisms the CMTS MUST support the streaming of the ad-hoc session along with an event based or time interval session of that IPDR Service Definition at the same time where each session could be within the same connection or in separate connections.

Due to the nature of the record streaming at the Exporter, it is up to the Collector to detect duplicate records along simultaneous collection methodologies. Possible scenarios are the following:

- Collector starts ad-hoc session first and doesn't start event session for the same service until ad-hoc session finishes and it gets initial state.
- Collector starts both ad-hoc and corresponding event sessions with the same service at the same time. Exporter doesn't send any events (changes) until is done with sending initial state and stops ad-hoc session.

<sup>32</sup> Revised per OSSIV3.0-N-07.0477-2 by ab on 7/10/07, per OSSIV3.0-N-07.0506-3 by ab on 10/11/07 and per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>33</sup> Revised per OSSIV3.0-N-10.0970-2 by JB on 1/20/11.

<sup>34</sup> Revised per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

- Exporter can start sending event records while the ad-hoc session has not terminated. In this case Collector will have to figure out based on the recreation time that event record it has already received is newer than ad-hoc record which represents initial state so it could discard obsolete ad-hoc record.

In the case when adhoc session is established while event session is not for the same service, the CMTS Exporter SHOULD send any events that occur while sending an adhoc "snapshot" within the adhoc session. The CMTS Exporter SHOULD use record type interim(1) for snapshot records and record type stop(2), start(3) or event(4) for event records (record is created, destroyed or changed respectively). Event records are sent as events occur or are detected. Adhoc session lasts as long as it is necessary to send a snapshot. If in the meantime corresponding event session is established the CMTS Exporter SHOULD send any subsequent events using that session as it would normally do. It is up to the Collector to make sure there is always either adhoc or event session open for sending events in order to make sure no events are lost.

Refer to Table 6-6 and Figure 6-6 for multisession streaming example.

### 6.2.6 Requirements for IPv6<sup>35</sup>

The CMTS MUST support IPDR/SP transport for Collectors that have IPv4 addresses [IPDR/SP]. The CMTS SHOULD support an interoperable IPDR/SP transport mechanism for both IPv4 and IPv6 addresses [IPDR/SP].

### 6.2.7 Data Collection Methodologies for DOCSIS IPDR Service Definitions<sup>36</sup>

This specification, as well as [IPDR/SP], defines a mechanism for the Collector and Exporter to coordinate the state control of DOCSIS IPDR Service Definitions that support multiple collection methodologies. In this case the session message provides information about the streaming methodology used for that session id. In other words, an additional session ID of the same service template is associated with a specific collection methodology (e.g., ad-hoc). This is achieved by placing special requirements in the SessionBlock.reserved attribute of the IPDR/SP GET SESSIONS RESPONSE message as follows:

The CMTS MUST define a sessionID for each collection mechanism supported for each IPDR Service Definition.

The CMTS MUST define the SessionBlock.sessionType attribute of the IPDR/SP GET SESSIONS RESPONSE as defined in [IPDR/SP]. The SessionBlock.sessionType attribution is shown below:

```
struct SessionBlock {
    char sessionId;
    char sessionType;
    UTF8String sessionName;
    UTF8String sessionDescription;
    int ackTimeInterval;
    int ackSequenceInterval;
};
```

The field description for sessionType:

Type of Session: Integer values of first three least significant bits of this field identify the following session types:

0 - Equivalent of sessionType Information Not Available

1 - Time Interval

2 - Adhoc

3 - Event

4 - Time Based Event

---

<sup>35</sup> Revised per OSSIV3.0-N-09.0846-1 on 9/15/09 by JB. Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

<sup>36</sup> Section added per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

## 7 OSS MANAGEMENT OBJECTS

### 7.1 SNMP Management Information Bases (MIBS)<sup>37</sup>

This section defines the minimum set of managed objects required to support the management of a CM. This section defines the minimum set of managed objects required to support the management of a CMTS.

The CM MAY augment the required MIBs with objects from other standard or vendor-specific MIBs where appropriate. The CMTS MAY augment the required MIBs with objects from other standard or vendor-specific MIBs where appropriate.

The DOCSIS OSSI 3.0 specification has priority over the IETF MIBs and all objects. Though deprecated or optional in the IETF MIB, the object can be required by this specification as mandatory.

The CM MUST implement the MIB requirements in accordance with this specification regardless of the value of an IETF MIB object's status (e.g., deprecated or optional).

The CMTS MUST implement the MIB requirements in accordance with this specification regardless of the value of an IETF MIB object's status (e.g., deprecated or optional).

If not required by this specification, deprecated objects are optional. If a CM implements a deprecated MIB object, the CM MUST implement the MIB object correctly according to the MIB definition. If a CMTS implements a deprecated MIB object, the CMTS MUST implement the MIB object correctly according to the MIB definition.

If a CM does not implement a deprecated MIB object, the following conditions MUST be met:

- The CM MUST NOT instantiate the deprecated MIB object.
- The CM MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the deprecated MIB object is made.

If a CMTS does not implement a deprecated MIB object, the following conditions MUST be met:

- The CMTS MUST NOT instantiate the deprecated MIB object.
- The CMTS MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the deprecated MIB object is made

If not required by this specification, additional objects are optional. If a CM implements any additional MIB objects, the CM MUST implement the MIB object correctly according to the MIB definition. If a CMTS implements any additional MIB objects, the CMTS MUST implement the MIB object correctly according to the MIB definition.

If a CM does not implement one or more additional MIB objects, the following conditions MUST be met:

- The CM MUST NOT instantiate the additional MIB object or objects.
- The CM MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c when an attempt to access the non existent additional MIB object is made, when the additional MIB object or objects are accessed.

If a CMTS does not implement one or more additional objects, the following conditions MUST be met:

- The CMTS MUST NOT instantiate the additional MIB object or objects.

The CMTS MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the non existent additional MIB object is made.

If not required by this specification, obsolete objects are optional. If a CM implements an obsolete MIB object, the CM MUST implement the MIB object correctly according to the MIB definition. If a CMTS implements an obsolete MIB object, the CMTS MUST implement the MIB object correctly according to the MIB definition.

If a CM does not implement an obsolete MIB object, the following conditions MUST be met:

<sup>37</sup> Section revised per OSSIV3.0-N-08.0608-1 on 4/10/08 by KN.

- The CM MUST NOT instantiate the obsolete MIB object.
- The CM MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the obsolete MIB object is made.

If a CMTS does not implement an obsolete MIB object, the following conditions MUST be met:

- The CMTS MUST NOT instantiate the obsolete MIB object.
- The CMTS MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access the obsolete MIB object is made

Objects which are not supported by this specification are not implemented by an agent.

- The CM MUST NOT instantiate not supported MIB objects.
- The CM MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access a not supported MIB object is made.
- The CMTS MUST NOT instantiate not supported MIB objects.
- The CMTS MUST respond with the appropriate error/exception condition, such as noSuchObject for SNMPv2c, when an attempt to access a not supported MIB object is made.

Section 7.1.1 and Section 7.1.2 include an overview of the MIB modules required for management of the facilities specified in the [MULPI] and [SEC] specifications.

### 7.1.1 IETF Drafts and Others<sup>38</sup>

*Table 7-1 - IETF Drafts and Others<sup>39</sup>*

Reference	MIB Module	Applicable Device(s)
Annex H	DOCSIS Interface Extension 2 MIB Module: DOCS-IFEXT2-MIB	CM and CMTS
Annex Q	CableLabs Topology MIB Module: CLAB-TOPO-MIB	CMTS
Annex Q	DOCSIS Diagnostic Log MIB Module: DOCS-DIAG-MIB	CMTS
Annex Q	DOCSIS Interface 3 MIB Module: DOCS-IF3-MIB	CM and CMTS
Annex Q	DOCSIS Multicast MIB Module: DOCS-MCAST-MIB	CMTS
Annex Q	DOCSIS Multicast Authorization MIB Module: DOCS-MCAST-AUTH-MIB	CMTS
Annex Q	DOCSIS Quality of Service 3 MIB Module: DOCS-QOS3-MIB	CM and CMTS
Annex Q	DOCSIS Security MIB Module: DOCS-SEC-MIB	CMTS
Annex Q	DOCSIS Subscriber Management 3 MIB Module: DOCS-SUBMGT3-MIB	CMTS

<sup>38</sup> Revised per OSSIV3.0-N-07.0481-2 by ab on 7/17/07 and per OSSIV3.0-N-09.0835-2 on 9/15/09 by JB.

<sup>39</sup> Table edited per OSSIV3.0-N-07.0376-1 by ab on 5/3/07 and per OSSIV3.0-N-07.0402-1, #2 on 5.7/07 by KN. Also, per OSSIV3.0-N-07.0522-7 by ab on 11/5/07, and OSSIV3.0-N-07.0553-4 by ab on 11/13/07.

Reference	MIB Module	Applicable Device(s)
Annex Q	DOCSIS Load Balancing 3 MIB Module: DOCS-LOADBAL3-MIB	CMTS
[M-OSSI]	DOCSIS DRF MIB Module: DOCS-DRF-MIB	CMTS

### 7.1.2 IETF RFCs

**Table 7-2 - IETF RFCs<sup>40</sup>**

Reference	MIB Module	Applicable Device(s)
[RFC 2786]	Diffie-Helman USM Key MIB Module: SNMP-USM-DH-OBJECTS-MIB	CM and CMTS
[RFC 2790]	Host Resources MIB Module: HOST-RESOURCES-MIB	CM and CMTS
[RFC 2863]	Interfaces Group MIB Module: IF-MIB	CM and CMTS
[RFC 2933]	Internet Group Management Protocol MIB Module: IGMP-STD-MIB	CM
[RFC 3083]	DOCSIS Baseline Privacy MIB Module: DOCS-BPI-MIB	CM
[RFC 3410] [RFC 3411] [RFC 3412] [RFC 3413] [RFC 3414] [RFC 3415] [RFC 3584]	SNMPv3 MIB Modules: 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	CM and CMTS
[RFC 3418]	SNMPv2 MIB Module: SNMPv2-MIB	CM and CMTS
[RFC 3433]	Entity Sensor MIB Module: ENTITY-SENSOR-MIB	CM and CMTS
[RFC 3635]	Ethernet Interface MIB Module: EtherLike-MIB	CM and CMTS
[RFC 4022]	Transmission Control Protocol MIB Module: TCP-MIB	CM and CMTS
[RFC 4113]	User Datagram Protocol MIB Module: UDP-MIB	CM and CMTS
[RFC 4131]	DOCSIS Baseline Privacy Plus MIB Module: DOCS-IETF-BPI2-MIB	CM and CMTS
[RFC 4133]	Entity MIB Module: ENTITY-MIB	CM and CMTS

<sup>40</sup> Table edited per OSSIV3.0-N-07.0376-1 by ab on 5/3/07, per OSSIV3.0-N-07.0522-7 by ab on 11/5/07, per OSSIV3.0-N-07.0532-4 on 1/29/08 by KN, per OSSIV3.0-N-08.0651-3 on 1/7/09 by JS and per OSSIV3.0-N-09.0835-2 on 9/15/09 by JB.

Reference	MIB Module	Applicable Device(s)
[RFC 4188]	Bridge MIB Module: BRIDGE-MIB	CM and CMTS
[RFC 4293]	Internet Protocol MIB Module: IP-MIB	CM and CMTS
[RFC 4546]	DOCSIS RF MIB Module: DOCS-IS-MIB	CM and CMTS
[RFC 4639]	DOCSIS Device MIB Module: DOCS-CABLE-DEVICE-MIB	CM and CMTS
[RFC 5132]	IP Multicast MIB Module: IPMC-CAST-MIB	CMTS
[RFC 5519]	Multicast Group Membership Discovery MIB: MGMD-STD-MIB	CMTS

### 7.1.3 Managed objects requirements<sup>41</sup>

The following sections detail additional implementation requirements for the RFCs listed.

The CM MUST implement the compliance and syntax of the MIB objects as specified in Annex A.

The CMTS MUST implement the compliance and syntax of the MIB objects as specified in Annex A.

The CM MUST support a minimum of 10 available SNMP table rows, unless otherwise specified by RFC or DOCSIS specification. The CMTS MUST support a minimum of 10 available SNMP table rows, unless otherwise specified by RFC or DOCSIS specification. The CM minimum number of available SNMP table rows SHOULD mean rows (per table) that are available to support device configuration. The CMTS minimum number of available SNMP table rows SHOULD mean rows (per table) that are available to support device configuration. The CM used (default) SNMP table row entries MUST NOT apply to the minimum number of available SNMP table rows. The CMTS used (default) SNMP table row entries MUST NOT apply to the minimum number of available SNMP table rows.

#### 7.1.3.1 Requirements for DOCSIS Device MIB [RFC 4639]<sup>42</sup>

The CM MUST implement [RFC 4639].

The CMTS MUST implement [RFC 4639].

**Note:** [RFC 4639] includes Compliance requirements for DIFFSERV-MIB [RFC 3289] to support IPv6 filtering as a replacement for the deprecated docsDevFilterIpTable. For backwards compatibility, this specification has requirements for docsDevFilterIpTable. IPv6 filtering requirements are specified in Annex F This specification does not define requirements for [RFC 3289].<sup>43</sup>

Additional requirements affecting [RFC 4639] are also found in Section 9.4, Protocol Filtering.

#### 7.1.3.2 Requirements for DOCSIS RF MIB [RFC 4546]<sup>44</sup>

The CMTS MUST implement [RFC 4546].

The CM MUST implement [RFC 4546].

<sup>41</sup> Revised per OSSIV3.0-N-07.0481-2 by ab on 7/17/07, and per OSSIV3.0-N-07.0553-4 by ab on 11/13/07.

<sup>42</sup> Revised per OSSIV3.0-N-07.0395-3 by ab on 5/4/07.

<sup>43</sup> OSSIV3.0-N-07.0395 #1, PO 5/15/07

<sup>44</sup> Revised per OSSIV3.0-N-07.0392-1 by ab on 5/3/07. Per OSSIV3.0-N-07.0443-2 and OSSIV3.0-N-07.0446-4 on 5/10/07 by KN, per OSSIV3.0-N-07.0477-2 by ab on 7/10/07 and OSSIV3.0-N-07.0481-2 on 7/17/07. Revised per OSSIV3.0-N-07.0602-1 on 1/31/08 by KN. Revised per OSSIV3.0-N-08.0651-3 on 1/7/09 by JS. Revised per OSSIV3.0-N-09.0834-3 on 9/15/09 by JB. Revised per EC N-12-1040-3 on 7/24/12 by JS.

The CMTS MUST report the value of docsIfDownChannelPower [RFC 4546] within 2 dB of the actual power specified in dBmV as specified in [PHY].

If the CMTS provides an IF Output, the CMTS MUST report a value of zero for the docsIfDownChannelPower MIB object.

If downstream transmit power management is not implemented, the CMTS MUST support the MIB object docsIfDownChannelPower [RFC 4546] as read-only and report the value of 0 (zero).

The CM MUST implement the docsIfDownChannelPower MIB object with read-only access. The CM MUST report a power value for docsIfDownChannelPower within 3 dB of the actual received channel power when operated at nominal line-voltage, at normal room temperature (refer to [PHY]).

For any 1 dB change in input power, the CM MUST report a power change in the same direction that is not less than 0.6 dB and not more than 1.4 dB, as specified in [PHY].

The CMTS MUST implement read-write access for the docsIfDownChannelFrequency object, if the CMTS is in control of the downstream frequency. However, if a CMTS provides IF Output, the CMTS MUST implement read-only access for the docsIfDownChannelFrequency object and return 0.

The CMTS MUST implement the range for the docsIfQosProfMaxTransmitBurst object the same as the range defined in the "Maximum Upstream Channel Transmit Burst Configuration Setting" section of [MULPI].

The maximum number of modulation profiles that a CMTS can support in docsIfCmtsModulationTable is vendor - specific.

The CMTS MAY provide pre-defined modulation profiles (entries in the DOCS-IF-MIB docsIfCmtsModulationTable) for the purpose of being used by operators directly, or as templates to define other modulation profiles. The pre-defined modulation profiles provided by the CMTS MAY be read-only to prevent users from making accidental modifications. Consequently, adding or creating entries with new docsIfCmtsModIntervalUsageCode values and the same docsIfCmtsModIndex value as a pre-defined modulation profile could result in an error.

The modulation profiles are PHY layer specific. Modulation profiles with the same value of docsIfCmtsModIndex might not be optimal for all upstream channels with different PHY hardware. As a result, re-using modulation profiles for upstream channels with different PHY hardware could decrease upstream performance. Therefore, SNMP set operations might result in an error when modulation profiles with the same value of docsIfCmtsModIndex are assigned to upstream channels with different PHY hardware.

The CMTS supports the ability to configure upstream and downstream channel IDs via read-create access to the docsIf3MdChCfgChId object in the DOCS-IF3-MIB. To support this ability, the CMTS implements the MIB objects docsIfDownChannelId and docsIfUpChannelId with read-only access. When a downstream channel is not assigned to a MAC Domain then the CMTS MUST report the corresponding docsIfDownChannelId as zero. The CMTS SHOULD NOT allow changes to the DS Channel Ids when modems are present on those channels, since any CMs that are already online will re-initialize and/or attempt to use a channel other than the one intended. The CMTS MUST ensure that an upstream or downstream channel ID is unique within a MAC Domain.

The CMTS MUST support the objects in the docsIfCmtsUpChannelCounterTable that are described in the DOCS-IF-MIB as being optional. However, certain impairment events on the upstream channel (e.g., burst noise) could be indistinguishable from collisions, and hence could be counted as such.

With the introduction of Multiple Transmit Channel (MTC) mode and upstream channel bonding, the docsIfCmtsServiceTable usage has been modified for a DOCSIS 3.0 CMTS. A CMTS that does not support DOCSIS 1.0 CMs MAY implement MIB objects from docsIfCmtsServiceTable. A CMTS that supports DOCSIS 1.0 CMs and can model 1.0 Class of Service registrations as Service Flows in the DOCS-QOS3-MIB implements the docsIfCmtsServiceTable with only the docsIfCmtsServiceQosProfile in the table. All other MIB objects in this table are deprecated and modeled as Service Flow Parameters in the DOCS-QOS3-MIB. A CMTS that supports DOCSIS 1.0 CMs and does not model 1.0 Class of Service registrations as Service flows is required to implement the full table with the exception of docsIfCmtsServiceInPackets. The CMTS MUST NOT count packets in the MIB object docsIfCmtsServiceInPackets for DOCSIS 3.0 CMs in a 1.0 Class of Service mode and MTC mode is

enabled.<sup>45</sup> The details of the requirements are defined in Table A-3, where objects from docsIfCmtsServiceTable are marked as "M/O" to signify varying requirements depending on CMTS support for DOCSIS 1.0 CMs.

In order to support these changes, the indexing for the docsIfCmtsServiceTable shall be defined as UsChanifIndex (the logical upstream channel the modem registered on) and SID. When a CM registers with a 1.0 Class of Service configuration file, the CMTS uses the Primary SID [MULPI] as the Service Identifier for the index. If the CM registers with 1.0 Class of Service configuration file and MTC is enabled, the CMTS uses the SID associated with the CM registration request.

The CMTS MAY report CMs registered in DOCSIS 1.1 QoS mode in docsIfCmtsServiceTable.

The CMTS MUST implement the extended version of the MIB object docsIfCmtsServiceEntry as defined in this specification. The extended version of docsIfCmtsServiceEntry is as follows:

```
docsIfCmtsServiceEntry OBJECT-TYPE
    SYNTAX      DocsIfCmtsServiceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Describes the attributes of a single upstream Class
         of Service. For a CMTS that does not support modeling
         1.0 Class of Service encodings as Service Flows,
         entries in this table exist for each Class of Service
         that is allocated beneath an ifEntry with an ifType of
         docsCableUpstreamChannel(205).
        For a CMTS that does support modeling 1.0 Class of
         Service encodings as Service Flows, the CMTS only
         captures the Qos Profile information in the
         docsIfCmtsServiceQosProfile. In these cases, the
         ServiceId value used in the index is the SID that
         the CM used for registration. Entries in this table
         are created with the creation of individual Service
         IDs by the MAC layer and removed when a Service ID
         is removed.
        The CMTS may report CMs registered in DOCSIS 1.1
         QoS mode in the docsIfCmtsServiceTable."
    INDEX { ifIndex, docsIfCmtsServiceId }
    Reference
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I07-080215"
    ::= { docsIfCmtsServiceTable 1 }
```

The CMTS assigns a unique numeric identifier to each individual CM that is used for per-CM reporting and management purposes. DOCSIS 3.0 defines this identifier as docsIf3CmtsCmRegStatusId. Prior to DOCSIS 3.0 this identifier was docsIfCmtsCmStatusIndex [RFC 4546]. DOCSIS 3.0 CMTS requirements include MIB modules based on docsIfCmtsCmStatusIndex; therefore, the CMTS MUST consider docsIfCmtsCmStatusIndex to be the same identifier as docsIf3CmtsCmRegStatusId for the purpose of CM identification in MIB modules defined through SNMP conceptual row extension, and SNMP conceptual row augmentation. See section "Relation between INDEX and AUGMENTS clauses" of [RFC 2578] for details on these concepts.

The CM MUST extend the MIB Textual-Convention DocsisVersion to include the enumeration 'docsis30'. The CMTS MUST extend the MIB Textual-Convention DocsisVersion to include the enumeration 'docsis30'. The extended DocsisVersion Textual-Convention is shown below.<sup>46</sup>

```
DocsisVersion ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
        "'docsis10' indicates DOCSIS 1.0.
         'docsis11' indicates DOCSIS 1.1.
```

<sup>45</sup> Modified per OSSIV3.0-N-09-0775-3 on 5/8/09 by JB.

<sup>46</sup> Section below modified per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

```

'docsis20' indicates DOCSIS 2.0.
'docsis30' indicates DOCSIS 3.0."
REFERENCE
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I03-070223, DOCSIS
Version section of the Common Radio Frequency
Interface Encodings Annex."
SYNTAX      INTEGER {
    docsis10 (1),
    docsis11 (2),
    docsis20 (3),
    docsis30 (4)
}

```

The MIB object `docsIfDocsisBaseCapability`, based on the `DocsisVersion` Textual-Convention, includes an updated `REFERENCE` to align with the extended `DocsisVersion` Textual-Convention.

```

docsIfDocsisBaseCapability OBJECT-TYPE
    SYNTAX      DocsisVersion
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indication of the DOCSIS capability of the device."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I03-070223, DOCSIS
        Version section of the Common Radio Frequency
        Interface Encodings Annex."
::= { docsIfBaseObjects 5 }

```

The CMTS MUST implement the `docsIfDownChannelWidth` value based on the value of `docsIf3MdCfgDownChannelAnnex`. The CMTS MUST derive instances of the `docsIfDownChannelAnnex` from the values of `docsIf3MdCfgDownChannelAnnex` in a given MAC Domain.

The `docsIfCmtsSyncInterval` object applies to Primary-Capable Downstream interfaces within the MAC Domain.

[RFC 4546] defined MIB object `docsIfCmStatusCode` has the `SYNTAX` updated to accommodate 7 characters in the status code.<sup>47</sup>

```

docsIfCmStatusCode OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE( 0 | 5 | 6 | 7 ))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Status code for a Cable Modem as defined in the
        OSSI Specification. The status code consists
        of a single character indicating error groups, followed
        by a two- or three-digit number indicating the status
        condition, followed by a decimal.
        An example of a returned value could be 'T101.0'.
        The zero-length OCTET STRING indicates no status code yet
        registered."
    REFERENCE
        "Data-Over-Cable Service Interface Specifications:
        Operations Support System Interface Specification
        SP-OSSIv2.0-C01-081104, Annex D."
::= { docsIfCmStatusEntry 2 }

```

---

<sup>47</sup> Added this paragraph and the following code per OSSIv3.0-N-09.0775-3 on 5/8/09 by JB.

### 7.1.3.3 Requirements for Interfaces Group MIB [RFC 2863]

The CMTS MUST implement the interface MIB [RFC 2863].

The CM MUST implement the interface MIB [RFC 2863].

The ifType object associated with a DOCSIS interface can have the following enumerated values:

- CATV MAC interface: docsCableMacLayer (127)
- CATV downstream channel: docsCableDownstream (128)
- CATV M-CMTS downstream channel: docsCableMCmtsDownstream (229) (See [M-OSSI])
- CATV upstream interface: docsCableUpStream (129)
- CATV logical upstream channel: docsCableUpstreamChannel (205)

#### 7.1.3.3.1 Interface organization and numbering<sup>48</sup>

Assigned interface numbers for CATV-MAC and Ethernet (Ethernet-like interface) are used in both the NMAccessTable and IP/LLC filtering table to configure access and traffic policy at these interfaces. These configurations are generally encoded in the configuration file using TLV encoding.

The following statements define the CM interface-numbering scheme requirements:

CM MUST implement an instance of ifEntry for each configured CATV-MAC interface, downstream channel, upstream interface, and for all of its LAN interfaces. If a CATV-MAC interface consists of more than one upstream and downstream channel, the CM MUST populate the ifTable with a separate instance of ifEntry for each channel.

The CM MAY fix LAN interfaces during the manufacturing process or determine these dynamically during the operation of the CM based on whether or not an interface has a CPE device attached to it.

If the CM has multiple CPE interfaces, but only one CPE interface that can be enabled at any given time, the CM MUST populate the ifTable to contain only the entry corresponding to the enabled or the default CPE interface.

The CM MUST populate the ifTable as specified in Table A-4 through Table A-7 of Annex A.2. The CM MUST maintain entries in the ifTable for the CATV downstream and CATV upstream interfaces for which the CMTS have configured DS Receive Channels and US Transmit Channels respectively for this particular CM, and not for the total number of the CM receivers and transmitters the CM supports. CMTS configured Receive Channels and Transmit Channels for a CM are defined in [MULPI].

While the CM is registered, the CM SHOULD use a different ifIndex to allocate a new CMTS configured Receive Channel or Transmit Channel, and avoid the reuse of previously assigned IfIndexes that are not currently part of the CMTS configured Receive Channel Set (RCS) or Transmit Channel Set (TCS).

When a CATV DS or US interface is configured as part of a RCS or TCS with a new channel id, the CM MUST update the ifCounterDiscontinuityTime and ifLastChange MIB variables.

The CM MUST populate ifStackTable with an entry for the CATV-MAC interface and include the CATV downstream and CATV upstream interfaces are reported in the ifTable.

The CM MUST implement the MIB variable ifStackLastChange to report the value of sysUpTime where the ifStackTable change as a consequence of an addition or removal of a channel id from a CM-SG as defined in [MULPI].

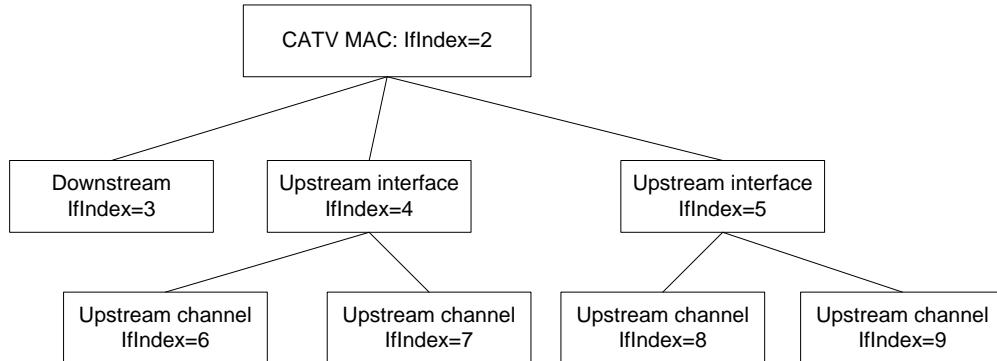
The following statements define the CMTS interface-numbering scheme requirements:

The CMTS MUST implement an instance of ifEntry for each CATV-MAC interface, downstream channel, upstream interface, logical upstream channel, and any other interface type that exists in the CMTS.

<sup>48</sup> Revised per OSSIV3.0-N-07.0540-4 by ab on 11/8/07.

The CMTS MUST populate the ifStackTable with the associations of CATV-MAC interfaces to upstream and downstream channels as defined in the MdChCfg configuration object (see Annex O).

The following example illustrates a MAC interface with one downstream and two upstream interfaces, each with two logical upstream channels for a CMTS.

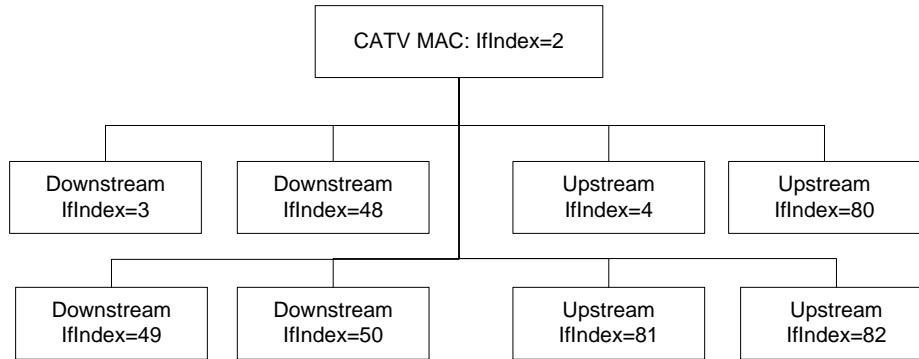


Implementation of ifStackTable for this example:

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 - ifIndex example for CMTS**

The following example illustrates a MAC interface with four downstream and four upstream interfaces for a CM.



Implementation of ifStackTable for this example:

ifStackHigherLayer	ifStackLowerLayer
0	2
2	3
2	4
2	48
2	49
2	50
2	80
2	81
2	82
3	0
4	0
48	0
49	0
50	0
80	0
81	0
82	0

**Figure 7-2 - ifIndex example for CM**

The CM MUST number its interfaces as described in Table 7-3.

**Table 7-3 - CM interface numbering**

Interface	Type
1	Primary CPE interface
2	CATV-MAC
3	One of the CATV downstream interface
4	One of the CATV upstream interfaces
5 - 15	Additional CPE interfaces
16 - 31	eDOCSIS eSAFE interfaces
32 - 47	Additional CPE interfaces
48 - 79	Additional CATV downstream interfaces
80 - 111	Additional CATV upstream interfaces

At any time, the CM MUST use ifIndex 3 for one of its downstream channels.

At any time, the CM MUST use ifIndex 4 for one of its upstream channels.

For example, if the RCS is configured with channels on ifIndex 3 and 48 and the Dynamic Bonding Change DBC message demands ifIndex 3 be removed, the ifIndex 48 becomes ifIndex 3.

If the CM has more than one CPE interface, the vendor is required to define which of the CPE interfaces is the primary CPE interface. The CM is permitted to have its primary CPE interface fixed during the manufacturing process, or determine it dynamically during operation based on which interface has a CPE device attached to it. Regardless of the number of CPE interfaces the CM has, or how the primary CPE interface is determined, the CM will set the primary interface to interface number 1.

The CM MAY have additional CPE interfaces fixed during the manufacturing process or determined dynamically during operation based on which interface has a CPE device attached to it. Additional CPE interface ifIndexes are described in Table 7-3.

#### 7.1.3.3.2 *ifOperStatus Relationships*<sup>49</sup>

##### 7.1.3.3.2.1 CmStatusValue and ifOperStatus Relationship

The CM MUST ensure that its CATV-MAC, downstream and upstream interfaces conform to the following relationships of ifOperStatus and CmStatusValue (see Annex N) when ifAdminStatus value of those interfaces is 'up':

**Table 7-4 - CmStatusValue and ifOperStatus relationship**

IfOperStatus	CmStatusValue
'down'	'other', 'notReady'
'dormant'	'notSynchronized', 'phySynchronized', 'usParametersAcquired', 'rangingComplete', 'dhcpV4Complete', 'dhcpV6Complete', 'todEstablished', 'configFileDownloadComplete', 'startRegistration', 'bpiInit', 'accessDenied'
'up'	'registrationComplete', 'securityEstablished', 'operational'

##### 7.1.3.3.2.2 USB state and ifOperStatus Relationships<sup>50</sup>

If the CM support USB as CPE interfaces, the CM SHOULD report the value of the MIB object ifOperStatus as follows:

**Table 7-5 - USB State and ifOperStatus relationship**

IfOperStatus	USB states and other conditions (see [USB])
'down'	'Attached', 'Powered', 'Default', and STALL operation
'dormant'	'Suspended', 'Address'
'up'	'Configured'

#### 7.1.3.3.3 *ifAdminStatus and Traffic*<sup>51</sup>

The CMTS MUST NOT accept or forward any traffic over an interface whose ifAdminStatus is 'down', (traffic includes data and MAC management traffic where applicable).

The CM MUST NOT accept or forward any traffic over an interface whose ifAdminStatus is 'down', (traffic includes data and MAC management traffic where applicable).

<sup>49</sup> Section changed per OSSIV3.0-N-07.0402-1 on 5/7/07 by KN.

<sup>50</sup> Section added per OSSIV3.0-N-07.0402-1, #9 on 5/7/07 by KN.

<sup>51</sup> Section changed per OSSIV3.0-N-07.0402-1, #10 on 5/7/07 by KN.

#### 7.1.3.3.4 SNMP Notification Control Requirements<sup>52</sup>

If a multi-layer interface model is present in the device, each sub-layer for which there is an entry in the ifTable can generate linkUp/Down traps. Since interface state changes would tend to propagate through the interface stack (from top to bottom, or bottom to top), it is likely that several traps would be generated for each linkUp/Down occurrence. The ifLinkUpDownTrapEnable object allows managers to control SNMP notification generation, and configure only the interface sub-layers of interest.

The CMTS MUST implement the MIB object ifLinkUpDownTrapEnable specified in [RFC 2863].

The CM MUST implement the MIB object ifLinkUpDownTrapEnable specified in [RFC 2863].

For linkUp/Down events on CM DOCSIS interfaces, the CM SHOULD generate an SNMP notification for the CM MAC interface and not for any sub-layers of the interface. Therefore, the CM MUST have its default setting of ifLinkUpDownTrapEnable for the CM MAC interface set to 'enabled'. The CM MUST have its default setting of ifLinkUpDownTrapEnable for the RF-Up interface(s) set to 'disable'. The CM MUST have its default setting of ifLinkUpDownTrapEnable for the RF-Down interface(s) set to 'disabled'. The CM SHOULD have its default setting of ifLinkUpDownTrapEnable for interfaces 1 and 5 through 47 listed in Table 7-3 set to 'disabled'.

If the ifLinkUpDownTrapEnable for the CM MAC interface set to 'enabled', the CM MUST generate a linkUp SNMP notification [RFC 2863].

For linkUp/Down events on CMTS DOCSIS interfaces, the CMTS SHOULD generate an SNMP notification for each CMTS interface. Therefore, the CMTS MUST have its default setting of ifLinkUpDownTrapEnable for each CMTS interface (MAC, RF-Downstream(s), RF-Upstream(s)) set to 'enabled'.

#### 7.1.3.3.5 ifTable and IfXTable Counters<sup>53</sup>

DOCSIS 3.0 has introduced changes in the CM and CMTS requirements for the ifTable and ifXTable [RFC 2863] interface counter objects to accommodate channel bonding.

Application of the [RFC 2863] ifTable and ifXTable MIB counter objects are done on a per-interface basis for DOCSIS 3.0 and are detailed in Table A-6 and Table A-7 of Annex A.2. These tables define specific SNMP Access and MIB requirements for each of the interface counters defined in [RFC 2863]. The CM MUST only count octets on the downstream and upstream interfaces. The CM MAY implement the packet counters from [RFC 2863], but when implemented on these interfaces, the counter object will return a value of zero. The CMTS MUST only count octets on the downstream and upstream interfaces (logical and physical). The CMTS MAY implement the packet counters from [RFC 2863], but when implemented on these interfaces, the counter object will return a value of zero. The CM and CMTS ethernet and MAC interfaces count both packet and octet counters. Per the requirements in [RFC 2863] Counter Size section, a given interface may support only 32-bit or 64-bit (High Capacity), or both sets of counters based on interface speed.

The CM MUST implement the ifTable and ifXTable [RFC 2863] Counter32 and Counter64 MIB objects as defined for each interface in Table A-6 and Table A-7 of Annex A.2.

The CMTS MUST implement the ifTable and ifXTable [RFC 2863] Counter32 and Counter64 MIB objects as defined for each interface in Table A-6 and Table A-7 of Annex A.2.

#### 7.1.3.3.6 ifSpeed and ifHighSpeed<sup>54</sup>

The CM MUST report in ifSpeed and ifHighSpeed MIB objects the current configured speed of the interface as stated in [RFC 2863]. See Annex A.2 for details on particular interfaces type.

The CMTS MUST report in ifSpeed and ifHighSpeed MIB objects the current configured speed of the interface as stated in [RFC 2863]. See Annex A.2 for details on particular interfaces type.

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<sup>52</sup> Revised per OSSIV3.0-N-07.0397-2 by ab on 5/4/07 AND per OSSIV3.0-N-07.0402-1, #11 on 5/7/07 by KN. Section also revised per OSSI-N-07.0397, #1 on 5/16/07 by KN.

<sup>53</sup> Section added per OSSIV3.0-N-07.0402-1 #12 on 5/7/07 by KN. Revised per OSSIV3.0-N-07.0540-4 by ab on 11/6/07.

<sup>54</sup> Section added per OSSIV3.0-N-07.0402-1, #13 on 5/7/07 by KN.

### 7.1.3.3.7 *ifDescr*<sup>55</sup>

#### 7.1.3.3.7.1 IfDescr for USB interfaces

If the CM support USB as CPE interfaces, the CM MUST report the value of the MIB object ifDescr for these interfaces as follows:

USB <dbcUSB> CDC Ethernet; <any text>

<dbcUSB> corresponds to the USB version in the format JJ.M.N (JJ – major version number, M – minor version number, N – sub-minor version number). See Standard USB Descriptor Definitions from [USB] specification.

E.g., if the dbcUSB field in the USB descriptor is 0x0213, <dbcUSB> is presented in ifDescrMib object as "2.1.3" and a value of 0x2000 in the dbcUSB field of the USB Descriptor is represented as "2.0" in ifDescr MIB object. In both cases without double quotes.

<Any text> indicates a vendor specific text.

A complete example of ifDescr for an USB device is as follows (Assume dbcUBC 0x2000):

USB 2.0 CDC Ethernet; <any text>

### 7.1.3.4 Requirements for Ethernet Interface MIB [RFC 3635]

The CMTS MUST implement [RFC 3635] for each of its Ethernet interfaces.

The CMs MUST implement [RFC 3635] if Ethernet interfaces are present.

### 7.1.3.5 Requirements for Bridge MIB [RFC 4188]<sup>56</sup>

The CM MUST implement the Bridge MIB [RFC 4188] to support the forwarding requirements defined in [MULPI].

If a CMTS is a Bridging CMTS, the CMTS MUST implement the Bridge MIB [RFC 4188] to manage the bridging process and represent state information about the CMTS Forwarders using link-layer (bridging) semantics.

The CM MUST implement a managed object (see docsDevSTPControl in [RFC 4639]) that controls the 802.1d spanning tree protocol (STP) policy in accordance with [MULPI] requirements.

If STP is enabled for the CM or CMTS, then the CM or CMTS implements the dot1dStp scalar group [RFC 4188] and optionally the dot1dStpPortTable [RFC 4188] as specified in Annex A.

### 7.1.3.6 Requirements for Internet Protocol MIB [RFC 4293]

The CMTS and CMs requirements for [RFC 4293] are defined in the following sections.

#### 7.1.3.6.1 The IP Group<sup>57</sup>

The CMTS MUST implement the ipv4GeneralGroup.

The CM MUST implement the ipv4GeneralGroup.

The CMTS MUST implement the ipv6GeneralGroup2.

The CM MUST implement the ipv6GeneralGroup2.

The CMTS MUST implement the ipv4InterfaceTable.

The CMTS MUST populate the ipv4InterfaceTable with each Ethernet interface with an assigned IPv4 address. The CMTS MAY record other interfaces in the ipv4InterfaceTable which have assigned IPv4 addresses.

<sup>55</sup> Section added per OSSIV3.0-N-07.0402-1, #14 on 5/7/07 by KN.

<sup>56</sup> Revised per OSSIV3.0-N-07.0475-3 by ab on 7/12/07, per OSSIV3.0-N-07.0516-2 by ab on 10/15/07, and per EC N-12-1058-3 on 7/24/12 by JS.

<sup>57</sup> Revised per OSSIV3.0-N-08.0700-4 on 1/7/09 by JS and per EC N-12-1058-3 on 7/24/12 by JS.

The CMTS MUST populate the ipv6InterfaceTable with each Ethernet interface with an assigned IPv6 address. The CMTS MAY record other interfaces in the ipv6InterfaceTable which have assigned IPv6 addresses.

The CM MUST implement the ipv4InterfaceTable.

The CM MUST populate the ipv4InterfaceTable with each Ethernet interface with an assigned IPv4 address. The CM MAY record other interfaces in the ipv4InterfaceTable which have assigned IPv4 addresses.

The CM MUST populate the ipv6InterfaceTable with each Ethernet interface with an assigned IPv6 address. The CM MAY record other interfaces in the ipv6InterfaceTable which have assigned IPv6 addresses.

The CMTS MAY implement the ipSystemStatsTable.

The CM MAY implement the ipSystemStatsTable.

The Routing CMTS MUST implement the ipIfStatsTable that includes both the CATV MAC interface and any NSI interfaces. The Bridging CMTS MAY implement the ipIfStatsTable.<sup>58</sup>

The CM MAY implement the ipIfStatsTable.

The Routing CMTS MUST implement the ipAddressPrefixTable. The Bridging CMTS MAY implement the ipAddressPrefixTable.

The CM MAY implement the ipAddressPrefixTable.

The Routing CMTS MUST implement the ipAddressTable as Read-Only. The Bridging CMTS MAY implement the ipAddressTable.

The CM MAY implement the ipAddressTable.

The Routing CMTS MUST implement the ipNetToPhysicalTable. The Bridging CMTS MAY implement the ipNetToPhysicalTable.

The CM MAY implement the ipNetToPhysicalTable.

The Routing CMTS MUST implement the ipDefaultRouterTable. The Bridging CMTS MAY implement the ipDefaultRouterTable.

If the CMTS has been configured for a default route, the Routing CMTS MUST populate the default router in the ipDefaultRouterTable.

The CMTS can populate the ipDefaultRouterTable with an IPv4 and/or IPv6 statically configured default router or a default router learned through a dynamic update mechanism such as a routing protocol update or IPv6 router advertisement message.

The CM MAY implement the ipDefaultRouterTable.

The Routing CMTS MUST implement the ipv6RouterAdvertTable. The Bridging CMTS MUST NOT implement the ipv6RouterAdvertTable.

The CM MUST NOT implement the ipv6RouterAdvertTable.

#### *7.1.3.6.2 The ICMP Group*

The CMTS MUST implement the icmpStatsTable.

The CM MUST implement the icmpStatsTable.

The CMTS MUST implement the icmpMsgStatsTable.

The CM MUST implement the icmpMsgStatsTable.

#### **7.1.3.7 Requirements for User Datagram Protocol MIB [RFC 4113]<sup>59</sup>**

The CMTS SHOULD implement the UDP-MIB [RFC 4113].

<sup>58</sup> Revised per OSSIV3.0-N-10.0945-2 on 9/23/10 by JB.

<sup>59</sup> Section revised per OSSIV3.0-N-07.0404-1, #2 on 5/11/07 by KN.

The CM MAY implement the UDP-MIB in [RFC 4113].

### **7.1.3.8 Requirements for Transmission Control Protocol (TCP) MIB [RFC 4022]**

#### *7.1.3.8.1 The TCP Group*

The CMTS SHOULD implement the TCP group in [RFC 4022].

The CM MAY implement the TCP group in [RFC 4022].

### **7.1.3.9 Requirements for SNMPv2 MIB [RFC 3418]**

#### *7.1.3.9.1 The System Group*

The CMTS MUST implement the System Group of [RFC 3418].

The CM MUST implement the System Group of [RFC 3418].

See Section 8.2.1 for sysDescr requirements details.

#### *7.1.3.9.2 The SNMP Group*

This group provides SNMP protocol statistics and protocol errors counters.

The CMTS MUST implement The SNMP Group from [RFC 3418].

The CM MUST implement The SNMP Group from [RFC 3418].

### **7.1.3.10 Requirements for Internet Group Management Protocol MIB [RFC 2933]**

The CM MUST implement [RFC 2933].

Refer to Annex E for DOCSIS 3.0 IGMP-STD-MIB CM implementation details.

The CM IGMP Passive and Active Modes (see Annex E) are maintained for backward compatibility with pre-3.0 DOCSIS systems, including the support of [RFC 2933]. For CMs operating with DSID Based Forwarding enabled, the CM is not responsible for proxying or snooping Multicast traffic, thus no MGMD or [RFC 2933] MIB requirements are needed on the CM. When CMs operate with DSID Based Multicast forwarding disabled, the CM is required to support [RFC 2933] passive mode. The CM may support [RFC 2933] Active mode per the requirements in Annex E.

### **7.1.3.11 Requirements for Multicast Group Membership Discovery MIB [RFC 5519]<sup>60</sup>**

The CMTS MUST implement [RFC 5519].

Refer to Annex E for DOCSIS 3.0 MGMD CMTS implementation details.

### **7.1.3.12 Requirements for DOCSIS Baseline Privacy Plus MIB [RFC 4131]<sup>61</sup>**

The CMTS MUST implement [RFC 4131].

The CMTS MUST implement the CMTS extensions to [RFC 4131] listed in Annex L.

The CM MUST implement [RFC 4131].

The CM MUST implement the CM extensions to [RFC 4131] listed in Annex L.

The CMTS MUST report values for the MIB object docsBpi2CmtsCACertTrust of either 'trusted', 'untrusted', or 'root'. The CMTS MAY persist entries with a docsBpi2CmtsCACertTrust value of 'chained' across reboots. The CMTS MUST be capable of removing entries in the docsBpi2CmtsCACertTable via SNMP by setting the row status to 'destroy'. The CMTS MUST NOT allow new entries to be created for certificates that already exist in the docsBpi2CmtsCACertTable.

<sup>60</sup> Revised per OSSIV3.0-N-09.0835-2 on 9/15/09 by JB.

<sup>61</sup> Section modified per OSSIV3.0-N-08.0612-2 on 4/10/08 by KN, and modified per OSSIV3.0-N-08.0700-4 on 1/7/09 by JS.

The CMTS MUST persist the entries in docsBpi2CmtsProvisionedCmCertTable across reboots. The CMTS MUST be capable of removing entries in docsBpi2CmtsProvisionedCmCertTable via SNMP by setting the row status to 'destroy'. The CMTS MUST NOT allow new entries to be created for certificates that already exist in the docsBpi2CmtsProvisionedCmCertTable.

The CMTS MUST extend the MIB object docsBpi2CmtsAuthBpkmCmCertValid enumerations as follows:

```

docsBpi2CmtsAuthBpkmCmCertValid          OBJECT-TYPE
SYNTAX      INTEGER {
    unknown (0),
    validCmChained (1),
    validCmTrusted (2),
    invalidCmUntrusted (3),
    invalidCAUntrusted (4),
    invalidCmOther (5),
    invalidCAOther (6),
    invalidCmRevoked(7),
    invalidCARevoked(8)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Contains the reason why a CM's certificate is deemed
valid or invalid.
Return unknown(0) if the CM is running BPI mode.
ValidCmChained(1) means the certificate is valid
because it chains to a valid certificate.
ValidCmTrusted(2) means the certificate is valid
because it has been provisioned (in the
docsBpi2CmtsProvisionedCmCert table) to be trusted.
InvalidCmUntrusted(3) means the certificate is invalid
because it has been provisioned (in the
docsBpi2CmtsProvisionedCmCert table) to be untrusted.
InvalidCAUntrusted(4) means the certificate is invalid
because it chains to an untrusted certificate.
InvalidCmOther(5) and InvalidCAOther(6) refer to
errors in parsing, validity periods, etc., which are
attributable to the CM certificate or its chain,
respectively; additional information may be found
in docsBpi2AuthRejectErrorString for these types
of errors.
invalidCmRevoked(7) means the certificate is
invalid as it was marked as revoked.
invalidCARevoked(8) means the CA certificate is
invalid as it was marked as revoked.
"
REFERENCE
    "DOCSIS Security Specification CM-SP-SECv3.0-I08-080522,
     Certificate Revocation section."
::= { docsBpi2CmtsAuthEntry 19 }

```

A DOCSIS 3.0 CMTS uses the value of MdifIndex as the ifIndex key in the following tables:

- docsBpi2CmtsBaseTable
- docsBpi2CmtsAuthTable
- docsBpi2CmtsTEKTable
- docsBpi2CmtsIpMulticastMapTable

Entries in the docsBpi2CmtsIpMulticastMapTable are only populated when an authorized joiner for a specific multicast group, which has been configured in the CmtsGrpCfg object for encryption (i.e., a CmtsGrpEncrypt object instance exists and is referenced by a CmtsGrpCfg instance), has successfully joined a session. Thus entries in this table are only created when active sessions have been initiated to authorized clients.

### **7.1.3.13 Requirements for Diffie-Helman USM Key MIB [RFC 2786]**

The CM MUST implement [RFC 2786].

The CMTS MAY implement [RFC 2786].

### **7.1.3.14 Requirements for DOCSIS Baseline Privacy MIB [RFC 3083]**

The CM MUST implement [RFC 3083].

Due to the editorial error in [RFC 3083] documented in the corresponding Errata for [RFC 3083], the CM MUST use the following definition for docsBpiCmAuthState and not the definition in [RFC 3083]:

```
docsBpiCmAuthState OBJECT-TYPE
  SYNTAX INTEGER {
    start(1),
    authWait(2),
    authorized(3),
    reauthWait(4),
    authRejectWait(5)
  }
  MAX-ACCESS read-only
  STATUS current
  DESCRIPTION
    "The value of this object is the state of the CM authorization FSM.
     The start state indicates that FSM is in its initial state."
  REFERENCE
    "DOCSIS Baseline Privacy Interface Specification, States Section."
  ::= { docsBpiCmBaseEntry 3 }
```

In addition, the CM MAY create new entries in the docsBpiCmTEKTable for any multicast SAID(s) it receives in Auth-Reply messages. If the CM implements multicast SAID(s) in the docsBpiCmTEKTable, the CM MUST use the multicast SAID as an index in the docsBpiCmTEKTable in the docsIfCmServiceId field. If the multicast SAID is used in the docsBpiCmTEKTable, the CM MUST NOT allow a corresponding entry in the docsIfCmServiceTable for the multicast SAID, due to the definition of the docsIfCmServiceId in the DOCS-IF-MIB.<sup>62</sup>

A DOCSIS 3.0 CMTS uses the value of MdifIndex as the ifIndex key in the following tables:<sup>63</sup>

- docsBpiCmtsBaseTable
- docsBpiCmtsAuthTable
- docsBpiCmtsTEKTable
- docsBpiIpMulticastMapTable

### **7.1.3.15 Requirements for SNMPv3 MIB Modules**

The CM MUST implement the MIBs defined in [RFC 3411] through [RFC 3415] and [RFC 3584].

The CMTS MUST implement the MIBs defined in [RFC 3411] through [RFC 3415] and [RFC 3584].

The CM MUST support the default value of 'volatile' for any SNMPv3 object with a StorageType syntax. This overrides the default value specified in [RFC 3411] through [RFC 3415] and [RFC 3584]. The CM MUST only accept the value of 'volatile' for any SNMPv3 object with a StorageType syntax. An attempted set to a value of 'other', 'nonVolatile', 'permanent', or 'readOnly' will result in an "inconsistentValue" error. Values other than the valid range (1-5) would result in a "wrongValue" error.

The CM SHOULD support a minimum of 30 available rows in the vacmViewTreeFamilyTable object.

The CMTS SHOULD support a minimum of 30 available rows in the vacmViewTreeFamilyTable object.

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<sup>62</sup> Original section which followed this deleted per OSSIV3.0-N-07.0532-4 on 1/29/08 by KN.

<sup>63</sup> Added 11/14/08 per OSSIV3.0-N-08.0700-4 by JS.

### 7.1.3.16 Requirements for Entity MIB [RFC 4133]<sup>64</sup>

The CM MAY implement the ENTITY-MIB [RFC 4133].

The CMTS MAY implement the ENTITY-MIB [RFC 4133].

#### 7.1.3.16.1 CMTS Guidelines for the implementation of the Entity MIB [RFC 4133]

The Entity MIB [RFC 4133] provides a physical component layer applicable to managed objects defined for DOCSIS devices. In particular for the entPhysicalTable MIB objects, not all the physical components listed need to instantiate all the object's attributes in entPhysicalTable (the Maximum Access is as defined in [RFC 4133].) Therefore, Annex A Table A-3, columns "CMTS" or "CM" with value "O" (optional) need to be interpreted on a physical component basis as well as the column "Access".

Table 7-6 represents high level constraints for any instance of entPhysicalTable.

**Table 7-6 - entPhysicalTable Requirements**

MIB object	Value
entPhysicalIndex	n
entPhysicalDescr	Text Description
entPhysicalVendorType	Enterprise-specific OID or zeroDotZero
entPhysicalContainedIn	0..n
entPhysicalClass	Physical Class per [RFC 4133]
entPhysicalParentRelPos	-1..n per [RFC 4133]
entPhysicalName	Physical element name In case of a component mapped to an interface Index ifName can be reported, otherwise zero-length string
entPhysicalHardwareRev	Hardware revision or zero-length string
entPhysicalFirmwareRev	Firmware revision or zero-length string
entPhysicalSoftwareRev	Software revision or zero-length string
entPhysicalSerialNum	Serial Number or zero-length string
entPhysicalMfgName	Manufacturer Name or zero-length string
entPhysicalModelName	Model Name or zero-length string
entPhysicalAlias	Physical element operator defined alias In case of a component mapped to an interface Index ifAlias can be reported and implemented as read-only, otherwise zero-length string
entPhysicalAssetID	User defined Asset ID or zero-length string
entPhysicalIsFRU	'true' or 'false'
entPhysicalMfgDate	Manufacturer data or all zeros '0000000000000000'H
entPhysicalUrIs	URI or zero-length string

The following sections detail requirements for the CMTS on specific topics where the DOCSIS 3.0 requirements interact with the Entity MIB have been set.

#### 7.1.3.16.1.1 CMTS requirements for entLogicalTable, entLPMMappingTable and entConfigChange Notification

The CMTS is not required to support multiple naming scopes. Therefore, this specification has no CMTS requirements for entLogicalTable and entLPMMappingTable and is left for vendor-specific implementation.

<sup>64</sup> Section modified per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN; subsections added 11/14/08 per OSSIV3.0-N-08.0651-3 by JS.

In addition, this specification has no CMTS requirements for the entConfigChange Notification and is left for vendor-specific implementation.

#### 7.1.3.16.1.2 CMTS requirements for entPhysicalTable

The CMTS MAY provide as much information as possible about entPhysicalTable listed in Table A-6 for major components such as CMTS chassis, backplanes and containers or modules in the form or cards and/or field replaceable units (RFUs) when possible. Modules within a modules (or card) or other contained physical components need not be detailed.

The CMTS MAY report an entry in the entPhysicalTable for the chassis component with Physical Class 'chassis'.

The CMTS MAY report entries in the entPhysicalTable of Physical Class 'container' (such as slots) that contains physical Field Removable Units (FRU) normally modeled as elements of Physical Class 'module'.

The CMTS MAY report temperature sensors in the form of instances in the entPhysicalTable for elements of Physical Class 'sensor' with the corresponding entPhySensorType 'celsius' value in the corresponding entPhySensorTable instance of the ENTITY-SENSOR-MIB [RFC 3433].

The [DRFI] specification defines a multi-channel RF port capability. The set of downstream channels within the same RF port is also known as a "Channel Block" (See [DRFI]).

The [MULPI] specification does not have a concrete definition of multiple upstream interfaces being part of the same RF spigot as [DRFI] does for downstream channels, but in several diagrams (e.g., [MULPI] Figure 5-5) those options are discussed. For the upstream interfaces, only the physical upstream interfaces are modeled in the Entity MIB. The logical upstream interfaces are defined as specified in Section 7.1.3.3.1.

A Channel Block is defined as the set of downstream interfaces (Physical Class 'port') that share the same immediate physical component of Physical Class 'module' in the containment tree (entPhysicalContainsTable).

The Entity MIB entries below the 'chassis' container will at a minimum consist of the downstream and upstream interfaces and optionally the logical Mac Domain groupings. The goal in this reporting structure is to catalog and report those interfaces that may be combined to logically for MAC Domains.

The CMTS MAY report RF port as Physical Class 'module' elements in the entPhysicalTable. The CMTS MAY include the text "RF port" within the description of the SNMP object entPhysicalDescr for RF ports modeled in the entPhysicalTable.

The CMTS MAY report MAC Domain interfaces (ifType = 127) as Physical Class 'module' in the entPhysicalTable.

The CMTS MAY report downstream interfaces (ifType = 128), as Physical Class 'port' in the entPhysicalTable.

The CMTS MAY report upstream interfaces (ifType = 129) as Physical Class 'port' in the entPhysicalTable. Upstream logical channels are not represented in the entPhysicalTable as those are subinterfaces illustrated in the ifStackTable [RFC 2863].

The CMTS MAY represent interfaces other than the defined above as part of the entPhysicalTable.

#### 7.1.3.16.1.3 CMTS requirements for entPhysicalContainsTable

The purpose of the entPhysicalContainsTable in the CMTS is to represent the association of multiple downstream and upstream interfaces within the physical construction of the CMTS. These associations are already modeled in the entPhysicalTable (entPhysicalContainedIn and entPhysicalParentRelPos). The entPhysicalContainsTable provide a more direct relationship of those parent-child associations. Additionally it may provide mechanisms to indicate other associations like restrictions and configurability of downstream and upstream interfaces within a particular MAC Domain as defined below.

For the purpose of identifying downstream and upstream interfaces within an RF port as well as Channel Blocks, the CMTS MAY report in the entPhysicalContainsTable the physical component of Physical Class 'module' as the entPhysicalIndex value for each of the downstream or upstream interface Physical Indexes as the values for entPhysicalChildIndex.

For the purpose of modeling which upstream and downstream interfaces can physically and logically be configured within a MAC Domain, the CMTS MAY define logical components of Physical Class 'backplane' (in entPhysicalTable) to include (in entPhysicalContainsTable) all the MAC Domain interface resources and downstream/upstream interfaces that could potentially be added in a particular MAC Domain.

If supported, the CMTS MAY apply the following rules to indicate containment models for MAC Domain and downstream/upstream associations:

- The 'backplane' physical component entries in entPhysicalTable have a valid Physical Index for entPhysicalContainedIn (e.g., the CMTS 'chassis' or another 'backplane' Physical Class component).
- The 'backplane' physical components are not referenced by other physical components in entPhysicalTable as their entPhysicalContainedIn value.
- Physical components 'backplane' are the parent index in entPhysicalContainsTable for children indexes representing MAC Domain interfaces, downstream/upstream interfaces, and/or physical components 'modules' that represent RF ports or Channel Blocks. When this set of parent-child entries contains 'modules' (e.g., Channel Blocks) instead of individual US/DS interfaces, it indicates that the complete 'module' is configurable within a single MAC Domain, while the existence of individual 'backplane' – downstream/upstream interfaces parent-children entries in entPhysicalContainsTable indicates that individual channels (even within a Channel Block) can be associated with specific MAC Domains).

The CMTS does not need to report in the entPhysicalContainsTable the MAC Domain downstream/upstream channel hierarchy normally represented in the ifStackTable.

#### 7.1.3.16.1.4 CMTS requirements for entAliasMappingTable

The entAliasMappingTable is used in this specification to associate the physical elements modeled in the Entity MIB with the logical components of the CMTS management model. Normally the entAliasLogicalIndexOrZero value is '0' as there are no CMTS requirements to support multiple logical entities within the CMTS. However, vendors may opt to define multiple logical entities, in which case this object value will be non-zero.

The CMTS MAY represent the mapping of MAC Domain, downstream and upstream interfaces in the entAliasMappingTable.

The CMTS MAY represent the mapping of other logical components with physical components in the entAliasMappingTable.

#### 7.1.3.16.2 CM Guidelines for the implementation of the Entity MIB [RFC 4133]

If the CM implements the ENTITY-SENSOR-MIB [RFC 3433], the CM is required to implement the entPhysicalTable with entries corresponding to any sensors managed in the ENTITY-SENSOR-MIB (e.g., temperature sensors). For sensor entries in the entPhysicalTable, the CM reports a value of 'sensor' for entPhysicalClass.

#### 7.1.3.17 Requirements for Entity Sensor MIB [RFC 3433]

The CM MAY implement the Entity Sensor MIB [RFC 3433].

The CMTS MAY implement the Entity Sensor MIB [RFC 3433].

#### 7.1.3.17.1 CMTS Guidelines for the implementation of the Entity Sensor MIB [RFC 3433]

For ENTITY-MIB [RFC 4133] entPhysicalTable instances with entPhysicalClass of 'sensor', the CMTS MAY implement the entPhySensorTable with the same entPhysicalIndex used in the entPhysicalTable and the entPhySensorType of 'celsius'.

#### 7.1.3.17.2 CM Guidelines for the implementation of the Entity Sensor MIB [RFC 3433]

The CM MAY implement the entPhySensorTable for instances which exist in the entPhysicalTable of the ENTITY-MIB [RFC 4133] with an entPhysicalClass of 'sensor'. It is recommended that for temperature sensors, the CM report a value for entPhySensorType of 'celsius'.

**7.1.3.18 Requirements for Host Resources MIB [RFC 2790]<sup>65</sup>**

The CM MAY implement the HOST-RESOURCES-MIB [RFC 2790].

The CMTS MAY implement the HOST-RESOURCES-MIB [RFC 2790].<sup>66</sup>

**7.1.3.19 Requirements for DOCSIS Interface Extension 2 MIB (Annex H)**

The CM MUST implement DOCS-IFEXT2-MIB, as specified in Annex H.

The CMTS MUST implement DOCS-IFEXT2-MIB, as specified in Annex H.

**7.1.3.20 Requirements for CableLabs Topology MIB (Annex Q)**

The CMTS MUST implement CLAB-TOPO-MIB, as specified in Annex Q.

**7.1.3.21 Requirements for DOCSIS Diagnostic Log MIB (Annex Q)**

The CMTS MUST implement DOCS-DIAG-MIB, as specified in Annex Q.

**7.1.3.22 Requirements for DOCSIS Interface 3 MIB (Annex Q)**

The CMTS MUST implement the DOCS-IF3-MIB, as specified in Annex Q.

The CM MUST implement the DOCS-IF3-MIB, as specified in Annex Q.

**7.1.3.23 Requirements for DOCSIS Multicast MIB (Annex Q)**

The CMTS MUST implement the DOCS-MCAST-MIB, as specified in Annex Q.

**7.1.3.24 Requirements for DOCSIS Multicast Authorization MIB (Annex Q)**

The CMTS MUST implement the DOCS-MCAST-AUTH-MIB, as specified in Annex Q.

**7.1.3.25 Requirements for DOCSIS Quality of Service 3 MIB (Annex Q)**

The CMTS MUST implement the DOCS-QOS3-MIB, as specified in Annex Q.

The CM MUST implement the DOCS-QOS3-MIB, as specified in Annex Q.

A DOCSIS 3.0 CMTS populates entries in the docsQosUpstreamStatsTable with information for Pre-3.0 DOCSIS devices. Devices operating in Multiple Transmit Channel mode will not be recorded in the docsQosUpstreamStatsTable and will instead be recorded in the docsQosServiceFlowCcfStatsTable.

**7.1.3.26 Requirements for DOCSIS Security MIB (Annex Q)**

The CMTS MUST implement the DOCS-SEC-MIB, as specified in Annex Q.

**7.1.3.27 Requirements for DOCSIS Subscriber Management 3 MIB (Annex Q)**

The CMTS MUST implement the DOCS-SUBMGT3-MIB, as specified in Annex Q.

**7.1.3.28 Requirements for DOCSIS Load Balancing 3 MIB (Annex Q)**

The CMTS MUST implement the DOCS-LOADBAL3-MIB, as specified in Annex Q.

**7.1.3.29 Requirements for DOCSIS DRF MIB [M-OSSI]**

The CMTS MUST implement the managed objects from DOCS-DRF-MIB [M-OSSI] specified in Annex A for all the Downstream Channel interfaces that are integrated (ifType = 'docsCableDownstream').

<sup>65</sup> Section modified per OSSIV3.0-N-08.0618-3 on 4/11/08 by KN.

<sup>66</sup> Section modified per OSSIV3.0-N-07.0402-1 on 5/7/07 by KN.

### 7.1.3.30 Requirements for IP Multicast MIB [RFC 5132]<sup>67</sup>

The CMTS MUST implement [RFC 5132].

If the CMTS has any one of the following multicast protocols enabled, PIM [RFC 4601], MLD [RFC 2710] [RFC 3810], or IGMP [RFC 1112] RFC 2236] [RFC 3376], the CMTS MUST report a value of 'true' for ipMcastEnabled. When all three multicast protocols, PIM, MLD and IGMP are disabled in the CMTS, the value of 'false' is reported for ipMcastEnabled.

## 7.2 IPDR Service Definition Schemas<sup>68</sup>

This section defines the IPDR Service Definitions required for DOCSIS 3.0. Table 7-7 lists the DOCSIS 3.0 IPDR Service Definitions, corresponding schemas, applicable device and object model specification reference. Refer to Section 6.2 for an overview of the IPDR/SP protocol and Section 8.5 for an overview of the SAMIS IPDR Service Definition. The Service Definition schemas are defined in Annex R.

**Table 7-7 - DOCSIS 3.0 IPDR Service Definitions and Schemas<sup>69</sup>**

Object Model Reference	Schema	Applicable Device(s)
Annex B	Subscriber Account Management Interface Specification (SAMIS) Service Definition: SAMIS-TYPE-1 Schema Definition: DOCSIS-SAMIS-TYPE-1_<version> Subscriber Account Management Interface Specification (SAMIS Optimized) Service Definition: SAMIS-TYPE-2 Schema Definition: DOCSIS-SAMIS-TYPE-2_<version>	CMTS only
Annex G	Diagnostic Log Service Definition: DIAG-LOG-TYPE Schema Definition: DOCSIS-DIAG-LOG-TYPE_<version> Service Definition: DIAG-LOG-EVENT-TYPE Schema Definition: DOCSIS-DIAG-LOG-EVENT-TYPE_<version> Service Definition: DIAG-LOG-DETAIL-TYPE Schema Definition: DOCSIS-DIAG-LOG-DETAIL-TYPE_<version>	CMTS only
Annex J	Spectrum Measurement Service Definition: SPECTRUM-MEASUREMENT-TYPE Schema Definition: DOCSIS-SPECTRUM-MEASUREMENT-TYPE_<version>	CMTS only
Annex N	CMTS CM Registration Status Information Service Definition: CMTS-CM-REG-STATUS-TYPE Schema Definition: DOCSIS-CMTS-CM-REG-STATUS-TYPE_<version> CMTS CM Upstream Status Information Service Definition: CMTS-CM-US-STATS-TYPE Schema Definition: DOCSIS-CMTS-CM-US-STATS-TYPE_<version>	CMTS only
Annex O	CMTS Topology Service Definition: CMTS-TOPOLOGY-TYPE Schema Definition: DOCSIS-CMTS-TOPOLOGY-TYPE_<version>	CMTS only

<sup>67</sup> Section added per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

<sup>68</sup> Replaced figure per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB; table updated per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO..

<sup>69</sup> Table revised per OSSIV3.0-N-07.0550-2 by ab on 11/9/07 and OSSIV3.0-N-08.0642-3 on 4/25/08 by KN. Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 and per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB. Revised per OSSIV3.0-N-10.0968-2 by JB on 1/21/11.

<b>Object Model Reference</b>	<b>Schema</b>	<b>Applicable Device(s)</b>
Annex P	CPE Service Definition: CPE-TYPE Schema Definition: DOCSIS-CPE-TYPE_<version>	CMTS only
Annex R	CMTS Upstream Utilization Statistics Service Definition: CMTS-US-UTIL-STATS-TYPE Schema Definition: DOCSIS-CMTS-US-UTIL-STATS-TYPE_<version> CMTS Downstream Utilization Statistics Service Definition: CMTS-DS-UTIL-STATS-TYPE Schema Definition: DOCSIS-CMTS-DS-UTIL-STATS-TYPE_<version> CMTS Service Flow Information Service Definition: CMTS-CM-SERVICE-FLOW-TYPE Schema Definition: DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE_<version> CMTS IP Multicast Statistics Service Definition: IP-MULTICAST-STATS-TYPE Schema Definition: DOCSIS-IP-MULTICAST-STATS-TYPE_<version>	CMTS only

Figure 7-3 represents the high level organization of the DOCSIS IPDR Service Definitions listed in Table 7-7. The DOCSIS IPDR Service Definitions are XML schemas derived from the IPDR Master Schema document (IPDRDoc). See Section 6.2.3.3 for details of the IPDR Master Schema. This specification names DOCSIS IPDR Service Definitions in the form of DOCSIS-<SERVICE-NAME>-TYPE (e.g., DOCSIS-SAMIS-TYPE-1, DOCSIS-DIAG-LOG-TYPE).

In addition to the conventional IPDR Service Definition models, this specification defines Object Model Schemas (Auxiliary Schemas) to represent network components being referenced by the Service Definitions themselves. For example, the DOCSIS-CMTS-INFO Auxiliary Schema offers Topology information at the Physical and MAC layer of the CMTS-CM arrangements. For the same example, a DOCSIS Service Definition (service aware) can include the object schema DOCSIS-CMTS-INFO to complete the CM-CMTS identification and to offer context for the statistics and parameters reported in the document records. This modular abstraction allows the definition of different schema documents for the same Service Definition at different elements of the collection infrastructure. Refer to Annex C for a list of Auxiliary Schemas defined for DOCSIS 3.0.

One example is the SAMIS model that supports two different models (see detailed SAMIS requirements in Annex B):

- The Service Definition Schema DOCSIS-SAMIS-TYPE-1

Each document record contains the information modeled by the Service Definition DOCSIS-CMTS-INFO. CMTS-CM related information is duplicated for each SAMIS record.

- The Service Definition Schema DOCSIS-SAMIS-TYPE-2

Each document record contains a reference to the last updated DOCSIS-CMTS-INFO, reducing the amount of data sent over the network. DOCSIS-CMTS-INFO information is sent periodically (e.g., any time an update to the CMTS-CM Status is performed). The collector system is in charge of correlating the information received from records of DOCSIS-SAMIS-TYPE-2 and DOCSIS-CMTS-INFO to re-create the equivalent record obtained when using the DOCSIS-SAMIS-TYPE-1 Service Definition schema.

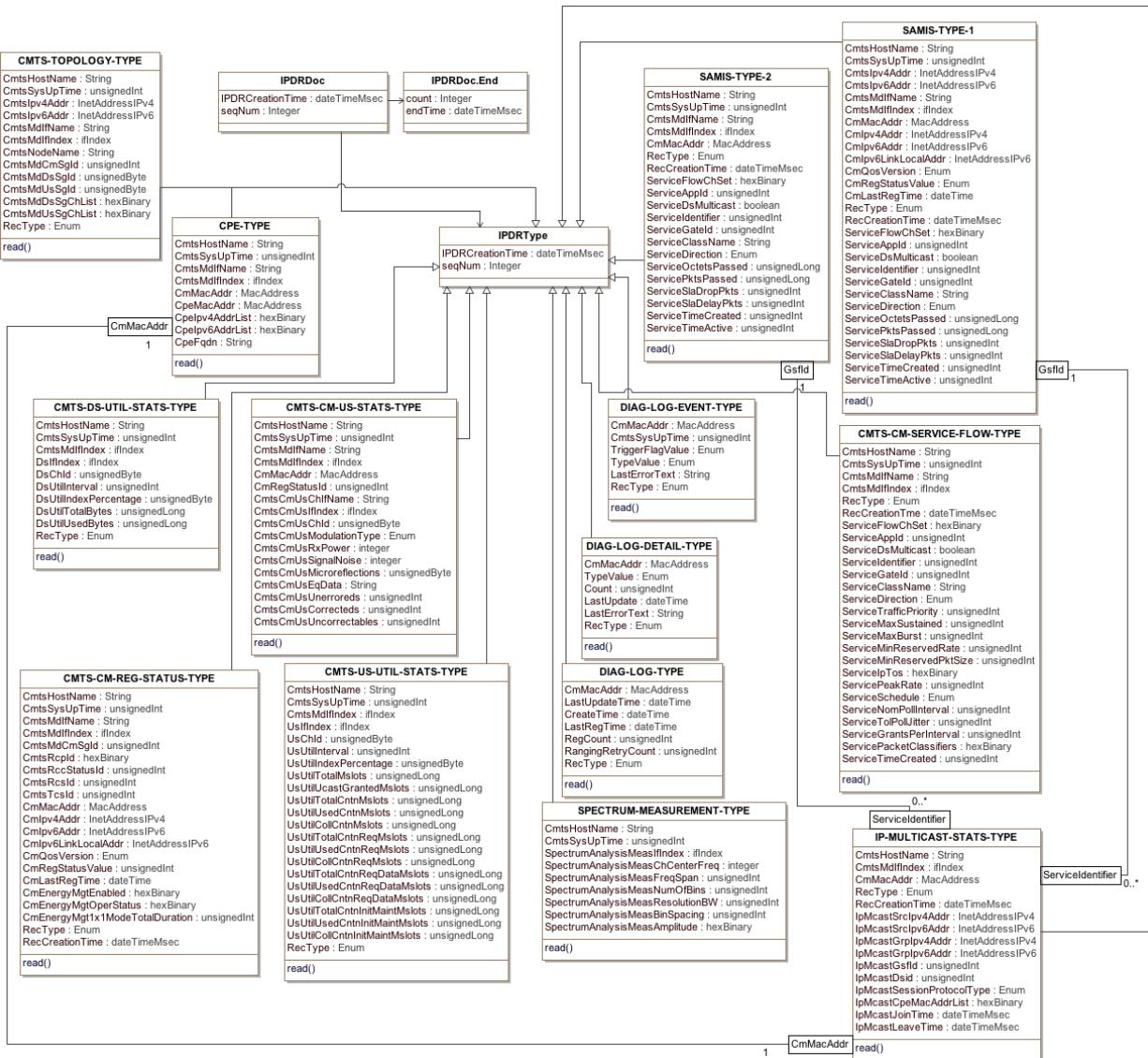


Figure 7-3 - DOCSIS IPDR Service Definition <sup>70</sup>

This section defines the minimum set of objects required to support the DOCSIS 3.0 IPDR Service Definitions. The CMTS MAY define IPDR Service Definitions which extend the DOCSIS requirements to include vendor-specific features.

### 7.2.1 Requirements for DOCSIS SAMIS Service Definitions

The CMTS MUST implement SAMIS-TYPE-1 as specified in Annex B.

The CMTS MUST implement SAMIS-TYPE-2 as specified in Annex B.

<sup>70</sup> Figure replaced per OSSIV3.0-N-11.0993-1 on 6/2/11 by JB, updated per OSSIV3.0-N-12.1073-3 on 11/1/12 by PO, updated per OSSIV3.0-12.1083-5 on 3/20/13 by PO; updated per OSSIV3.0-14.1151-2 on 7/15/14 by PO.

### 7.2.1.1 Records Collection<sup>71</sup>

Subscriber Usage Billing Records report the absolute traffic counter values for each Service Flow that has become active during the billing collection interval as seen at the end of the interval. Normal Service Flows used by a Cable Modem or Class or Service (Subscriber) are reported. Group Service Flows are reported by Service Flow without CM association. It is understood that CMs registering in DOCSIS 1.0 mode are associated to SIDs and CMs that register in DOCSIS 1.1 mode are associated to SFIDs. In this section the term SFID/SID is used to refer to both cases. The collection interval is defined as the time between:

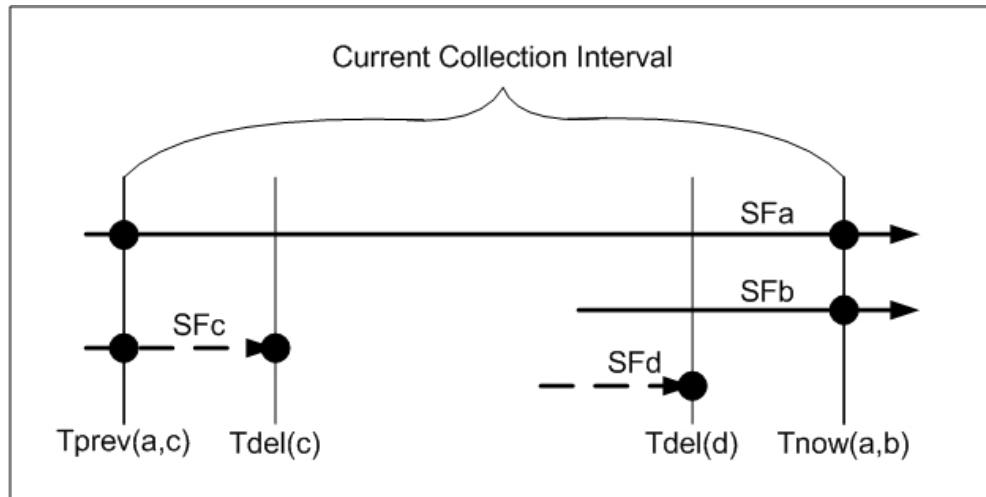
- The creation of the previous billing document denoted as Tprev.
- The creation of the current billing document denoted as Tnow.

In reference to Figure 7-4 below, there are two kinds of records reported for a SFID/SID in the current billing document: 1) SFIDs/SIDs that are still running at the time the billing document is created (called 'Interim' records) and 2) terminated SFIDs/SIDs that have been deleted and logged during the collection interval (called 'Stop' records). The CMTS MUST report 'Interim' records at the end of the collection interval. The CMTS MUST NOT record a provisioned or admitted state SF that was deleted before it became active in the billing document, even though it was logged by the CMTS.

The CMTS MUST report any currently running SFIDs/SIDs using Tnow as the timestamp for its counters and identify them in the IPDR RecType element as 'Interim'. The CMTS MUST report a terminated SFIDs/SIDs only once in the current billing document. Terminated SFIDs/SIDs have a deletion time (Tdel) later than Tprev. A CMTS MUST report a terminated SFID/SID using its Tdel from the log as the timestamp for its counters and identify it in the IPDR RecType element as 'Stop'. Note that the timestamps are based on the formatter's reporting times. Since the collection cycle may vary over time, the reporting times in the billing document can be used to construct an accurate time base over sequences of billing documents.

In the example shown in Figure 7-4 below there are four Service Flows recorded for a Subscriber in the current billing document being created at Tnow. SFa is a long running SF that was running during the previous collection interval (it has the same SFID in both the current and the previous billing documents). SFa was recorded as type Interim at Tprev in the previous billing document and is recorded again as type Interim at Tnow in the current document. SFb is a running SF that was created during the current collection interval. SFb is recorded as type Interim for the first time at Tnow in the current document. SFc is a terminated SF that was running during the previous collection interval but was deleted and logged during the current collection interval. SFc was recorded respectively as type Interim at Tprev in the previous billing document and is reported as type Stop at the logged Tdel(c) in the current document. SFd is a terminated SF that was both created and deleted during the current collection interval. SFd is reported only once as type Stop at the logged Tdel(d) in the current billing document only.

<sup>71</sup> Revised per OSSIV3.0-N-10.0971-2 on 4/26/11 by JB.



**Figure 7-4 - Billing Collection Interval Example**

The CMTS MUST support streaming of SAMIS-TYPE-1 and SAMIS-TYPE-2 record collections as a time interval session and an ad-hoc session. The CMTS MUST support a minimum collection interval of 15 minutes and a maximum collection interval of 1440 minutes with a default of 15 minutes for time interval session streaming of SAMIS-TYPE-1 and SAMIS-TYPE-2 records. The CMTS SHOULD support a minimum collection interval of 5 minutes for time interval session streaming of SAMIS-TYPE-1 and SAMIS-TYPE-2.<sup>72</sup>

### 7.2.1.2 Template Negotiation<sup>73</sup>

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS SAMIS Service Definitions. Refer to Appendix IV for details on the IPDR Template messages.

## 7.2.2 Requirements for DOCSIS Spectrum Measurement Service Definition

The CMTS MUST implement SPECTRUM-MEASUREMENT-TYPE as specified in Annex R.

### 7.2.2.1 Record Collection

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure the diagnostic (i.e., create the interface and attributes; destroy the interface).
- IPDR/SP is used to stream the measurement statistics (large data set).

Spectrum Measurement records report the spectrum measurement statistics for all the pre-configured interfaces and their attributes as specified in Annex J.

The CMTS MUST support streaming of SPECTRUM-MEASUREMENT-TYPE record collections as a time interval session and an ad-hoc session. The rate at which records are streamed when only one interface is configured will not exceed the estimated time interval defined in Annex J. If more than one interface is configured, that rate can be lower than the estimated time interval defined in Annex J.<sup>74</sup>

<sup>72</sup> Paragraph inserted per OSSlv3.0-N-07.0588-3 on 1/31/08 by KN. Revised per OSSlv3.0-N-10.0970-2 by JB on 1/20/11.

<sup>73</sup> Revised per OSSlv3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>74</sup> Text modified per OSSlv3.0-N-07.0588-3 on 1/31/08 by KN.

### 7.2.2.2 **Template Negotiation<sup>75</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS Spectrum Measurement Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

### 7.2.3 Requirements for DOCSIS Diagnostic Log Service Definitions

The CMTS MUST implement DIAG-LOG-TYPE as specified in Annex R.

The CMTS MUST implement DIAG-LOG-EVENT-TYPE as specified in Annex R.

The CMTS MUST implement DIAG-LOG-DETAIL-TYPE as specified in Annex R.

#### 7.2.3.1 **Record Collection<sup>76</sup>**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure the Diagnostic Log.
- IPDR/SP is used to stream the Diagnostic Log instances.

The CMTS MUST support streaming of DIAG-LOG-TYPE record collections as an ad-hoc session.

The CMTS MUST support streaming of DIAG-LOG-EVENT-TYPE record collections as an event session.

The CMTS MUST support streaming of DIAG-LOG-DETAIL-TYPE record collections as a time interval session, an ad-hoc session and an event session.

For event-based Diagnostic Log records, the CMTS streams the record when the event is logged in the Diagnostic Log. For time interval based Diagnostic Log records, the CMTS streams a snapshot of the Diagnostic Log. The CMTS MUST support a minimum collection interval of 5 minutes and a maximum collection interval of 1440 minutes with a default of 15 minutes for time interval session streaming of the Diagnostic Log records.

#### 7.2.3.2 **Template Negotiation<sup>77</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS Diagnostic Log Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

### 7.2.4 Requirements for DOCSIS CMTS CM Registration Status Service Definition

The CMTS MUST implement CMTS-CM-REG-STATUS-TYPE as specified in Annex R.

#### 7.2.4.1 **Record Collection<sup>78</sup>**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure CMTS CM Registration Status service definition.
- IPDR/SP is used to stream CMTS CM Registration Status instances.

The CMTS MUST support streaming of CMTS-CM-REG-STATUS-TYPE record collections as a time interval session, an ad-hoc session and an event session. The CMTS MUST support a minimum collection interval of 5 minutes and a maximum collection interval of 1440 minutes with a default of 15 minutes for time interval session streaming of the CMTS-CM-REG-STATUS-TYPE records.

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<sup>75</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>76</sup> Section modified per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN. Revised per OSSIV3.0-N-10.0970-2 by JB on 1/20/11.

<sup>77</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>78</sup> Section added per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN. Revised per OSSIV3.0-N-10.0970-2 by JB on 1/20/11.

### **7.2.4.2 *Template Negotiation*<sup>79</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CMTS CM Registration Status Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

## **7.2.5 Requirements for DOCSIS CMTS CM Upstream Status Service Definition**

The CMTS MUST implement CMTS-CM-US-STATS-TYPE as specified in Annex R.

### **7.2.5.1 *Record Collection*<sup>80</sup>**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure CMTS CM Upstream Status service definition.
- IPDR/SP is used to stream CMTS CM Upstream Status instances.

The CMTS MUST support streaming of CMTS-CM-US-STATS-TYPE record collections as a time interval session and an ad-hoc session. The CMTS MUST support a minimum collection interval of 5 minutes and a maximum collection interval of 1440 minutes with a default of 15 minutes for time interval session streaming of the CMTS-CM-US-STATS-TYPE records.

### **7.2.5.2 *Template Negotiation*<sup>81</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CMTS CM Upstream Status Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

## **7.2.6 Requirements for DOCSIS CMTS Topology Service Definition**

The CMTS MUST implement CMTS-TOPOLOGY-TYPE as specified in Annex R.

### **7.2.6.1 *Record Collection*<sup>82</sup>**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure the topology.
- IPDR/SP is used to stream the topology information.

The CMTS MUST support streaming of CMTS-TOPOLOGY-TYPE record collections as an ad-hoc session and event session.

### **7.2.6.2 *Template Negotiation*<sup>83</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CMTS Topology Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

## **7.2.7 Requirements for DOCSIS CPE Service Definition**

The CMTS MUST implement CPE-TYPE as specified in Annex R.

### **7.2.7.1 *Record Collection*<sup>84</sup>**

This Service Definition defines the IPDR Streaming using a two step process:

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<sup>79</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>80</sup> Section added per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN. Revised per OSSIV3.0-N-10.0970-2 by JB on 1/20/11.

<sup>81</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>82</sup> Section modified per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN.

<sup>83</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>84</sup> Section added per OSSIV3.0-N-07.0588-3 on 1/31/08 by KN.

- SNMP or other configuration management interface such as CLI is used to configure DOCSIS CPE service definition.
- IPDR/SP is used to stream DOCSIS CPE instances.

The CMTS MUST support streaming of CPE-TYPE record collections as an ad-hoc session and event session.

### **7.2.7.2 *Template Negotiation*<sup>85</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CPE Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

### **7.2.8 Requirements for DOCSIS CMTS Upstream Utilization Statistics Service Definition<sup>86</sup>**

The CMTS MUST implement CMTS-US-UTIL-STATS-TYPE as specified in Annex R.

#### **7.2.8.1 *Record Collection***

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure CMTS Upstream Utilization Statistics service definition.
- IPDR/SP is used to stream CMTS Upstream Utilization Statistics instances.

The CMTS MUST create CMTS-US-UTIL-STATS-TYPE records using the configured utilization interval. The CMTS MUST support streaming of CMTS-US-UTIL-STATS-TYPE record collections as an event based session.

#### **7.2.8.2 *Template Negotiation*<sup>87</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CMTS Upstream Utilization Statistics Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

### **7.2.9 Requirements for DOCSIS CMTS Downstream Utilization Statistics Service Definition**

The CMTS MUST implement CMTS-DS-UTIL-STATS-TYPE as specified in Annex R

#### **7.2.9.1 *Record Collection***

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure CMTS Downstream Utilization Statistics service definition.
- IPDR/SP is used to stream CMTS Downstream Utilization Statistics instances.

The CMTS MUST create CMTS-DS-UTIL-STATS-TYPE records using the configured utilization interval. The CMTS MUST support streaming of CMTS-DS-UTIL-STATS-TYPE record collections as an event based session.

#### **7.2.9.2 *Template Negotiation*<sup>88</sup>**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the DOCSIS CMTS Downstream Utilization Statistics Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

### **7.2.10 Requirements for DOCSIS CMTS CM Service Flow Service Definition<sup>89</sup>**

The CMTS MUST implement CMTS-CM-SERVICE-FLOW-TYPE as specified in Annex R.

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<sup>85</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>86</sup> Sections 7.2.8 thru 7.2.9.2 added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN.

<sup>87</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>88</sup> Revised per OSSIV3.0-N-10.0938-3 on 9/23/10 by JB.

<sup>89</sup> Revised per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB.

### **7.2.10.1 Record Collection**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure the CMTS CM SERVICE FLOW Service Definition.
- IPDR/SP is used to stream the CMTS CM SERVICE FLOW instances.

The CMTS MUST support streaming of CMTS-CM-SERVICE-FLOW-TYPE record collections as an ad-hoc session and event session. The CMTS MUST report all Active service flows on an ad-hoc session. The CMTS MUST report all new service flows that become active on an event session.

### **7.2.10.2 Template Negotiation**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the CMTS CM SERVICE FLOW Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

## **7.2.11 Requirements for DOCSIS IP Multicast Statistics Service Definition<sup>90</sup>**

The CMTS MUST implement IP-MULTICAST-STATS-TYPE as specified in Annex R.

### **7.2.11.1 Record Collection**

This Service Definition defines the IPDR Streaming using a two step process:

- SNMP or other configuration management interface such as CLI is used to configure the IP Multicast Statistics Service Definition.
- IPDR/SP is used to stream the IP-MULTICAST-STATS-TYPE record instances.

The CMTS MUST support streaming of IP-MULTICAST-STATS-TYPE record collections as a time interval session. The CMTS MUST support a minimum collection interval of 5 minutes and a maximum collection interval of 1440 minutes with a default of 15 minutes for time interval session streaming of the IP-MULTICAST-STATS-TYPE records.

### **7.2.11.2 Template Negotiation**

The CMTS SHOULD support Template Negotiation (see Section 6.2.5.1.2.1) for the IP-MULTICAST-STATS-TYPE Service Definition. Refer to Appendix IV for details on the IPDR Template messages.

## **7.2.12 Requirements for Auxiliary Schemas**

The CMTS MUST implement the auxiliary schemas as specified in Annex C.

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<sup>90</sup> Text added per OSSIV3.0-14.1151-2 on 7/15/14 by PO.

## 8 OSS FOR PHY, MAC AND NETWORK LAYERS<sup>91</sup>

### 8.1 Fault Management

This section defines requirements for remote monitoring/detection, diagnosis, reporting, and correction of problems. Refer also to Section 7, OSS MANAGEMENT OBJECTS, for requirements for managed objects supporting CMTS and CM fault management.

#### 8.1.1 SNMP Usage<sup>92</sup>

In the DOCSIS environment, SNMP is used to achieve the goals of fault management: remote detection, diagnosis, reporting, and correction of CM and CMTS network faults. Therefore, the CM MUST support SNMP management traffic across the CATV MAC interfaces as long as the CM has ranged and registered. In addition, the CM MUST support SNMP management traffic across the CPE interfaces regardless of the CM's connectivity state.

The CM SNMP access might be restricted by configuration parameters to support the operator's policy goals. Cable operators' CM installation personnel can use SNMP queries from a station on the CMCI side to perform on-site CM and diagnostics and fault classification (note that this may require temporary provisioning of the CM from a local DHCP server). Further, CMCI side subscriber applications, using SNMP queries, can diagnose simple post-installation problems, avoiding visits from service personnel and minimizing help desk telephone queries.

The cable device (CMTS/CM) sends SNMP notifications to one or more NMSs (subject to operator imposed policy). CM and CMTS requirements for SNMP notifications are detailed in Section 8.1.2. The cable device (CMTS/CM) sends events to a syslog server. CM and CMTS requirements for syslog events are detailed in Section 8.1.2.

#### 8.1.2 Event Notification<sup>93</sup>

A cable device (CMTS/CM) is required to generate asynchronous events that indicate malfunction situations and notify about important events. The methods for reporting events are defined below:

1. Stored in Local Log (docsDevEventTable [RFC 4639]).
2. Reported to SNMP entities as an SNMP notification.
3. Sent as a message to a syslog server.

This specification defines the support of DOCSIS specific events (see Annex D) and IETF events. The former are normally in the form of SNMP notifications. The delivery of IETF Notifications to local log and syslog server is optional.

Event Notifications are enabled and disabled by configuration. IETF SNMP notifications normally define specific controls to enable and disable notifications. For example, see Section 7.1.3.3.4 for requirements on ifLinkUpDownTrapEnable. DOCSIS specific events can be reported to local log and as syslog message and/or SNMNP notification as defined in docsDevEvControlTable [RFC 4639], Section 8.1.2.2, and Annex N, CmEventCtrl and CmtsEventCtrl. A CM supports event notification functions including local event logging, syslog (limiting/throttling) and SNMP notification (limiting/throttling), as specified in [RFC 4639] and this specification. A CM operating in SNMP v1/v2c NmAccess mode is required to support SNMP trap control as specified in [RFC 4639] and this specification. A CM operating in SNMP Coexistence mode is required to support SNMP notification functions, as specified in [RFC 3416] and [RFC 3413] and this specification.

A CMTS supports event notification functions including local event logging, SYSLOG (limiting/throttling) and SNMP notification (limiting/throttling), as specified in [RFC 4639] and this specification. If a CMTS supports SNMP v1/v2c NmAccess mode, it is required to support SNMP trap control as specified in [RFC 4639] and this specification. A CMTS operating in SNMP Coexistence mode supports event notification functions, including SNMP notification, as specified in [RFC 3416] and [RFC 3413] and this specification.

<sup>91</sup> Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

<sup>92</sup> Section revised per OSSIV3.0-N-07.0403-1 on 5/8/07 by KN.

<sup>93</sup> Section revised per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

### 8.1.2.1 Format of Events

Annex D lists all DOCSIS events.

The following sections explain in detail how to report these events by any of the three mechanisms (local event logging, SNMP notification and syslog).

#### 8.1.2.1.1 Local Event Logging<sup>94</sup>

A CM MUST maintain Local Log events, defined in Annex D, in both local-volatile storage and local non volatile storage. A CMTS MUST maintain Local Log events, defined in Annex D, in local-volatile storage or local non volatile storage or both. A CMTS MAY retain in local non-volatile storage events designated for local volatile storage. A CM MAY retain in local non-volatile storage events designated for local volatile storage. A CMTS MAY retain in local volatile storage events designated for local non-volatile storage. A CM MAY retain in local volatile storage events designated for local non-volatile storage.

A CM MUST implement its Local Log as a cyclic buffer with a minimum of ten entries. A CMTS MUST implement its Local Log as a cyclic buffer. The number of entries supported by the CMTS for the Local Log is vendor specific with a minimum of ten entries. The CM Local Log non-volatile storage events MUST persist across reboots. The CMTS Local Log MAY persist across reboots. The CM MUST provide access to the Local Log events through the docsDevEventTable [RFC 4639]. The CMTS MUST provide access to the Local Log events through the docsDevEventTable [RFC 4639].

Aside from the procedures defined in this document, event recording conforms to the requirements of [RFC 4639]. Event descriptions are defined in English. A CM MUST implement event descriptors such that no event descriptor is longer than 255 characters, which is the maximum defined for SnmpAdminString [RFC 3411]. A CMTS MUST implement event descriptors such that no event descriptor is longer than 255 characters, which is the maximum defined for SnmpAdminString [RFC 3411].

Events are identical if their EventIds are identical. For identical events occurring consecutively, the CM MAY choose to store only a single event. If a CM stores as a single event multiple identical events that occur consecutively, the CM MUST reflect in the event description the most recent event.

The EventId digit is a 32-bit unsigned integer. EventIds ranging [RFC 4639] from 0 to ( $2^{31} - 1$ ) are reserved by DOCSIS. The CM MUST report in the docsDevEvTable [RFC 4639] the EventId as a 32-bit unsigned integer and convert the EventId from the error codes defined in Annex D to be consistent with this number format. The CMTS MUST report in the docsDevEvTable [RFC 4639] the EventId as a 32-bit unsigned integer and convert the EventId from the error codes defined in Annex D to be consistent with this number format.

The CM MUST implement EventIds ranging from  $2^{31}$  to ( $2^{32} - 1$ ) as vendor-specific EventIds using the following format:

- Bit 31 is set to indicate vendor-specific event
- Bits 30-16 contain the lower 15 bits of the vendor's SNMP enterprise number
- Bits 15-0 are used by the vendor to number events

The CMTS MUST implement EventIds ranging from  $2^{31}$  to ( $2^{32} - 1$ ) as vendor-specific EventIds using the following format:

- Bit 31 is set to indicate vendor-specific event
- Bits 30-16 contain the lower 15 bits of the vendor's SNMP enterprise number
- Bits 15-0 are used by the vendor to number events

Section 8.1.2.1.3 describes rules to generate unique EventIds from the error code.

The [RFC 4639] docsDevEvIndex object provides relative ordering of events in the log. The creation of local-volatile and local non volatile logs necessitates a method for synchronizing docsDevEvIndex values between the two Local Logs after reboot. The CM MUST adhere to the rules listed below for creating local volatile and local non-

<sup>94</sup> Section revised per OSSIV3.0-N-07.0477-2 by ab on 7/12/07 and OSSIV3.0-N-10.0937-4 on 9/24/10 by JB.

volatile logs following a re-boot. A CMTS which supports local non volatile storage MUST adhere to the rules listed below for creating local volatile and local non-volatile logs following a re-boot:

- Renumber the values of docsDevEvIndex maintained in the local non-volatile log beginning with 1.
- Initialize the local volatile log with the contents of the local non-volatile log.
- Use the value of the last restored non-volatile docsDevEvIndex plus one as the docsDevEvIndex for the first event recorded in the new active session's local volatile log.

The CM MUST clear both the local volatile and local non-volatile event logs when an event log reset is initiated through an SNMP SET of the docsDevEvControl object [RFC 4639]. The CMTS MUST clear both the local volatile and local non-volatile event logs when an event log reset is initiated through an SNMP SET of the docsDevEvControl object [RFC 4639].

#### **8.1.2.1.2 SNMP Notifications<sup>95</sup>**

A CM MUST implement the generic SNMP notifications according to Annex Q. A CMTS MUST implement the generic SNMP notifications according to Annex Q:

When any event causes a generic SNMP notification occurrence in the CM, the CM MUST send notifications if throttling/limiting mechanisms defined in [RFC 4639] and other limitations [RFC 3413] do not restrict notification sending.

When any event causes a generic SNMP notification occurrence in a CMTS, the CMTS MUST send notifications if throttling/limiting mechanism [RFC 4639] and other limitations [RFC 3413] do not restrict notification sending.

A CM MUST implement SNMP notifications defined in DOCS-IF3-MIB from Annex Q. A CMTS MUST implement SNMP notifications defined in DOCS-DIAG-MIB and DOCS-IF3-MIB from Annex Q.

A CM operating in SNMP v1/v2c NmAccess mode MUST support SNMPv1 and SNMPv2c Traps as defined in [RFC 3416].

A CMTS operating in SNMP v1/v2c NmAccess mode MUST support SNMPv1 and SNMPv2c Traps as defined in [RFC 3416].

A CM operating in SNMP Coexistence mode MUST support SNMP notification type 'trap' and 'inform' as defined in [RFC 3416] and [RFC 3413].

A CMTS operating in SNMP Coexistence mode MUST support SNMP notification type 'trap' and 'inform' as defined in [RFC 3416] and [RFC 3413].

The CM MUST send notifications for any event, if docsDevEvControl object [RFC 4639], throttling/limiting mechanism [RFC 4639] and [RFC 3413] limitations applied later do not restrict notification sending.<sup>96</sup>

The CMTS MUST send notifications for any event, if docsDevEvControl object [RFC 4639], throttling/limiting mechanism [RFC 4639] and [RFC 3413] limitations applied later do not restrict notification sending.

The CM MUST NOT report via SNMP notifications vendor-specific events that are not described in instructions submitted with certification testing application documentation. The CMTS MUST NOT report via SNMP notifications vendor-specific events that are not described in instructions submitted with certification testing application documentation.

#### **8.1.2.1.3 Syslog message format**

When the CM sends a syslog message for a DOCSIS-defined event, the CM MUST send it in the following format:

```
<level>CABLEMODEM[vendor]: <eventId> text vendor-specific-text
```

---

<sup>95</sup> Updated per OSSIV3.0-N-07.0511-2 by ab on 10/11/07. Section modified per OSSIV3.0-N-07.0532-4 on 1/29/08 and OSSIV3.0-N-078.0614-1 by KN.

<sup>96</sup> docsDevCmtsTrapControl changed to docsDevCmtsNotifControl in this and following para per OSSIV3.0-N-07.0442-3, 5/9/07, PO.

When the CMTS sends a syslog message for a DOCSIS-defined event, the CMTS MUST send it in the following format:

```
<level>TIMESTAMP HOSTNAME CMTS[vendor]: <eventId> text vendor-specific-text
```

Where:

- *level* is an ASCII representation of the event priority, enclosed in angle brackets, which is constructed as an OR of the default Facility (128) and event priority (0-7). The resulting level ranges between 128 and 135.
- *TIMESTAMP* and *HOSTNAME* follow the format of [RFC 3164]. The single space after *TIMESTAMP* is part of the *TIMESTAMP* field. The single space after *HOSTNAME* is part of the *HOSTNAME* field.
- *vendor* is the vendor name for the vendor-specific syslog messages or DOCSIS for the standard DOCSIS messages.
- *eventId* is an ASCII representation of the INTEGER number in decimal format, enclosed in angle brackets, which uniquely identifies the type of event. The CM MUST equate the eventId with the value stored in the docsDevEvId object in docsDevEventTable. The CMTS MUST equate the eventId with the value stored in the docsDevEvId object in docsDevEventTable. For the standard DOCSIS events this number is converted from the error code using the following rules:
  - The number is an eight-digit decimal number.
  - The first two digits (left-most) are the ASCII code for the letter in the Error code.
  - The next four digits are filled by 2 or 3 digits between the letter and the dot in the Error code with zero filling in the gap in the left side.
  - The last two digits are filled by the number after the dot in the Error code with zero filling in the gap in the left side.

For example, event D04.2 is converted into 68000402, and Event I114.1 is converted into 73011401. This convention only uses a small portion of available number space reserved for DOCSIS (0 to  $2^{31}-1$ ). The first letter of an error code is always in upper-case. See Annex D for event definitions.

- *text* contains the textual description for the standard DOCSIS event message, as defined in Annex D.
- *vendor-specific-text* contains vendor specific information. This field is optional.

For example, the syslog event for the event D04.2, "ToD Response received - Invalid data format", is as follows:

```
<132>CABLEMODEM[DOCSIS]: <68000402> ToD Response received - Invalid data format
```

The number 68000402 in the example is the number assigned by DOCSIS to this particular event.

The CM MAY report non-DOCSIS events in the standard syslog message format [RFC 3164] rather than the DOCSIS syslog message format defined above.

The CMTS MAY report non-DOCSIS events in the standard syslog message format [RFC 3164] rather than the DOCSIS syslog message format defined above.

When the CM sends a syslog message for an event not defined in this specification, the CM MAY send it according to the format and semantics of the elements defined above.

When the CMTS sends a syslog message for an event not defined in this specification, the CMTS MAY send it according to the format and semantics of the elements defined above.

### **8.1.2.2 BIT Values for docsDevEvReporting [RFC 4639]**

Permissible BIT values for [RFC 4639] docsDevEvReporting objects include:

- 1: local(0)
- 2: traps(1)
- 3: syslog(2)

4: localVolatile(8)

5: stdInterface(9)

Bit-0 means non-volatile Local Log storage and bit-8 is used for volatile Local Log storage (see Section 8.1.2.1). Bit-1 means SNMP Notifications which correspond to both SNMP Trap and SNMP Inform.

For backward compatibility with Pre-3.0 DOCSIS devices, the CM MUST support bit-3 in docsDevEvReporting BITS encoding for volatile Local Log storage.

For backward compatibility with Pre-3.0 DOCSIS devices, the CMTS MUST support bit-3 in docsDevEvReporting BITS encoding for volatile Local Log storage.

DOCSIS 3.0 devices need to support bit override mechanisms during SNMP SET operations with either one-byte or two-byte BITS encoding for docsDevEvReporting for backward compatibility with Pre-3.0 DOCSIS behavior.

The CM MUST use the bit-3 value to set both bit-3 and bit-8 for SNMP SET operations on docsDevEvReporting using a one-byte BITS encoded value. Therefore, the CM reports bit-3 and bit-8 with identical values for SNMP GET operations.

The CMTS MUST use the bit-3 value to set both bit-3 and bit-8 for SNMP SET operations on docsDevEvReporting using a one-byte BITS encoded value, therefore, the CMTS reports bit-3 and bit-8 with identical values for SNMP GET operations.

The CM MUST use the bit-8 value to set both bit-3 and bit-8 for SNMP SET operations, irrespective of the bit-3 value, on docsDevEvReporting using a two or more byte BITS encoded value.

The CMTS MUST use the bit-8 value to set bit-3 and bit-8 for SNMP SET operations, irrespective of the bit-3 value, on docsDevEvReporting using a two or more byte BITS encoded value.

The CM MAY support bit-9 in docsDevEvReporting BITS encoding in accordance with [RFC 4639] definition.

The CMTS MAY support bit-9 in docsDevEvReporting BITS encoding in accordance with [RFC 4639] definition.

A CM that reports an event by SNMP Notification or syslog MUST also report the event by a Local Log (volatile or non-volatile).

A CMTS that reports an event by SNMP Notification or syslog MUST also report the event by a Local Log (volatile or non-volatile).

Combinations of docsDevEvReporting with traps(1) and/or syslog(2) bits with no Local Log bits (bit-0, bit-3 or bit-8) set are known as unacceptable combinations.

The CM MUST reject and report a 'Wrong Value' error for SNMPv2c/v3 PDUs or a 'Bad Value' error for SNMPv1 PDUs for any attempt to set docsDevEvReporting with unacceptable combinations.

The CM MUST accept any SNMP SET operation to docsDevEvReporting different than the unacceptable combinations.

The CM MUST ignore any undefined bits in docsDevEvReporting on SNMP SET operations and report a zero value for those bits.

The CMTS MUST reject and report a 'Wrong Value' error for SNMPv2c/v3 PDUs or a 'Bad Value' error for SNMPv1 PDUs for any attempt to set docsDevEvReporting with unacceptable combinations.

The CMTS MUST accept any SNMP SET operation to docsDevEvReporting different than the unacceptable combinations.

The CMTS MUST ignore any undefined bits in docsDevEvReporting on SNMP SET operations and report a zero value for those bits.

Refer to Section 8.1.2.1.1 for details on Local Log requirements for the CMTS and CM.

The CM MUST maintain the non-volatile storage when both non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority. The CM MAY maintain the volatile storage when both non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority. When both

non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority, the CM MUST NOT report duplicate events in the docsDevEventTable.

If CMTS supports both volatile and non-volatile storage, the CMTS MUST maintain the non-volatile storage when both non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority. If CMTS supports both volatile and non-volatile storage, the CMTS MAY maintain the volatile storage when both non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority. When both non-volatile Local Log and volatile Local Log bits are set for a specific docsDevEvReporting event priority, the CMTS MUST NOT report duplicate events in the docsDevEventTable.

### **8.1.2.3 Standard DOCSIS events for CMs**

The DOCS-CABLE-DEVICE-MIB [RFC 4639] defines 8 priority levels and a corresponding reporting mechanism for each level.

#### **Emergency event (priority 1)**

Reserved for vendor-specific 'fatal' hardware or software errors that prevents normal system operation and causes the reporting system to reboot.

Every vendor may define their own set of emergency events. Examples of such events might be 'no memory buffers available', 'memory test failure', etc.

#### **Alert event (priority 2)**

A serious failure, which causes the reporting system to reboot, but it is not caused by hardware or software malfunctioning.

#### **Critical event (priority 3)**

A serious failure that requires attention and prevents the device from transmitting data, but could be recovered without rebooting the system. Examples of such events might be configuration file problems detected by the modem or the inability to get an IP address from the DHCP server.

#### **Error event (priority 4)**

A failure occurred that could interrupt the normal data flow, but will not cause the modem to re-register. Error events could be reported in real time by using the trap or syslog mechanism.

#### **Warning event (priority 5)**

A failure occurred that could interrupt the normal data flow, but will not cause the modem to re-register. 'Warning' level is assigned to events that both CM and CMTS have information about. To prevent sending the same event, both from the CM and the CMTS, the trap and syslog reporting mechanism is disabled by default for the CM for this level.

#### **Notice event (priority 6)**

The event is important, but is not a failure and could be reported in real time by using the trap or syslog mechanism. For a CM, an example of a Notice event is any event from 'SW UPGRADE SUCCESS' group.

#### **Informational event (priority 7)**

The event is of marginal importance, and is not failure, but could be helpful for tracing the normal modem operation.

#### **Debug event (priority 8)**

Reserved for vendor-specific non-critical events.

During CM initialization or reinitialization, the CM MUST support, as a minimum, the default event reporting mechanism shown in Table 8-1.

The CM MAY implement default reporting mechanisms above the minimum requirements listed in Table 8-1.

The reporting mechanism for each priority could be changed from the default reporting mechanism by using docsDevEvReporting object of DOCS-CABLE-DEVICE-MIB [RFC 4639].

The CM MUST populate the code of an event (as defined in Annex D) with Critical or Alert event priority through the docsIf3CmStatusCode SNMP object of DOCS-IF3-MIB Annex Q before it recovers from the event. The CM MUST persist the docsIf3CmStatusCode across system reinitializations.<sup>97</sup>

**Table 8-1 - CM default event reporting mechanism versus priority**

Event Priority	Local Log Non-volatile	SNMP Notification	Syslog	Local Log Volatile
Emergency	Yes	No	No	No
Alert	Yes	No	No	No
Critical	Yes	No	No	No
Error	No	Yes	Yes	Yes
Warning	No	No	No	Yes
Notice	No	Yes	Yes	Yes
Informational	No	No	No	No
Debug	No	No	No	No

The CM MUST format notifications that it generates for standard DOCSIS events as specified in 0.

#### 8.1.2.4 Standard DOCSIS events for CMTS

CMTSs use the same levels of the event priorities as a CM (see Section 8.1.2.3); however, the priority definition of the events is different. Events with the priority level of 'Warning' and less, specify problems that could affect the individual user (for example, individual CM registration problem).

Every CMTS vendor may define their own set of 'Alert' events.

Priority level of 'Error' indicates problems with a group of CMs (for example CMs that share same upstream channel).

Priority level of 'Critical' indicates a problem that affects the whole cable system operation, but is not a faulty condition of the CMTS device.

Priority level of 'Emergency' is vendor-specific and indicates problems with the CMTS hardware or software, which prevents CMTS operation.

During CMTS initialization or reinitialization, the CMTS MUST support, as a minimum, the default event reporting mechanism shown in Table 8-2 or Table 8-3 or Table 8-4.

The CMTS MAY implement default reporting mechanisms above the minimum requirements listed in Table 8-2 or Table 8-3 or Table 8-4 with the exception of the 'Debug' priority level.

The reporting mechanism for each priority could be changed from the default reporting mechanism by using docsDevEvReporting object of DOCS-CABLE-DEVICE-MIB [RFC 4639].

**Table 8-2 - CMTS default event reporting mechanism versus priority (non-volatile Local Log support only)**

Event Priority	Local Log Non-volatile	SNMP Notification	Syslog	Local Log Volatile
Emergency	Yes	No	No	Not Used
Alert	Yes	No	No	Not Used
Critical	Yes	Yes	Yes	Not Used
Error	Yes	Yes	Yes	Not Used

<sup>97</sup> Paragraph modified per Ossiv3.0-N-07.0583-1 on 1/29/08 and OSSIV3.0-N-08.0614-1 on 1/30/08 by KN.

Event Priority	Local Log Non-volatile	SNMP Notification	Syslog	Local Log Volatile
Warning	Yes	Yes	Yes	Not Used
Notice	Yes	Yes	Yes	Not Used
Informational	No	No	No	Not Used
Debug	No	No	No	Not Used

**Table 8-3 - CMTS default event reporting mechanism versus priority (volatile Local Log support only)**

Event Priority	Local Log Non-volatile	SNMP Notification	Syslog	Local Log Volatile
Emergency	Not Used	No	No	Yes
Alert	Not Used	No	No	Yes
Critical	Not Used	Yes	Yes	Yes
Error	Not Used	Yes	Yes	Yes
Warning	Not Used	Yes	Yes	Yes
Notice	Not Used	Yes	Yes	Yes
Informational	Not Used	No	No	No
Debug	Not Used	No	No	No

**Table 8-4 - CMTS default event reporting mechanism versus priority**

Event Priority	Local Log Non-volatile	SNMP Notification	Syslog	Local Log Volatile
Emergency	Yes	No	No	No
Alert	Yes	No	No	No
Critical	Yes	Yes	Yes	No
Error	No	Yes	Yes	Yes
Warning	No	Yes	Yes	Yes
Notice	No	Yes	Yes	Yes
Informational	No	No	No	No
Debug	No	No	No	No

The CMTS MUST format notifications for standard DOCSIS events as specified in Annex D.

#### **8.1.2.5 Event Priorities for DOCSIS and Vendor Specific Events**

A CM MUST assign DOCSIS and vendor specific events as indicated in Table 8-5.

A CMTS MUST assign DOCSIS and vendor specific events as indicated in Table 8-5.

**Table 8-5 - Event Priorities Assignment for CMs and CMTS**

<b>Event Priority</b>	<b>CM Event Assignment</b>	<b>CMTS Event Assignment</b>
Emergency	Vendor Specific	Vendor Specific
Alert	DOCSIS and Vendor Specific (optional*)	Vendor Specific
Critical	DOCSIS and Vendor Specific (optional*)	DOCSIS and Vendor Specific (optional*)
Error	DOCSIS and Vendor Specific (optional*)	DOCSIS and Vendor Specific (optional*)
Warning	DOCSIS and Vendor Specific (optional*)	DOCSIS and Vendor Specific (optional*)
Notice	DOCSIS and Vendor Specific (optional*)	DOCSIS and Vendor Specific (optional*)
Informational	DOCSIS and Vendor Specific (optional*)	DOCSIS and Vendor Specific (optional*)
Debug	Vendor Specific	Vendor Specific

**\*Table Note:**  
Vendor-specific optional event definitions are recommended only where the CM/CMTS allows for sufficient storage of such events.

### 8.1.3 Throttling, Limiting and Priority for Event, Trap and Syslog

#### 8.1.3.1 Trap and Syslog Throttling, Trap and Syslog Limiting

A CM MUST support SNMP TRAP/INFORM and syslog throttling and limiting as described in DOCS-CABLE-DEVICE-MIB [RFC 4639], regardless of SNMP mode. A CMTS MUST support SNMP TRAP/INFORM and syslog throttling and limiting as described in DOCS-CABLE-DEVICE-MIB [RFC 4639], regardless of SNMP mode.

#### 8.1.4 SNMPv3 Notification Receiver Config file TLV <sup>98</sup>

This section specifies processing requirements for the SNMPv3 Notification Receiver TLV [MULPI] when present in the configuration file. The SNMPv3 Notification Receiver TLV is used to configure SNMPv3 tables for notification transmission. The CM MUST process the SNMPv3 Notification Receiver TLV only if the CM is in SNMPv3 Coexistence Mode.

Based on the SNMPv3 Notification Receiver TLV, the CM MUST create entries in the following tables in order to cause the desired trap transmission:

- snmpNotifyTable
- snmpTargetAddrTable
- snmpTargetAddrExtTable
- snmpTargetParamsTable
- snmpNotifyFilterProfileTable
- snmpNotifyFilterTable
- snmpCommunityTable
- usmUserTable
- vacmContextTable
- vacmSecurityToGroupTable

<sup>98</sup> Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

- vacmAccessTable
- vacmViewTreeFamilyTable

The CM MUST not set to 'active' an entry created using the SNMPv3 Notification Receiver TLV (see the Common Radio Frequency Interface Encodings Annex of [MULPI]) which does not satisfy the corresponding [RFC 3413] requirements to do so. This type of misconfiguration doesn't stop the CM from registering, however the SNMP notification process may not work as expected.

The mapping from the TLV to these tables is described in the following section.

#### **8.1.4.1 Mapping of TLV fields into created SNMPv3 table rows<sup>99</sup>**

The following sections illustrate how the fields from the config file SNMPv3 Notification Receiver TLV elements are placed into the SNMPv3 tables. The TLV fields are shown below as:

**Table 8-6 - SNMPv3 Notification Receiver TLV Mapping**

Sub-TLVs	Variable Name	Associated MIB Object
SNMPv3 Notification Receiver IPv4 Address	TAddress	snmpTargetAddrTAddress [RFC 3413]
SNMPv3 Notification Receiver IPv6 Address	TAddress	snmpTargetAddrTAddress [RFC 3413]
SNMPv3 Notification Receiver UDP Port Number	Port	snmpTargetAddrTAddress [RFC 3413]
SNMPv3 Notification Receiver Trap Type	TrapType	see following sections
SNMPv3 Notification Receiver Timeout	Timeout	snmpTargetAddrTimeout [RFC 3413]
SNMPv3 Notification Receiver Retries	Retries	snmpTargetAddrRetryCount [RFC 3413]
SNMPv3 Notification Receiver Filtering Parameters	FilterOID	see following sections
SNMPv3 Notification Receiver Security Name	SecurityName	see following sections

The variable names from Table 8-6 are defined as follows:

- <TAddress> A 32-bit IPv4 or IPv6 address of a notification receiver
- <Port> A 16-bit UDP Port number on the notification receiver to receive the notifications
- <TrapType> Defines the notification type as explained above
- <Timeout> 16-bit timeout, in milliseconds to wait before sending a retry of an Inform Notification
- <Retries> 16-bit number of times to retry an Inform after the first Inform transmission
- <FilterOID> The OID of the snmpTrapOID value that is the root of the MIB subtree that defines all of the notifications to be sent to the Notification Receiver.
- <SecurityName> The security name specified on the TLV element, or "@config" if not specified.

Table 8-7 through Table 8-18 are shown in the order that the agent will search down through them when a notification is generated in order to determine to whom to send the notification, and how to fill out the contents of the notification packet.

In configuring entries in these SNMPv3 tables, note the following:

The Community Name for traps in SNMPv1 and SNMPv2 packets is configured as "public". The Security Name in traps and informs in SNMPv3 packets where no security name has been specified is configured as "@config", in which case the security level is "noAuthNoPriv".

<sup>99</sup> Section revised per OSSIV3.0-N-07.0435-2, #1 on 5/10/07 by KN.

Several columnar objects are configured with a value beginning with the string "@config". If these tables are configured through other mechanisms, network operators should not use values beginning with "@config" to avoid conflicts with the mapping process specified here.

#### 8.1.4.1.1 *snmpNotifyTable*

The snmpNotifyTable is defined in the "Notification MIB Module" section of [RFC 3413].

The CM MUST create two rows with fixed values if one or more SNMPv3 Notification Receiver TLV elements are present in the config file.

**Table 8-7 - *snmpNotifyTable***

Column Name (* = Part of Index)	1st Row Column Value	2nd Row Column Value
* snmpNotifyName	"@config_inform"	"@config_trap"
snmpNotifyTag	"@config_inform"	"@config_trap"
snmpNotifyType	inform (2)	trap (1)
snmpNotifyStorageType	volatile (2)	volatile (2)
snmpNotifyRowStatus	active (1)	active (1)

#### 8.1.4.1.2 *snmpTargetAddrTable*<sup>100</sup>

The snmpTargetAddrTable is defined in the "Definitions" section of [RFC 3413].

The CM MUST create one row in snmpTargetAddrTable for each entry defined in Table 8-8 - snmpTargetAddrTable.

Thus, two entries are created in this table if both SNMPv3 Notification Receiver IPv4 Address and SNMPv3 Notification Receiver IPv6 Address sub-TLVs are included in the same TLV. All other parameters are the same.

**Table 8-8 - *snmpTargetAddrTable***

Column Name (* = Part of Index)	Column Value
* snmpTargetAddrName	"@config_n_IPv[4   6]" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs @config_n_IPv4 is for an entry created if SNMPv3 Notification Receiver config file TLV contains <TrapType> of TDomain SnmpUDPEndPoint @config_n_IPv6 is for an entry created if SNMPv3 Notification Receiver config file TLV contains <TrapType> of TDomain TransportAddressIPv6
snmpTargetAddrTDomain	IPv4: snmpUDPDomain [RFC 3417] IPv6: transportDomainUdpIpv6 [RFC 3419]
snmpTargetAddrTAddress (IP Address and UDP Port of the Notification Receiver)	IPv4: SnmpUDPEndPoint [RFC 3417] OCTET STRING (6) Octets 1-4: <TAddress> Octets 5-6: <Port> IPv6: TransportAddressIPv6 [RFC 3419] OCTET STRING (18) Octets 1-16: <TAddress> Octets 17-18: <Port>
snmpTargetAddrTimeout	<Timeout>
snmpTargetAddrRetryCount	<Retries>
snmpTargetAddrTagList	"@config_trap" if <TrapType> is 1, 2, or 4 "@config_inform" if <TrapType> is 3 or 5,

<sup>100</sup> Section revised per OSSIV3.0-N-08.0641-2 on 4/25/08 by KN.

Column Name (* = Part of Index)	Column Value
snmpTargetAddrParams	"@config_n"
snmpTargetAddrStorageType	volatile (2)
snmpTargetAddrRowStatus	active (1)

#### 8.1.4.1.3 *snmpTargetAddrExtTable*<sup>101</sup>

The snmpTargetAddrExtTable is defined in the "SNMP Community MIB Module" section of [RFC 3584].

The CM MUST create one row in snmpTargetAddrExtTable for each entry defined in Table 8-8, snmpTargetAddrTable.

**Table 8-9 - snmpTargetAddrExtTable**

Column Name (* = Part of Index)	Column Value
* snmpTargetAddrName	"@config_n_IPv[4   6]" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs (see Table 8-8 for details).
snmpTargetAddrTMask	<Zero-length OCTET STRING>
snmpTargetAddrMMS	SM Maximum Message Size

#### 8.1.4.1.4 *snmpTargetParamsTable*

The snmpTargetParamsTable is defined in the "Definitions" section of [RFC 3413].

The CM MUST create one row in snmpTargetParamsTable for each SNMPv3 Notification Receiver TLV in the config file.

**Table 8-10 - snmpTargetParamsTable**

Column Name (* = Part of Index)	Column Value
* snmpTargetParamsName	"@config_n" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs
snmpTargetParamsMPModel SYNTAX: SnmpMessageProcessingModel	SNMPv1 (0) if <TrapType> is 1 SNMPv2c (1) if <TrapType> is 2 or 3 SNMPv3 (3) if <TrapType> is 4 or 5
snmpTargetParamsSecurityModel SYNTAX: SnmpSecurityModel	SNMPv1 (1) if <TrapType> is 1 SNMPv2c (2) if <TrapType> is 2 or 3 USM (3) if <TrapType> is 4 or 5 <b>Note:</b> The mapping of SNMP protocol types to value here are different from snmpTargetParamsMPModel
snmpTargetParamsSecurityName	If <TrapType> is 1, 2, or 3, or if the <Security Name> field is zero-length: "@config" If <TrapType> is 4 or 5, and the <Security Name> field is non-zero length: <SecurityName>

<sup>101</sup> Section revised per OSSIV3.0-N-08.0641-2 on 4/25/08 by KN.

Column Name (* = Part of Index)	Column Value
snmpTargetParamsSecurityLevel	If <TrapType> is 1, 2, or 3, or if the <Security Name> field is zero-length: noAuthNoPriv (1) If <TrapType> is 4 or 5, and the <Security Name> field is non-zero length: The security level of <SecurityName>
snmpTargetParamsStorageType	volatile (2)
snmpTargetParamsRowStatus	active (1)

#### 8.1.4.1.5 snmpNotifyFilterProfileTable

The snmpNotifyFilterProfileTable is defined in the "Notification MIB Module" section of [RFC 3413].

The CM MUST create one row in snmpNotifyFilterProfileTable for each SNMPv3 Notification Receiver TLV that has a non-zero <FilterOID>.

**Table 8-11 - snmpNotifyFilterProfileTable**

Column Name (* = Part of Index)	Column Value
* snmpTargetParamsName	"@config_n" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs
snmpNotifyFilterProfileName	"@config_n" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs
snmpNotifyFilterProfileStorType	volatile (2)
snmpNotifyFilterProfileRowStatus	active (1)

#### 8.1.4.1.6 snmpNotifyFilterTable

The snmpNotifyFilterTable is defined in the "Notification MIB Module" section of [RFC 3413].

The CM MUST create one row in snmpNotifyFilterTable for each SNMPv3 Notification Receiver TLV that has a non-zero <FilterOID>.

**Table 8-12 - snmpNotifyFilterTable**

Column Name (* = Part of Index)	Column Value
* snmpNotifyFilterProfileName	"@config_n" where n is 0..m-1 and m is the number of SNMPv3 Notification Receiver config file TLVs
* snmpNotifyFilterSubtree	<FilterOID>
snmpNotifyFilterMask	<Zero-length OCTET STRING>
snmpNotifyFilterType	included (1)
snmpNotifyFilterStorageType	volatile (2)
snmpNotifyFilterRowStatus	active (1)

#### 8.1.4.1.7 snmpCommunityTable

The snmpCommunityTable is defined in the "SNMP Community MIB Module" section of [RFC 3584].

The CM MUST create one row in snmpCommunityTable with fixed values if one or more SNMPv3 Notification Receiver TLVs are present in the config file. This causes SNMPv1 and v2c notifications to contain the community string in snmpCommunityName.

**Table 8-13 - snmpCommunityTable**

Column Name (* = Part of Index)	Column Value
* snmpCommunityIndex	"@config"
snmpCommunityName	"public"
snmpCommunitySecurityName	"@config"
snmpCommunityContextEngineID	<the engineID of the cable modem>
snmpCommunityContextName	<Zero-length OCTET STRING>
snmpCommunityTransportTag	<Zero-length OCTET STRING>
snmpCommunityStorageType	volatile (2)
snmpCommunityStatus	active (1)

#### 8.1.4.1.8 usmUserTable

The usmUserTable is defined in the "Definitions" section of [RFC 3414].

The CM MUST create one row in usmUserTable with fixed values if one or more SNMPv3 Notification Receiver TLVs are present in the config file. Other rows are created, one each time the engine ID of a trap receiver is discovered. This specifies the user name on the remote notification receivers to which notifications are to be sent.

One row in the usmUserTable is created. When the engine ID of each notification receiver is discovered, the agent copies this row into a new row and replaces the 0x00 in the usmUserEngineID column with the newly-discovered value.

**Table 8-14 - usmUserTable**

Column Name (* = Part of Index)	Column Value
* usmUserEngineID	0x00
* usmUserName	"@config" When other rows are created, this is replaced with the <SecurityName> field from the SNMPv3 Notification Receiver config file TLV.
usmUserSecurityName	"@config" When other rows are created, this is replaced with the <SecurityName> field from the SNMPv3 Notification Receiver config file TLV.
usmUserCloneFrom	<don't care> This row cannot be cloned.
usmUserAuthProtocol	None When other rows are created, this is replaced with None or MD5, depending on the security level of the V3 User.
usmUserAuthKeyChange	<don't care> Write-only
usmUserOwnAuthKeyChange	<don't care> Write-only
usmUserPrivProtocol	None When other rows are created, this is replaced with None or DES, depending on the security level of the V3 User.

Column Name (* = Part of Index)	Column Value
usmUserPrivKeyChange	<don't care> Write-only
usmUserOwnPrivKeyChange	<don't care> Write-only
usmUserPublic	<Zero-length OCTET STRING>
usmUserStorageType	volatile (2)
usmUserStatus	active (1)

#### 8.1.4.1.9 vacmContextTable

The vacmContextTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create one row in vacmContextTable with the zero length octet string for vacmContextName object.

**Table 8-15 - vacmContextTable**

Column Name (* = Part of Index)	Column Value
* vacmContextName	<Zero-length OCTET STRING>

#### 8.1.4.1.10 vacmSecurityToGroupTable

The vacmSecurityToGroupTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create three rows in vacmSecurityToGroupTable with fixed values if one or more SNMPv3 Notification Receiver TLVs are present in the config file.

Table 8-16 depicts the three rows with fixed values which are used for the SNMPv3 Notification Receiver TLV entries with *<TrapType>* set to 1, 2, or 3, or with a zero-length *<SecurityName>*. The SNMPv3 Notification Receiver TLV entries with *<TrapType>* set to 4 or 5 and a non-zero length *<SecurityName>* will use the rows created in the vacmSecurityToGroupTable by the DH Kickstart process.

**Table 8-16 - vacmSecurityToGroupTable**

Column Name (* = Part of Index)	First Row Column Value	Second Row Column Value	Third Row Column Value
* vacmSecurityModel	SNMPV1 (1)	SNMPV2c (2)	USM (3)
* vacmSecurityName	"@config"	"@config"	"@config"
vacmGroupName	"@configV1"	"@configV2"	"@configUSM"
vacmSecurityToGroupStorageType	volatile (2)	volatile (2)	volatile (2)
vacmSecurityToGroupStatus	active (1)	active (1)	active (1)

#### 8.1.4.1.11 vacmAccessTable

The vacmAccessTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create three rows in vacmAccessTable with fixed values if one or more SNMPv3 Notification Receiver TLVs are present in the config file.

Table 8-17 depicts the three rows with fixed values which are used for the SNMPv3 Notification Receiver TLV entries with *<TrapType>* set to 1, 2, or 3, or with a zero-length *<SecurityName>*. The SNMPv3 Notification

Receiver TLV entries with *<TrapType>* set to 4 or 5 and a non-zero length *<SecurityName>* will use the rows created in the vacmAccessTable by the DH Kickstart process.

**Table 8-17 - vacmAccessTable**

Column Name (* = Part of Index)	First Row Column Value	Second Row Column Value	Third Row Column Value
* vacmGroupName	"@configV1"	"@configV2"	"@configUSM"
* vacmAccessContextPrefix	<zero-length string>	<zero-length string>	<zero-length string>
* vacmAccessSecurityModel	SNMPV1 (1)	SNMPV2c (2)	USM (3)
* vacmAccessSecurityLevel	noAuthNoPriv (1)	noAuthNoPriv (1)	noAuthNoPriv (1)
vacmAccessContextMatch	exact (1)	exact (1)	exact (1)
vacmAccessReadViewName	<Zero-length OCTET STRING>	<Zero-length OCTET STRING>	<Zero-length OCTET STRING>
vacmAccessWriteViewName	<Zero-length OCTET STRING>	<Zero-length OCTET STRING>	<Zero-length OCTET STRING>
vacmAccessNotifyViewName	"@config"	"@config"	"@config"
vacmAccessStorageType	volatile (2)	volatile (2)	volatile (2)
vacmAccessStatus	active (1)	active (1)	active (1)

#### 8.1.4.1.12 vacmViewTreeFamilyTable

The vacmViewTreeFamilyTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create one row in vacmViewTreeFamilyTable with fixed values if one or more SNMPv3 Notification Receiver TLVs are present in the config file.

This row is used for the SNMPv3 Notification Receiver TLV entries with *<TrapType>* set to 1, 2, or 3 or with a zero-length *<SecurityName>*. The SNMPv3 Notification Receiver TLV entries with *<TrapType>* set to 4 or 5 and a non-zero length *<SecurityName>* will use the rows created in the vacmViewTreeFamilyTable by the DH Kickstart process.

**Table 8-18 - vacmViewTreeFamilyTable**

Column Name (* = Part of Index)	Column Value
* vacmViewTreeFamilyViewName	"@config"
* vacmViewTreeFamilySubtree	1.3
vacmViewTreeFamilyMask	<default from MIB>
vacmViewTreeFamilyType	included (1)
vacmViewTreeFamilyStorageType	volatile (2)
vacmViewTreeFamilyStatus	active (1)

#### 8.1.5 Non-SNMP Fault Management Protocols

The OSS can use a variety of tools and techniques to examine faults at multiple layers. For the IP layer, useful non-SNMP based tools include ping (ICMP Echo and Echo Reply), and trace route (UDP and various ICMP Destination Unreachable flavors). The CM MUST respond to ICMP Echo Request (ping) messages received through its CMCI [CMCI] interface(s) to enable local connectivity testing from a subscriber's PC to the modem. The CM MUST support IP end-station generation of ICMP error messages and processing of all ICMP messages. The CMTS MUST support IP end-station generation of ICMP error messages and processing of all ICMP messages.

Syslog requirements are defined in Section 8.1.2.

## 8.2 Configuration Management

Modifying the configuration information of a CM and/or CMTS can be categorized as *non-operational* or *operational*.

Non-operational changes occur when a NMS issues a modify command to a CM/CMTS, and the change doesn't affect the operating environment. For example, a NMS can change contact information, such as the name and address of the person responsible for a CMTS.

Operational changes occur when a NMS issues a modify command to a CM/CMTS, and the change affects the underlying resource or environment. For example, a NMS can change the CMTS stored value for the CMTS MIC which in turn will cause a change in the CM authorization policy during registration.

The CM and CMTS are required to support the SNMP protocol interface as specified in Section 6. Section 7 defines the SNMP MIB objects that are required to be supported by a CM and CMTS.

In addition to the SNMP interface to modify the attribute values stored in the CM and CMTS, vendor specific methods such as Command Line Interface (CLI) or an HTTP interface could be present. Irrespective of the method used, it is necessary to assure the data integrity as a result of changes performed using different interfaces. For example when the attribute value is modified using one management interface, this changed value is reported when that attribute is accessed from any of the other interfaces. When a change in the value of the attribute does not succeed, requesting the same change from another interface also results in failure (assuming the same level of access control for all those interfaces for the specific operation). If an event is generated as a result of making the change in one management interface, this is reported independent of how the change was initiated.

### 8.2.1 Version Control

The CM MUST support software revision and operational parameter configuration interrogation.

The CM includes the hardware version, boot ROM image version, vendor name, current software version, and model number in the sysDescr object (from [RFC 3418]).

The CM MUST support docsDevSwCurrentVers MIB object (from [RFC 4639]) and report the current software version of the CM.

The CM MUST report for the sysDescr object the Type and Value fields identified in Table 8-19:

**Table 8-19 - sysDescr Format**

Type	Value
HW_REV	<Hardware Version>
VENDOR	<Vendor Name>
BOOTR	<Boot ROM Version>
SW_REV	<Software Version>
MODEL	<Model Number>

The CM MUST report each Type and Value for the sysDescr object identified in Table 8-20; with each Type field and corresponding Value field separated with a colon followed by a single blank space and each Type-Value pair is separated by a semicolon followed by a single blank space. The correct format is illustrated below.

HW\_REV: <value>; VENDOR: <value>; BOOTR: <value>; SW\_REV: <value>; MODEL: <value>

For instance, a sysDescr of a CM of vendor X, hardware version 5.2, boot ROM image version 1.4, software version 2.2, and model number Z is formatted as follows:

any text<<HW\_REV: 5.2; VENDOR: X; BOOTR: 1.4; SW\_REV: 2.2; MODEL: Z>>any text

The CM MUST report all of the information necessary in determining what software the CM is capable of being upgraded to. If any fields in Table 8-19 are not applicable, the CM MUST report "NONE" as the value.

For instance, a sysDescr of a CM of vendor X, hardware version 5.2, no boot ROM image information, software version 2.2, and model number Z is formatted as follows:

any text<<HW\_REV: 5.2; VENDOR: X; BOOTR: NONE; SW\_REV: 2.2; MODEL: Z>>any text

The intent of specifying the format of sysDescr is to define how to report information in a consistent manner so that sysDescr field information can be programmatically parsed. This format specification does not intend to restrict the vendor's hardware version numbering policy.

The CMTS MUST implement the sysDescr object (from [RFC 3418]). For the CMTS, the format and content of the information in sysDescr is vendor-dependent.

## 8.2.2 System Configuration

The CM MUST support system configuration by configuration file, configuration-file-based SNMP encoded object, and SNMP Set operation. The CM MUST support any valid configuration file created in accordance with configuration file size limitations defined in the CM Configuration Interface Specification Annex in [MULPI].

The CMTS MUST support system configuration through SNMP Set operation.

## 8.2.3 Secure Software Download<sup>102</sup>

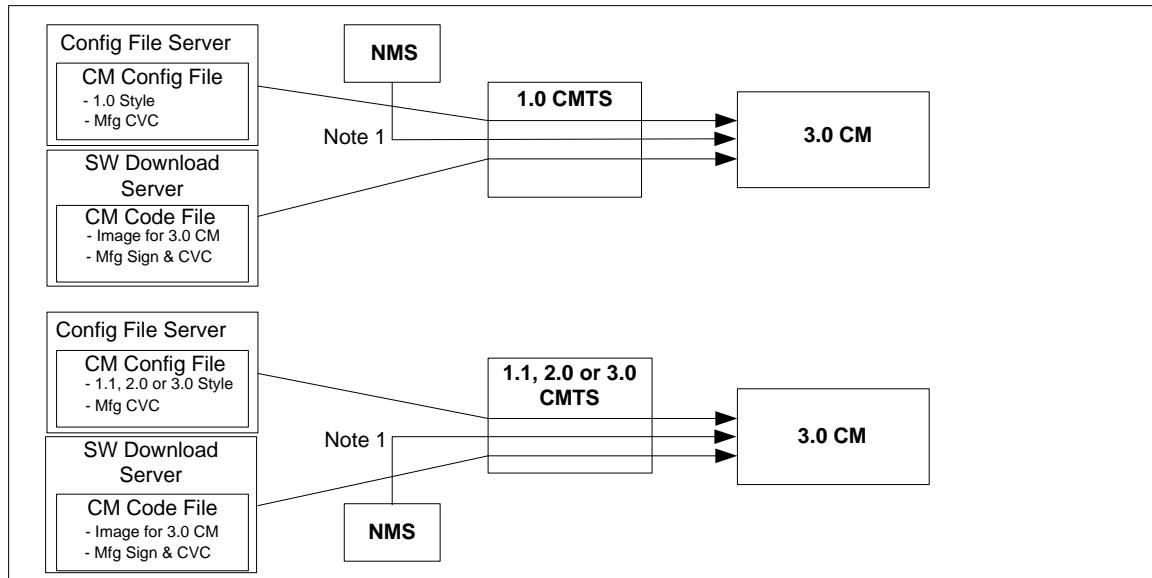
The CM Secure Software Download (SSD) process is documented in detail in the Secure Software Download section of [SEC].

The CM MUST use the Secure Software Download mechanism to perform software upgrade regardless of the version (pre-3.0 DOCSIS or 3.0 DOCSIS) of the CMTS to which it is connected.

There are two available Secure Software Download schemes: the manufacturer control scheme and the operator control scheme.

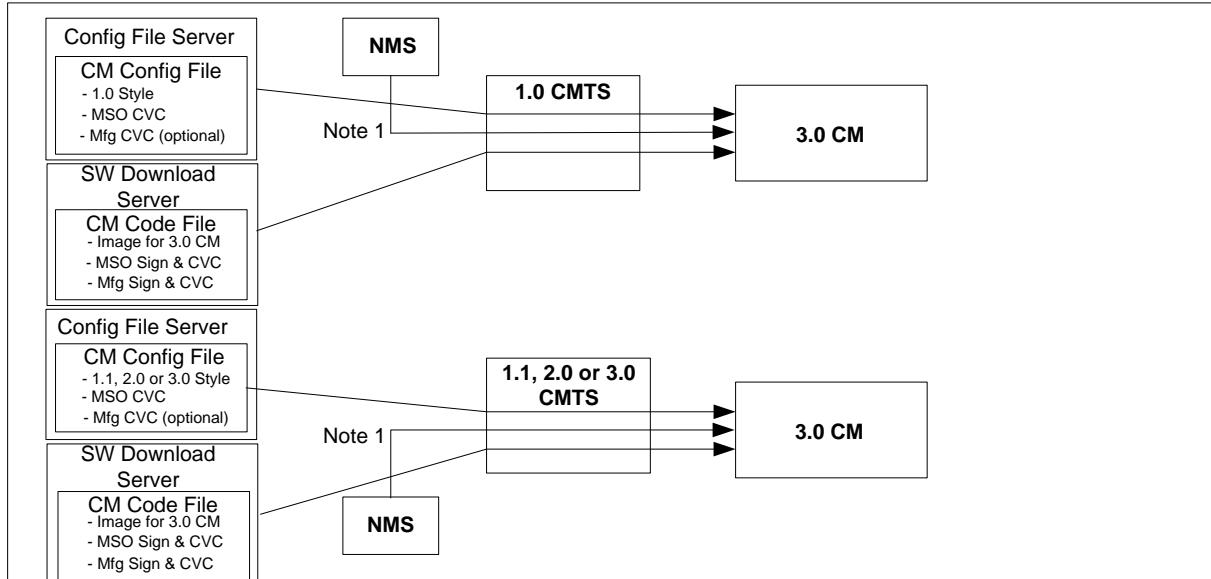
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<sup>102</sup> Section revised per OSSIV3.0-N-07.0477-2 by ab on 7/12/07 and per OSSIV3.0-N-07.0581-2 on 1/29/08 by KN.

**Figure 8-1 - Manufacturer control scheme**

In reference to Figure 8-1 above:

Note 1: Use docsDevSoftware group ([RFC 2669], [RFC 4639]) in case that the software downloading is triggered by the MIB.

**Figure 8-2 - Operator control scheme**

In reference to Figure 8-2 above:

Note 1: Use docsDevSoftware group ([RFC 2669], [RFC 4639]) in case that the software downloading is triggered by the MIB.

Prior to Secure Software Download initialization, CVC information needs to be initialized at the CM for software upgrade. Depending on the scheme (described above) that the operator chooses to implement, the CM requires

appropriate CVC information in the configuration file. It is recommended that CVC information always be present in the configuration file so that a device will always have the CVC information initialized and read if the operator decides to use a SNMP-initiated upgrade as a method to trigger a Secure Software Download operation. If the operator decides to use a configuration-file-initiated upgrade as a method to trigger Secure Software Download, CVC information needs to be present in the configuration file at the time the CM is rebooted to get the configuration file that will trigger the upgrade only.

There are two methods to trigger Secure Software Download: SNMP-initiated and configuration-file-initiated. The CM MUST support both SNMP-initiated and configuration-file-initiated methods to trigger Secure Software Download. The CMTS MAY support either one or both methods to trigger Secure Software Download.

The following describes the SNMP-initiated mechanism. Prior to a SNMP-initiated upgrade, a CM MUST have valid X.509-compliant code verification certificate information. From a network management station:

1. Set docsDevSwServerAddressType to 'ipv4' or 'ipv6'.
2. Set docsDevSwServerAddress to the IPv4 or IPv6 address of the Software Download server for software upgrades.
3. Set docsDevSwFilename to the file path name of the software upgrade image.
4. Set docsDevSwAdminStatus to 'upgradeFromMgt'.

If docsDevSwAdminStatus is set to 'ignoreProvisioningUpgrade', the CM MUST ignore any software download configuration file setting and not attempt a configuration file initiated upgrade.

The CM MUST preserve the value of docsDevSwAdminStatus across reset/reboots until over-written from an SNMP manager or by a TLV-11 [MULPI] setting in the CM configuration file. That is, the value of docsDevSwAdminStatus is required to persist across CM reboots.

The CM MUST report 'allowProvisioningUpgrade' as the default value of docsDevSwAdminStatus until it is over-written by 'ignoreProvisioningUpgrade', following a successful SNMP-initiated software upgrade or otherwise altered by the management station.

The CM MUST preserve the value of docsDevSwOperStatus across reset/reboots. That is, the value of the CM's docsDevSwOperStatus object is required to persist across resets to report the outcome of the last software upgrade attempt.

After the CM has completed a configuration-file-initiated secure software upgrade, the CM MUST reboot and become operational with the correct software image as specified in [MULPI]. After the CM is registered following a reboot after a configuration file initiated secure software upgrade, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MAY report the filename of the software currently operating on the CM as the value for docsDevSwFilename.
- The CM MAY report the IP address of the Software Download server containing the software that is currently operating on the CM as the value for docsDevSwServerAddress.
- The CM MUST report 'completeFromProvisioning' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of the software that is operating on the CM as the value for docsDevSwCurrentVers.

After the CM has completed an SNMP-initiated secure software upgrade, the CM MUST reboot and become operational with the correct software image as specified in [MULPI]. After the CM is registered following a reboot after an SNMP-initiated secure software upgrade, the CM MUST adhere to the following requirements:

- The CM MUST report 'ignoreProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MAY report the IP address of the Software Download server containing the software that is currently operating on the CM as the value for docsDevSwServerAddress.

- The CM MUST report 'completeFromMgt' as the value for docsDevOperStatus.
- The CM MUST report the current version of the software that is operating on the CM as the value for docsDevSwCurrentVers.

If the value of docsDevSwAdminStatus is 'ignoreProvisioningUpgrade', the CM MUST ignore any software upgrade value that is optionally included in the CM configuration file and become operational with the current software image after the CM is registered. After the CM is registered following a reboot with a software upgrade value in the CM configuration file, the CM MUST adhere to the following requirements:

- The CM MUST report 'ignoreProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MAY report the filename of the software currently operating on the CM as the value for docsDevSwFilename.
- The CM MAY report the IP address of the Software Download server containing the software that is currently operating on the CM as the value for docsDevSwServerAddress.
- The CM MUST report 'completeFromMgt' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of the software that is operating on the CM as the value for docsDevSwCurrentVers.

Retries due to a power loss or reset are only required for an SNMP-initiated upgrade. If a power loss or reset occurs during a configuration-file-initiated upgrade, the CM will follow the upgrade TLV directives in the configuration file upon reboot. It will not retry the previous upgrade. The config file upgrade TLVs essentially provides a retry mechanism that is not available for an SNMP-initiated upgrade.

If a CM suffers a loss of power or resets during an SNMP-initiated upgrade, the CM MUST resume the upgrade without requiring manual intervention. When the CM resumes the upgrade process after a reset that occurred during an SNMP-initiated software upgrade, the CM MUST adhere to the following requirements:

- The CM MUST report 'upgradeFromMgt' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename of the software image to be upgraded as the value for docsDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software upgrade image to be upgraded as the value for docsDevSwServerAddress.
- The CM MUST report 'inProgress' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

In the case where the CM reaches the maximum number of TFTP Download Retries, as specified in the Parameters and Constraints Annex of [MULPI], resulting from multiple losses of power or resets during an SNMP-initiated upgrade, the CM MUST behave as specified in [MULPI]. In this case, after the CM is registered, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename of the software that failed the upgrade process as the value for docsDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software that failed the upgrade process as the value for docsDevSwServerAddress.
- The CM MUST report 'other' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

When the CM reboots following a reset that occurred during a configuration file-initiated software download, the CM MUST ignore the fact that a previous upgrade was in progress and either not perform an upgrade if no upgrade

TLVs are present in the config file, or if upgrade TLVs are present, take the action described in the requirements in the section "Downloading Cable Modem Operating Software" of [MULPI], at the time of the reboot.

In the case where the CM had a configuration-file-initiated upgrade in progress during a reset and if there are no upgrade TLVs in the config file upon reboot, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MAY report the filename of the current software image as the value for docsDevSwFilename.
- The CM MAY report the IP address of the Software Download server containing the software that is currently operating in the CM as the value for docsDevSwServerAddress.
- The CM MUST report 'other' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

In the case where the CM had a configuration-file-initiated upgrade in progress during a reset, if there are upgrade TLVs in the config file upon reboot, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename contained in TLV-9 [MULPI] of the config file as the value for docsDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software to be loaded into the CM as the value for docsDevSwServerAddress, per the requirements stated in the section "Downloading Cable Modem Operating Software" of [MULPI].
- The CM MUST report 'inProgress' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

If a CM exhausts the required number of TFTP Request Retries, as specified in the Parameters and Constraints Annex of [MULPI], the CM MUST behave as specified in [MULPI]. If a CM exhausts the maximum number of configured TFTP Request Retries without successfully downloading the specified file, the CM MUST fall back to last known working image and proceed to an operational state. After a CM falls back to the last known working software image after exhausting the maximum number of configured TFTP Request Retries without successfully downloading the specified file, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docDevSwAdminStautus.
- The CM MUST report the filename of the software that failed the upgrade process as the value for docDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software that failed the upgrade process as the value for docsDevSwServerAddress.
- The CM MUST report 'failed' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

In the case where a CM successfully downloads (or detects during download) an image that is not intended for the CM device, the CM behaves as specified in the section "Downloading Cable Modem Operating Software" of [MULPI]. If a CM successfully downloads an image that is not intended for it, or detects during the download of a software image that the image is not for itself, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename of the software that failed the upgrade as the value for docsDevSwFilename.

- The CM MUST report the IP address of the Software Download server containing the software that failed the upgrade process as the value for docsDevSwServerAddress.
- The CM MUST report 'other' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

In the case where the CM determines that the download image is damaged or corrupted, the CM MUST reject the newly downloaded image. The CM MAY re-attempt to download if the maximum number of TFTP Download Retries has not been reached, as specified in the Parameters and Constants Annex of [MULPI]. If the CM chooses not to retry, the CM MUST fall back to the last known working image and proceed to an operational state and generate appropriate event notification as specified in 0. If the CM does not retry to download a corrupted software image and falls back to the last known working software image, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename of the software that failed the upgrade as the value for docsDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software that failed the upgrade process as the value for docsDevSwServerAddress.
- The CM MUST report 'other' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

In the case where the CM determines that the image is damaged or corrupted, the CM MAY re-attempt to download the new image if the maximum number of TFTP Download Retries has not been reached, as specified in Parameters and Constraints Annex of [MULPI]. On the final consecutive failed retry of the CM software download attempt, the CM MUST fall back to the last known working image and proceed to an operational state and generate appropriate event notification as specified in Annex D. If a CM falls back to the last known working software image after failing the defined consecutive retry attempts, the CM MUST send two notifications, one to notify that the max retry limit has been reached, and another to notify that the image is damaged. Immediately after the CM reaches the operational state after failing the defined consecutive retry attempts to download a software image and falling back to the last known working software image, the CM MUST adhere to the following requirements:

- The CM MUST report 'allowProvisioningUpgrade' as the value for docsDevSwAdminStatus.
- The CM MUST report the filename of the software that failed the upgrade as the value for docsDevSwFilename.
- The CM MUST report the IP address of the Software Download server containing the software that failed the upgrade process as the value for docsDevSwServerAddress.
- The CM MUST report 'other' as the value for docsDevSwOperStatus.
- The CM MUST report the current version of software that is operating on the CM as the value for docsDevSwCurrentVers.

#### **8.2.4 CM configuration files, TLV-11 and MIB OIDs/values**

The following sections define the use of CM configuration file TLV-11 elements and the CM rules for translating TLV-11 elements into SNMP PDU (SNMP MIB OID-instance and MIB OID-instance value combinations; also referred to as SNMP varbinds).

This section also defines the CM behaviors, or state transitions, after either pass or fail of the CM configuration process.

For TLV-11 definitions refer to the Common Radio Frequency Interface Encodings Annex of [MULPI].

#### **8.2.4.1 CM configuration file TLV-11 element translation (to SNMP PDU)**

TLV-11 translation defines the process used by the CM to convert CM configuration file information (TLV-11 elements) into SNMP PDU (varbinds). The CM is required to translate CM configuration file TLV-11 elements into a single SNMP PDU containing (n) MIB OID-instance and value components (SNMP varbinds). Once a single SNMP PDU is constructed, the CM processes the SNMP PDU and determines the CM configuration pass/fail based on the rules for CM configuration file processing, described below. However, if a CM is not physically capable of processing a potentially large single CM configuration file-generated SNMP PDU, the CM is still required to behave as if all MIB OID-instance and value components (SNMP varbinds) from CM configuration file TLV-11 elements are processed as a single SNMP PDU.

In accordance with [RFC 3416], the single CM configuration file generated SNMP PDU will be treated "as if simultaneous" and the CM MUST behave consistently, regardless of the order in which TLV-11 elements appear in the CM configuration file, or SNMP PDU.

The CM configuration file MUST NOT contain duplicate TLV-11 elements (duplicate means SNMP MIB object has identical OID). If the configuration file received by the CM contains duplicate TLV-11 elements, the CM MUST reject the configuration file.

##### **8.2.4.1.1 Rules for CreateAndGo and CreateAndWait<sup>103</sup>**

The CM MUST support 'createAndGo' [RFC 2579] for row creation.

The CM MAY support 'createAndWait' [RFC 2579]. If the CM supports 'createAndWait', there is the constraint that CM configuration file TLV-11 elements MUST NOT be duplicated (all SNMP MIB OID-instance must be unique). If a CM constructs an SNMP PDU from a CM configuration file TLV-11 element that contains an SNMP 'createAndWait' value for a given SNMP MIB OID-instance, the CM MUST NOT also include in that SNMP PDU an SNMP Active value for the same SNMP MIB OID-instance (and vice versa). A CM MAY accept a configuration file that contains a TLV-11 'createAndWait' element if the intended result is to create an SNMP table row which will remain in the SNMP 'notReady' or SNMP 'notInService' state until a non-configuration file SNMP PDU is issued, from an SNMP manager, to update the SNMP table row status.

Both SNMP 'notReady' and SNMP 'notInService' states are valid table row states after an SNMP 'createAndWait' instruction.

#### **8.2.4.2 CM configuration TLV-11 elements not supported by the CM**

If any CM configuration file TLV-11 elements translate to SNMP MIB OIDs that are not MIB OID elements supported by the CM, then the CM MUST ignore those SNMP varbinds, and treat them as if they had not been present, for the purpose of CM configuration. This means that the CM will ignore SNMP MIB OIDs for other vendors' private MIBs as well as standard MIB elements that the CM does not support.

CMs that do not support SNMP CreateAndWait for a given SNMP MIB table MUST ignore, and treat as if not present, the set of columns associated with the SNMP table row.

If any CM configuration file TLV-11 element(s) are ignored, then the CM MUST report them via the CM configured notification mechanism(s), after the CM is registered. The CM MUST report ignored configuration file TLV-11 elements following the notification method in accordance with Section 8.1.2.3.

#### **8.2.4.3 CM state after CM configuration file processing success**

After successful CM configuration via CM configuration file, the CM MUST proceed to register with the CMTS and proceed to its operational state.

#### **8.2.4.4 CM state after CM configuration file processing failure**

If any CM configuration file generated SNMP PDU varbind performs an illegal set operation (illegal, bad, or inconsistent value) to any MIB OID-instance supported by the CM, the CM MUST reject the configuration file. The CM MUST NOT proceed with CM registration if it fails to download and process the configuration file.

<sup>103</sup> Revised per OSSIV3.0-N-07.0477-2 by ab on 7/10/07.

### 8.2.5 IPDR Exporter Configuration<sup>104</sup>

The CMTS SHOULD provide a management interface for IPDR Streaming set of mandatory requirements not limited to:

- Authorized Collectors access list.
- Redundant Collector Policies for Streaming Sessions.
- Configuration of Time intervals for exporting.
- IPDR/SP KeepAlive ackSequenceInterval and ackTimeInterval parameters.
- Configurable document boundaries using session start/stop messages (both for time interval and event sessions with topology services).
- Configuration of single service in multiple sessions that use different export methodologies (ad-hoc/event or ad-hoc/time).

## 8.3 Accounting Management<sup>105</sup>

This specification defines an accounting management interface for subscriber usage-based applications denominated Subscriber Account Management Interface Specification (SAMIS). SAMIS is defined to enable prospective vendors of cable modems and cable modem termination systems to address the operational requirements of subscriber account management in a uniform and consistent manner. It is the intention that this would enable operators and other interested parties to define, design and develop Operations and Business Support Systems necessary for the commercial deployment of different class of services over cable networks, with accompanying usage-based billing of services for each individual subscriber.

Subscriber Account Management described here refers to the following business processes and terms:

Class of Service Provisioning Processes, which are involved in the automatic and dynamic provisioning and enforcement of subscribed class of policy-based service level agreements (SLAs).

Usage-Based Billing Processes, which are involved in the processing of bills based on services rendered to and consumed by paying subscribers. This Specification focuses primarily on bandwidth-centric usage-based billing scenarios. It complements the PacketCable Event Messages Specifications [PC EMv10].

The business processes defined above are aligned with the scenarios for Subscriber Account Management described in Appendix I of this specification. In order to develop the DOCSIS-OSS Subscriber Account Management Specification, it is necessary to consider high-level business processes common to cable operators and the associated operational scenarios. These issues are discussed in Annex B.

### 8.3.1 Subscriber Usage Billing and class of services<sup>106</sup>

The [MULPI] specification uses the concept of class of service, as the term to indicate the type of data services a CM requests and receives from the CMTS, (see [MULPI]). From a high level perspective class of services are observed as subscriber types (e.g., residential or business) and the DOCSIS RFI MAC layer parameters fulfill the subscriber service needs.

The [MULPI] specification supports two service class definition types: DOCSIS 1.1 QoS which offers queuing and scheduling services and the optional, backward-compatible DOCSIS 1.0 Class of Service (CoS) which offers only Queuing services.

<sup>104</sup> Revised per OSSIV3.0-N-09.0849-6 on 11/19/09 by JB.

<sup>105</sup> Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

<sup>106</sup> Revised per OSSIV3.0-N-12-1040-3 on 7/24/12 by JS.

### 8.3.1.1 DOCSIS 1.1 Quality of Service (QoS)<sup>107</sup>

The [MULPI] specification provides a mechanism for a Cable Modem (CM) to register with its Cable Modem Termination System (CMTS) and to configure itself based on external QoS parameters when it is powered up or reset.

To quote (in part) from the Theory of Operation section of [MULPI]:

The principal mechanism for providing enhanced QoS is to classify packets traversing the RF MAC interface into a Service Flow. A Service Flow is a unidirectional flow of packets that provide a particular Quality of Service. The CM and the CMTS provide this QoS by shaping, policing, and prioritizing traffic according to the QoS Parameter Set defined for the Service Flow.

The requirements for Quality of Service include:

- A configuration and registration function for pre-configuring CM-based QoS Service Flows and traffic parameters.
- Utilization of QoS traffic parameters for downstream Service Flows.
- Classification of packets arriving from the upper layer service interface to a specific active Service Flow
- Grouping of Service Flow properties into named Service Classes, so upper layer entities and external applications (at both the CM and the CMTS) can request Service Flows with desired QoS parameters in a globally consistent way.

A Service Class Name (SCN) is defined in the CMTS by provisioning (see Annex O). An SCN provides an association to a QoS Parameter Set. Service Flows that are created using an SCN are considered to be "named" Service Flows. The SCN identifies the service characteristics of a Service Flow to external systems such as a billing system or customer service system. For consistency in billing, operators should ensure that SCNs are unique within an area serviced by the same BSS that utilizes this interface. A descriptive SCN might be something like PrimaryUp, GoldUp, VoiceDn, or BronzeDn to indicate the nature and direction of the Service Flow to the external system.

A Service Package implements a Service Level Agreement (SLA) between the MSO and its Subscribers on the RFI interface. A Service Package might be known by a name such as Gold, Silver, or Bronze. A Service Package is itself implemented by the set of named Service Flows (using SCNs) that are placed into a CM Configuration File<sup>108</sup> that is stored on a Config File server. The set of Service Flows defined in the CM Config File are used to create active Service Flows when the CM registers with the CMTS. Note that many Subscribers are assigned to the same Service Package and, therefore, many CMs use the same CM Config File to establish their active Service Flows.

A Service Package has to define at least two Service Flows known as Primary Service Flows that are used by default when a packet matches none of the classifiers for the other Service Flows. A CM Config File that implements a Service Package, therefore, must define the two primary Service Flows using SCNs (e.g., PrimaryUp and PrimaryDn) that are known to the CMTS if these Service Flows are to be visible to external systems by this billing interface. Note that it is often the practice in a usage sensitive billing environment to segregate the operator's own maintenance traffic, to and from the CM, into the primary service flows so that this traffic is not reflected in the traffic counters associated the subscriber's SLA service flows.

The [MULPI] specification also provides for dynamically created Service Flows. An example could be a set of dynamic Service Flows created by an embedded PacketCable Multimedia Terminal Adapter (MTA) to manage VoIP signaling and media flows. All dynamic Service Flows must be created using an SCN known to the CMTS if they are to be visible to the billing system. These dynamic SCNs do not need to appear in the CM Config File but the MTA may refer to them directly during its own initialization and operation.

During initialization, a CM communicates with a DHCP Server that provides the CM with its assigned IP address and, in addition, receives a pointer to the Config File server that stores the assigned CM Config File for that CM. The CM reads the CM Config File and forwards the set of Service Flow definitions (using SCNs) up to the CMTS.

<sup>107</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

<sup>108</sup> The CM Configuration File contains several kinds of information needed to properly configure the CM and its relationship with the CMTS, but for the sake of this discussion only the Service Flow and Quality of Service components are of interest

The CMTS then performs a macro-expansion on the SCNs (using its provisioned SCN templates) into QoS Parameter Sets sent in the Registration Response for the CM. Internally, each active Service Flow is identified by a 32-bit SFID assigned by the CMTS to a specific CM (relative to the RFI interface). For billing purposes, however, the SFID is not sufficient as the only identifier of a Service Flow because the billing system cannot distinguish the class of service being delivered by one SFID from another. Therefore, the SCN is necessary, in addition to the SFID, to identify the Service Flow's class of service characteristics to the billing system.

The billing system can then rate the charges differently for each of the Service Flow traffic counts based on its Service Class (e.g., Gold octet counts are likely to be charged more than Bronze octet counts). Thus, the billing system obtains, from the CMTS, the traffic counts for each named Service Flow (identified by SFID and SCN) that a subscriber's CM uses during the billing data collection interval. This is true even if multiple active Service Flows (i.e., SFIDs) are created using the same SCN for a given CM over time. This will result in multiple billing records for the CM for Service Flows that have the same SCN (but different SFIDs). Note that the SFID is the primary key to the Service Flow. When an active Service Flow exists across multiple sequential billing files, the SFID allows the sequence of recorded counter values to be correlated to the same Service Flow instance.

### **8.3.1.2 DOCSIS 1.0 Class of Service (CoS)**

The [MULPI] specification also provides the backward compatible mechanism to support DOCSIS 1.0 Class of Service for any CM version being provisioned with a DOCSIS 1.0-style config file.

DOCSIS 1.0 CoS offers, for the CM, upstream queuing services consisting of minimum guarantee upstream bandwidth, traffic priority, and maximum packet size per transmit opportunity. CoS also offers a policy mechanism for upstream and downstream Maximum bandwidth allocation per CM.

Even though the Subscriber Account Management Interface Specification defined herein was intended for billing services which use the DOCSIS 1.1 QoS feature set. However, the existing DOCSIS 1.0 CM installed-based merits the addition of DOCSIS 1.0 Class of Service profiles into the usage billing record with the following considerations:

The Subscriber Usage Billing record is not capable of differentiating a Service Package (as described in Section 8.3.1.1). In other words, for CoS there is no equivalent to SCN of DOCSIS 1.1 QoS that could be used to differentiate CMs with different CoS provisioning parameters or in the occurrence of CMs provisioned with more than one CoS configuration set.

DOCSIS 1.0 Class of Service Management interface [RFC 4546] does not provide a standard set of downstream data traffic counters associated to the CM queuing services. This Subscriber Usage Billing interface requires the implementation of downstream counters in a proprietary manner.

### **8.3.1.3 High-Level Requirements for Subscriber Usage Billing Records**

This section provides the high-level, functional requirements of this interface.

The CMTS provides formatted Subscriber Usage Billing Records for all subscribers attached to the CMTS, on demand, to mediation or billing systems.

The transfer of these Usage Billing Records from the CMTS to the mediation/billing system uses the streaming model defined in [IPDR/SP]. This is a mechanism for transmission of Usage Billing Records in near "real-time" from the CMTS to the mediation system.

The CMTS needs to support a minimum billing record transfer interval of 15 minutes.

The CMTS MUST support the processing and transmitting of Subscriber Usage Billing Records as follows:

- A Subscriber Usage Billing Record identifies the CMTS by host name and IP address and the date and time record is sent. The sysUpTime value for the CMTS is recorded, as well as the MAC domain, downstream and upstream information, the CM is registered on to facilitate the characterization of cable interfaces usage.
- A Subscriber Usage Billing Record is identified by CM MAC address (but not necessarily sorted). The Subscriber's current CM IP address is also present in the billing record for the Subscriber. If the CMTS is tracking CPE addresses behind the Subscriber's CM, then these CPE MAC and IP addresses are also be present in the billing record as well. CPE FQDNs (Fully Qualified Domain Name) are be present in the billing record only if gleaned from DHCP relay agent transactions (reverse DNS queries are not required).

- A Subscriber Usage Billing Record has entries for each active Service Flow (identified by SFID and Service Class Name) used by all CMs operating in DOCSIS 1.1 (or higher) registration mode during the collection interval. This includes all currently running Service Flows, as well as all terminated Service Flows that were deleted and logged during the collection interval. A provisioned or admitted state SF that was deleted before it became active, is not recorded in the billing document, even though it was logged by the CMTS. For CMs registered in DOCSIS 1.0 mode Service Class Name is not used and left empty.
- A Subscriber Usage Billing Record of a CM provisioned with DOCSIS 1.0 CoS is identified by Service Identifier (SID). The CMTS records information for primary SIDs and not for temporary SIDs. In other words, only information pertaining after the CM registration period is recorded.
- A Subscriber Usage Billing Record identifies a running Service Flows or a terminated Service Flows, as well as DOCSIS 1.0 running CM SIDs or a de-registered CMs. A terminated Service Flow or DOCSIS 1.0 SID is reported into a Subscriber Usage Billing Record once. Similarly, records for CMs running DOCSIS 1.0 Class of Service are based on Upstream Queue Services of the [RFC 4546] and proprietary information for downstream information.
- A Subscriber Usage Billing Record identifies the Service Flow or DOCSIS 1.0 CoS direction as upstream or downstream. It collects the number of packets and octets passed for each upstream and downstream Service Flow. The number of packets dropped and the number of packets delayed due to enforcement of QoS maximum throughput parameters (SLA) are also be collected for each Service Flow. In the case of an upstream Service Flow, the reported SLA drop and delay counters represent only the QoS policing performed by the CMTS. Note that since it is possible for a Subscriber to switch back and forth from one service package to another, or to have dynamic service flows occur multiple times, it is possible that there will be multiple Subscriber Usage Records for a given SCN during the collection period. This could also occur if a CM re-registers for any reason (such as CM power failure).
- All traffic counters within a Subscriber Usage Billing Record are absolute 32-bit or 64-bit counters. These traffic counters need to be reset to zero by the CMTS if it re-initializes its management interface. The CMTS sysUpTime value is used to determine if the management interface has been reset between adjacent collection intervals. It is expected that the 64-bit counters will not roll over within the service lifetime of the class of service CMTS.

#### **8.3.1.4 Subscriber Usage Billing Records Mapping to Existing DOCSIS Data model<sup>109</sup>**

In Section 8.3.1.3 the High-level requirements for Subscriber Usage Billing includes counters for consumption based billing. Part of that section deals with the collection of counters associated to DOCSIS 1.0 Class of service and DOCSIS 1.1 Quality of Service. The mapping described below is required to consistently define the Subscriber Usage Billing service specification based on mandatory and well-defined counter requirements as much as possible.

There are trade-offs when defining Subscriber Usage Billing service specifications to cover two different specification requirements. In particular, DOCSIS 1.1 Mode of operation defines QoS as the scheduling and queue prioritization mechanism in Section 8.3.1.1, while DOCSIS 1.0 mode of CM operation is based on the queue prioritization mechanism named CoS as described in Section 8.3.1.2, respectively. The [MULPI] specification does not define MAC layer primitives for usage counters associated to SFIDs and SIDs to be mapped to Management models like SNMP or this Subscriber Usage Billing service specification.

DOCSIS mandatory QoS and CoS counter requirements are contained in this specification. They are defined as SNMP SMI data models in Annex O and CoS [RFC 4546] respectively; see Section 7.1 for details.

This section illustrates the mapping of Subscriber Usage Billing Records for CMs registered in DOCSIS 1.0 mode in the CMTS based on the QoS model. The main design advantages of this approach include:

- Smooth transition to all QoS based DOCSIS networks,
- DOCSIS MAC schedulers are known to map CoS queues into QoS queues rather than define two separate schedulers and counter managers.

<sup>109</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07; revised per OSSIV3.0-N-14.1151-2 on 7/15/16.

- Uniform DOCSIS QoS based networks will simplify the management model (will happen after DOCSIS 1.0 CMs are updated to 1.1 QoS provisioning).
- Simplify the Subscriber Usage Billing service specification based on one XML schema rather than two separate definitions for DOCSIS 1.1 QoS and DOCSIS 1.0 CoS.
- Unifies both Capacity Management and Subscriber Usage Billing management by normalizing upstream and downstream Services, regardless of the Queue discipline. This abstraction layer is relevant especially for capacity management and for further extensions to areas not covered by Annex O, such as multicast SAIDs to SFIDs for proper capacity accounting.

The disadvantage of this design is the possible efficiency cost of meaningless QoS based billing elements in CoS related records where DOCSIS 1.0 is a significant proportion of the provisioned CMs, but limited to few bytes per record with the XDR encoding [IPDR/XDR].

Table 8-20 describes the Subscriber Usage Billing model mapping to this specification standard management object base and other requirements not defined in this specification. See Table Notes immediately following Table 8-20.

**Table 8-20 - Subscriber Usage Billing Model Mapping to DOCSIS Management Object<sup>110</sup>**

Subscriber Usage Billing Service Definition Elements		DOCS-QOS3-MIB DOCSIS QoS model Unicast and Multicast SFs	DOCS-IF-MIB DOCSIS CoS model Unicast CM Service Classes
Elements	Type	OBJECT-TYPE Record Interim, Stop	OBJECT-TYPE Record Interim, Stop <sup>2</sup>
serviceIdentifier	UnsignedInt	docsQosServiceFlowId <sup>1</sup>	docsIfCmtsServiceId <sup>6</sup>
serviceGateld	UnsignedInt		N/A <sup>5</sup>
serviceClassName	String	docsQosParamSetServiceClassName <sup>1</sup> , docsQosServiceFlowLogServiceClassName	N/A <sup>3</sup>
serviceDirection	UnsignedInt	docsQosServiceFlowDirection, docsQosServiceFlowLogDirection	Proprietary encoded <sup>4</sup>
serviceOctetPassed	UnsignedLong	docsQosServiceFlowOctets, docsQosServiceFlowLogOctets	docsIfCmtsServiceInOctets <sup>6</sup>
servicePktsPassed	UnsignedLong	docsQosServiceFlowPkts, docsQosServiceFlowLogPkts	Implementation Dependent <sup>6</sup>
serviceSlaDropPkts	UnsignedInt	docsQosServiceFlowPolicedDropPkts, docsQosServiceFlowLogPolicedDropPkts	Implementation Dependent <sup>4</sup>
serviceSlaDelayPkts	UnsignedInt	docsQosServiceFlowPolicedDelayPkts, docsQosServiceFlowLogPolicedDelayPkts	Implementation Dependent <sup>4</sup>
serviceTimeCreated	UnsignedInt	docsQosServiceFlowTimeCreated, docsQosServiceFlowLogTimeCreated	Implementation Dependent <sup>4</sup>
serviceTimeActive	UnsignedInt	docsQosServiceFlowTimeActive, docsQosServiceFlowLogTimeActive	Implementation Dependent <sup>4</sup>

<sup>110</sup> Table changed 1/6/09 per OSSlv3.0-N-08.0651-3 by JS.

**Table Notes:**

- 1 serviceIdentifier: for interim records applicable only to 'active' Service Flows
- 2 Stop Records are held in memory in a proprietary manner until being sent to the Collector.
- 3 Object not applicable and reported as zero-length string
- 4 All the [RFC 4546] Queuing Services in docsIfCmtsServiceTable are upstream. For downstream services, the [RFC 4546] does not provide counters and objects primitives. It is common industry to include vendor specific extensions for docsIfCmtsServiceTable for accounting CM downstream packets. This common practice might assume only one Class of Service being provisioned in the CM.
- 5 serviceGateId is not part of the DOCSIS QoS model but is available from [PKT-PCMM]
- 6 For a CMTS that supports modeling of CoS parameters as Service Flows, the docsQosServiceFlowOctets, docsQosServiceFlowLogOctets, docsQosServiceFlowPkts, and docsQosServiceFlowLogPkts measure the counts that previously were counted in docsIfCmtsServiceInOctets and docsIfCmtsServiceInPackets. For a CMTS that does not model CoS parameters as Service Flows, the use of docsIfCmtsServiceInPackets is only required for CMs that are not operating in MTC mode.

The Subscriber Usage Billing relationships for DOCSIS 1.0 Class of Service are:

- serviceDirection is encoded as 'upstream' for Upstream CM SIDs. For CM downstream traffic, this element is encoded as 'downstream'.
- serviceOctetsPassed corresponds to docsIfCmtsServiceInOctets for upstream SIDs. CM downstream traffic octet counters are proprietary.
- servicePktsPassed are implementation dependent; if not supported the CMTS reports a zero value.<sup>111</sup>
- serviceSlaDropPkts are implementation dependent, if not supported the CMTS reports a zero value.
- serviceSlaDelayPkts are implementation dependent, if not supported the CMTS reports a zero value.
- serviceTimeCreated is implementation dependent and is required.
- serviceTimeActive is implementation dependent and is required.

These elements are defined in Annex C.

For the case of DOCSIS 1.0 Class of Service, records for Downstream CM traffic are assigned to the first CM SID of its upstream queues. This model for practical reasons is expected to have only one Queue Service (SID) when provisioned in DOCSIS 1.0 CoS but is not limited to this.

The model above is intended to de-couple the internal management primitives of the required MIB objects as an indication that both processes might be updated independently, or as direct relationships of existing management objects. Therefore, in the case of an active Subscriber Usage Billing IPDR/SP Session, the CMTS SHOULD NOT allow the deletion of Service Flow log records until they have been exported by [IPDR/SP].<sup>112</sup>

If the CMTS supports DOCSIS 1.0 CMs, the CMTS MUST retain a terminated SID of a DOCSIS 1.0 Class of Service (CM de-registers) in memory until being successfully exported by [IPDR/SP].<sup>113</sup>

<sup>111</sup> Changed 1/6/09 per OSSIV3.0-N-08.0651-3 by JS.

<sup>112</sup> Modified per OSSIV3.0-N-09.0775-3 on 5/8/09 by JB.

<sup>113</sup> Revised per OSSIV3.0- N-12-1040-3 on 7/24/12 by JS.

### **8.3.1.5 SAMIS Records Optimization**

The CMTS MAY provide mechanisms to prevent exporting Subscriber Usage Billing Records (record suppression) that contain redundant information from a Collector perspective. If traffic counters (octets or packets) of a SFID or DOCSIS 1.0 SID reported in a previous collection interval do not change, the CMTS MUST NOT generate a record of this SFID or DOCSIS 1.0 SID for this collection interval. The serviceTimeActive counter is not considered a traffic counter and therefore does not influence record suppression.

### **8.3.1.6 Billing Collection Interval Subscriber Usage Billing Records Export<sup>114</sup>**

In the case of streaming data at the end of a collection interval, the CMTS (Exporter) MUST create a new IPDR document by starting, and stopping an IPDR/SP Session every collection period. Note that between scheduled collection cycles, the CMTS and the Collector(s) maintain an open TCP stream Connection and the Collector is also in a flow ready state. The CMTS MUST initiate a new Session when it is ready to transmit a complete set of IPDR records to the Collector for the current collection interval. Once the complete set of IPDR records has been transmitted, the CMTS MUST stop the session immediately or stop the session at the end of the collection interval thereby closing the IPDR document for the current collection interval. When the session is stopped immediately, all subsequent terminated SF's MUST be buffered by the Exporter until they can be transmitted in the next scheduled collection interval. The CMTS MAY also leave the session open until the next collection interval. In addition to the scheduled collection cycles, the CMTS MAY also initiate an unscheduled Session with a Collector whenever it needs to transmit IPDR records for terminated SFs because it is in danger of losing data (e.g., its SF log buffer is about to overflow). This unscheduled Session will only contain RecType = Stop IPDR records for the terminated SFs in the log buffer, thereby clearing the buffer. It is imperative that logged SFs are only reported once into an IPDR document. If no connection is available (e.g., for an unscheduled Session or existing open Session) with a Collector, then the CMTS MUST delete the oldest SF log entries first.

Other Management strategies may provide Collector control over the streaming data by executing FlowStop and FlowStart at its convenience (for example to perform load balancing or force the termination of streaming from an Exporter).

### **8.3.2 DOCSIS Subscriber Usage Billing Requirements<sup>115</sup>**

The CMTS MUST support Subscriber Usage Billing by implementing this Subscriber Accounting Management Interface Specification (SAMIS) based on [IPDR/BSR].

## **8.4 Performance Management**

At the CATV MAC and PHY layers, performance management focuses on the monitoring of the effectiveness of cable plant segmentation and rates of upstream traffic and collisions. Instrumentation is provided in the form of the standard interface statistics [RFC 2863] and service queue statistics (from [RFC 4546] and Annex O). It is not anticipated that the CMTS upstream bandwidth allocation function will require active network management intervention and tuning.

At the LLC layer, the performance management focus is on bridge traffic management. The CM implements the Bridge MIB [RFC 4188] as specified in Section 7.1.3.5 and Annex A. If the CMTS implements transparent bridging, it implements the Bridge MIB [RFC 4188] as specified in Section 7.1.3.5.

The CMTS diagnostic log capabilities, as described in Annex G, provides early detection of CM and cable plant problems.

The DOCS-IF-MIB [RFC 4546] includes variables to track PHY state such as codeword collisions and corruption, signal-to-noise ratios, transmit and receive power levels, propagation delays, micro-reflections, in channel response, and sync loss. The DOCS-IF-MIB [RFC 4546] also includes counters to track MAC state, such as collisions and excessive retries for requests, immediate data transmits, and initial ranging requests. Annex J provides enhanced signal quality monitoring and diagnostic capabilities for detecting cable plant.

<sup>114</sup> Revised per OSSIV3.0-N-10.0972-2 on 1/20/11 by JB. Revised per OSSIV3.0-N-11.0989-2 on 11/7/11 by JB.

<sup>115</sup> Revised per OSSIV3.0-N-11.1010-3 on 11/7/11 by JB.

A final performance concern is the ability to diagnose unidirectional loss. Both the CM and CMTS implement the MIB-II [RFC 1213] Interfaces Group [RFC 2863] as specified in Section 7.1.3.3 and Annex A.

#### 8.4.1 Treatment and interpretation of MIB counters

Octet and packet counters implemented as counter32 and counter64 MIB objects are monotonically increasing positive integers with no specific initial value and a maximum value based on the counter size that will roll-over to zero when it is exceeded. In particular, counters are defined such that the only meaningful value is the difference between counter values as seen over a sequence of counter polls. However, there are two situations that can cause this consistent monotonically increasing behavior to change: 1) resetting the counter due to a system or interface reinitialization or 2) a rollover of the counter when it reaches its maximum value of  $2^{32}-1$  or  $2^{64}-1$ . In these situations, it must be clear what the expected behavior of the counters should be.

**Case 1:** The state of an interface changes resulting in an "interface counter discontinuity" as defined in [RFC 2863].

In the case where the state of an interface within the CM changes resulting in an "interface counter discontinuity" [RFC 2863], the CM value of the ifXTable.ifXEntry.ifCounterDiscontinuityTime for the affected interface MUST be set to the current value of sysUpTime and ALL counters for the affected interface set to ZERO. When setting the ifAdminStatus of the affected interface to down(2), the CM MUST NOT consider this as an interface reset.

In the case where the state of an interface within the CMTS changes resulting in an "interface counter discontinuity" [RFC 2863], the CMTS value of the ifXTable.ifXEntry.ifCounterDiscontinuityTime for the affected interface MUST be set to the current value of sysUpTime and ALL counters for the affected interface set to ZERO. When setting the ifAdminStatus of the affected interface to down(2), the CMTS MUST NOT consider this as an interface reset.

**Case 2:** SNMP Agent Reset.

An SNMP Agent Reset is defined as the reinitialization of the SNMP Agent software caused by a device reboot or device reset initiated through SNMP.

In the case of an SNMP Agent Reset within the CM, the CM MUST:

- set the value of sysUpTime to zero (0)
- set all interface ifCounterDiscontinuityTime values to zero (0)
- set all interface counters to zero (0)
- set all other counters maintained by the CM SNMP Agent to zero (0).

In the case of an SNMP Agent Reset within the CMTS, the CMTS MUST:

- set the value of sysUpTime to zero (0)
- set all interface ifCounterDiscontinuityTime values to zero (0)
- set all interface counters to zero (0)
- set all other counters maintained by the CMTS SNMP Agent to zero (0).

**Case 3:** Counter Rollover.

When a counter32 object within the CM reaches its maximum value of 4,294,967,295, the next value MUST be ZERO. When a counter64 object within the CM reaches its maximum value of 18,446,744,073,709,551,615, the next value MUST be ZERO.

When a counter32 object within the CMTS reaches its maximum value of 4,294,967,295, the next value MUST be ZERO. When a counter64 object within the CMTS reaches its maximum value of 18,446,744,073,709,551,615, the next value MUST be ZERO.

**Note:** Unless a CM or CMTS vendor provides a means outside of SNMP to preset a counter64 or counter32 object to an arbitrary value, it will not be possible to test any rollover scenarios for counter64 objects (and many counter32 objects as well). This is because it is not possible for these counters to rollover during the service life of the device (see discussion in section 3.1.6 of [RFC 2863]).

## 8.5 Security Management

The cable device (CMTS/CM) is required to provide SNMP responses in accordance with the SNMP framework defined in [RFC 3411] through [RFC 3416] and the guidelines defined in this section.

### 8.5.1 CMTS SNMP Modes of Operation

CMTS SNMP Coexistence Mode is subject to the following requirements and limitations:

- The CMTS MUST process SNMP v1/v2c Packets as described in [RFC 3411] through [RFC 3415] and [RFC 3584].
- If the CMTS supports the SNMPv3 protocol, it MUST process SNMP v3 Packets as described in [RFC 3411] through [RFC 3415] and [RFC 3584].
- SNMP Access control is determined by the SNMP-COMMUNITY-MIB [RFC 3584], and SNMP-TARGET-MIB [RFC 3413], SNMP-VIEW-BASED-ACM-MIB [RFC 3415], and SNMP-User-Based-SM-MIB [RFC 3414].
- The CMTS MUST support the SNMP-COMMUNITY-MIB [RFC 3584], which controls SNMPv1/v2c packet community string associations to a security name to select entries for access control in the SNMP-VIEW-BASED-ACM-MIB [RFC 3415].
- The CMTS SHOULD support the SNMP-USER-BASED-SM-MIB [RFC 3414] and SNMP-VIEW-BASED-ACM-MIB [RFC 3415] to control SNMPv3 packets.
- The CMTS MUST support SNMP Notification destinations as specified in the SNMP-TARGET-MIB and SNMP-NOTIFICATION-MIB [RFC 3413].

The CMTS MAY support SNMPv3 with AES encryption as defined in [RFC 3826].

### 8.5.2 CMTS SNMP Access Control Configuration<sup>116</sup>

The CMTS SNMP access control initial configuration is outside of the scope of this specification. If the CMTS supports SNMPv3, the CMTS MUST support the SNMPv3 key change mechanism defined in [RFC 3414].

### 8.5.3 CM SNMP Modes of Operation

The CM MUST support SNMPv1, SNMPv2c, and SNMPv3 as well as SNMP-coexistence [RFC 3584] subject to the requirements in the following sections.

The CM access control configuration supports SNMPv1v2c in NmAccess mode and SNMPv1v2c Coexistence mode as described in [RFC 4639] and Section 8.5.4.7 respectively.

### 8.5.4 CM SNMP Access Control Configuration

The CM SNMP access control is configured via the CM config file and later updated for an authorized entity. The confidentiality and authenticity of the information in the config file is defined in [MULPI] and [SEC]. The CM access control configuration supports SNMPv3 configuration through the Diffie-Hellman SNMP Kickstart process defined in Section 8.5.4.5.

#### 8.5.4.1 SNMP operation before CM registration<sup>117</sup>

IP connectivity between the CM and the SNMP management station MUST be implemented as described in Section 9.1.

The CM MUST provide read-only access to the following MIB objects prior to CM registration:

- docsIfDownChannelFrequency

<sup>116</sup> Revised per OSSIV3.0-N-10.0958-2 on 1/20/11 by JB.

<sup>117</sup> Section revised per OSSIV3.0-07.0403-1, #2 on 5/8/07 by KN, and per OSSIV3.0-07.0469-2 on 7/10/07 by ab, and per OSSIV3.0-N-07.0477-2 by ab on 7/12/07.

- docsIfDownChannelPower
- docsIf3CmStatusValue
- docsDevEventTable

The CM MAY provide read-only access to the following MIB objects prior to CM registration:

- sysDescr
- sysUptime
- ifTable
- ifXTable
- docsIfUpChannelFrequency
- docsIfSignalQualityTable
- docsIfCmCmtsAddress
- docsIfCmStatusUsTxPower
- docsDevSwCurrentVers

The CM MUST NOT provide access to the following information prior to CM registration:

- CoS and QoS service flow information
- Configuration file contents
- Secure Software Download information
- Key authentication and encryption material
- SNMP management and control
- DOCSIS functional modules statistics and configuration
- Network provisioning hosts and servers IPs addresses

Additionally, prior to registration, the CM MUST adhere to the following requirements:

- The CM MAY provide access to additional information not listed in the statements above.
- The CM MUST NOT provide SNMP access from the RF interface prior to registration.
- The CM MUST accept any SNMPv1/v2c packets regardless of SNMP community string.
- The CM MUST drop all SNMPv3 packets.

The CM MUST NOT complete registration prior to successful processing of all MIB elements in the configuration file.

The CM MUST complete registration prior to beginning calculation of the public values in the USMDHKickstartTable.

If the CM configuration file contains SNMPv3 parameters, the CM MUST drop all SNMPv3 packets prior to calculating the public values in the USMDHKickstartTable.

#### **8.5.4.2 SNMP operation after CM registration**

After registration, the CM can be in one of the following SNMP operation modes:

- SNMPv1/v2c NmAccess mode
- SNMP Coexistence mode

**Note:** OpenAccess mode available in pre-3.0 DOCSIS OSSI specifications is not supported in DOCSIS 3.0.

The CM MUST NOT provide SNMP access if the configuration file does not contain SNMP access control TLVs such as docsDevNmAccessTable or SNMP coexistence TLV-11 or TLV-34, TLV-53 or TLV-54.

The SNMP mode of the CM is determined by the contents of the CM config file as follows:

- The CM is in SNMPv1/v2c NmAccess mode if the CM configuration file contains docsDevNmAccessTable settings for SNMP access control, does not contain SNMP coexistence TLV-11, TLV-34, TLV-38, TLV-53 or TLV-54 [MULPI].
- The CM is in SNMP coexistence mode if the CM configuration file contains snmpCommunityTable settings and/or TLV-34.1/34.2 and/or TLV-38. In this case, any entries made to the docsDevNmAccessTable are ignored.

#### SNMPv1/v2c NmAccess Mode (using docsDevNmAccess Table)

- The CM MUST implement docsDevNmAccessTable which controls access and trap destinations as described in [RFC 4639] for backward compatibility with pre-3.0 DOCSIS.
- The CM MUST process SNMPv1/v2c packets only in NmAccess mode and drop all SNMPv3 packets.
- The CM MUST NOT allow access to SNMPv3 MIBs as defined in [RFC 3411] through [RFC 3415] and [RFC 3584] while in NmAccess mode.

#### **8.5.4.3 SNMP Coexistence Mode<sup>118</sup>**

The CM MUST process SNMPv1/v2c/v3 messages for SNMP Access Control and SNMP notifications as described by [RFC 3411] through [RFC 3415] and [RFC 3584] as follows:

- The SNMP-COMMUNITY-MIB controls the translation of SNMPv1/v2c packet community string into security name which select entries in the SNMP-USER-BASED-SM-MIB. Access control is provided by the SNMP-VIEW-BASED-ACM-MIB.
- SNMP-USER-BASED-SM-MIB and SNMP-VIEW-BASED-ACM-MIB controls SNMPv3 packets.
- Notification destinations are specified in the SNMP-TARGET-MIB, SNMP-NOTIFICATION-MIB and SNMP-VIEW-BASED-ACM-MIB.
- The CM MUST NOT provide access to docsDevNmAccessTable.

When SNMPv3 is configured the CM conforms to the rules described in the following subsections.

##### **8.5.4.3.1 During calculation of USMDHKickstartTable public value**

- The CM MUST NOT allow SNMP access from the RF port.
- The CM MAY continue to allow access from the CPE port with the limited access as configured by the SNMP-COMMUNITY-MIB, SNMP-TARGET-MIB, SNMP-VIEW-BASED-ACM-MIB and SNMP-USER-BASED-SM-MIB.

#### **8.5.4.4 SNMPv3 Initialization and Key Changes**

Note that the SNMPv3 Initialization and Key Change process defined below is based on [RFC 2786] which always configures the SNMP agent with SNMPv3 HMAC-MD5-96 as the authentication protocol and CBC-DES as the privacy protocol, both specified in [RFC 3414]. Therefore, this specification does not provide a mechanism to initialize SNMPv3 using CFB128-AES-128 for privacy key, as defined in [RFC 3826] or any other configuration defined in [RFC 3414] and are left out of scope of this specification.

The DOCSIS 3.0 CM is designated as having a "very-secure" security posture in the context of [RFC 3414] and [RFC 3415] which means, that default usmUserTable and VACM tables entries defined in Appendix A of [RFC 3414] and Appendix A of [RFC 3415] MUST NOT be present. The major implication for the CM is that only the config file can be used to provide the initial SNMPv3 security configuration.

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<sup>118</sup> Subsection deleted per OSSIV3.0-N-07.0385-1 by ab on 5/3/07.

[RFC 2786] provides a mechanism to kick start an SNMPv3 agent User-based Security Model [RFC 3414] and extensions to the same model for key change. [RFC 2786] does not define the mechanism to configure the initial key material for the kick start process. This specification defines the configuration requirements to initialize the SNMPv3 KickStart initialization defined in [RFC 2786] to configure SNMPv3 for the CM.

The CM MUST support the config file TLV-34 as defined in [MULPI] to configure the initial key material (KickStart Security Name and KickStart Public Number) used for the SNMPv3 agent initialization.

The TLV-34.1 KickStart Security Name corresponds to the SNMPv3 userName [RFC 3414] to be initialized in the CM.

The TLV-34.2 KickStart Public Number is a Diffie-Helman public number generated as described in the description of usmDHKickstartMgrPublic MIB object of [RFC 2786].

The CM MUST support a minimum of 5 entries of TLV-34 in the config file.

The CM MUST provide, by default, pre-defined entries in the USM table and VACM tables to correctly create the userName 'dhKickstart' with security level 'noAuthNoPriv' that has read-only access to system group and usmDHkickstartTable of [RFC 2786].

The CM MUST provide access to TLV-34 [MULPI] and dhKickstart defined userNames in usmUserTable as follows:

- Access as specified in the config file or the default access if corresponding to usernames defined above
- StorageType is 'permanent'
- Prohibit entry deletion
- Entries do not persist across MAC initialization

#### *8.5.4.4.1 SNMPv3 Initialization*

For each of up to five different TLV-34 (KickStart Security Name, KickStart Public Number) [MULPI] pairs from the configuration file, the CM MUST populate in the usmDHKickstartTable the MIB objects usmDHKickstartSecurityName and usmDHKickstartMgrPublic (each pair as an entry).

When a usmDHKickstartMgrPublic instance is set with a valid value during the initialization, the CM MUST create a corresponding row in the usmUserTable as defined in the clause description of usmDHKickstartMgrPublic MIB object of [RFC 2786].

After the CM has registered with the CMTS:

- The CM MUST populate the usmDHKickstartMyPublic MIB object of the usmDHKickstartTable as defined in [RFC 2786] for each entry that a non-zero length usmDHKickstartSecurityName and usmDHKickstartMgrPublic.
- [RFC 2786] Textual Convention DHKeyChange defines the mechanism to determine the Diffie-Helman shared secret for the CM and the SNMP manager. With the Diffie-Helman shared secret, the CM and other entities can derive the SNMPv3 privacy and authentication keys for the corresponding USM userName.
- The CM MUST derive the USM userName security and authentication keys as described in the description clause of the usmDHKickstartMgrPublic MIB object of [RFC 2786].

At this point the CM has completed its SNMPv3 initialization process.

After SNMPv3 initialization process has been finished, the CM MUST allow appropriate access level to a valid securityName with the correct authentication key and/or privacy key.

The CM MUST properly populate keys to appropriate tables as specified by the SNMPv3-related RFCs and [RFC 2786].

The following describes the process that the manager uses to derive the CM's unique authentication key and privacy key:

- The SNMP manager accesses the contents of the usmDHKickstartTable using the security name of 'dhKickstart' with no authentication.
- The SNMP manager gets the value of the CM's usmDHKickstartMyPublic number associated with the securityName for which the manager wants to derive authentication and privacy keys.
- Using the private random number, the manager can calculate the DH shared secret. From that shared secret, the manager can derive operational authentication and confidentiality keys for the securityName that the manager is going to use to communicate with the CM.

#### 8.5.4.4.2 DH Key Changes

The CMs MUST support the key-change mechanism specified in the textual convention DHKeyChange of [RFC 2786].

#### 8.5.4.5 View-based Access Control Model (VACM) Profile

This section addresses the default VACM profile for DOCSIS CMs operating in SNMP Coexistence mode.

The CM MUST support pre-installed entries in VACM tables of [RFC 3415] as follows:

- The system manager, with full read/write/config access:

vacmSecurityModel: 3 (USM)  
vacmSecurityName: docsisManager  
vacmGroupName: docsisManager  
vacmSecurityToGroupStorageType: permanent  
vacmSecurityToGroupStatus: active

- An operator/CSR with read/reset access to full modem:

vacmSecurityModel: 3 (USM)  
vacmSecurityName: docsisOperator  
vacmGroupName: docsisOperator  
vacmSecurityToGroupStorageType: permanent  
vacmSecurityToGroupStatus: active

- RF Monitoring with read access to RF plant statistics:

vacmSecurityModel: 3 (USM)  
vacmSecurityName: docsisMonitor  
vacmGroupName: docsisMonitor  
vacmSecurityToGroupStorageType: permanent  
vacmSecurityToGroupStatus: active

- User debugging with read access to 'useful' variables:

vacmSecurityModel: 3 (USM)  
vacmSecurityName: docsisUser  
vacmGroupName: docsisUser  
vacmSecurityToGroupStorageType: permanent  
vacmSecurityToGroupStatus: active

- Group name to view translations <sup>119</sup>

vacmGroupName: docsisManager

<sup>119</sup> Section revised per OSSIV3.0-N-08.0643-1 on 4/25/08 by KN, revised per OSSIV3.0-N-08-0700-4 on 1/7/09 by JS and per OSSIV3.0-N-09.0775-3 on 5/8/09 by JB.

```

vacmAccessContextPrefix: "
vacmAccessSecurityModel: 3 (USM)
vacmAccessSecurityLevel: AuthPriv
vacmAccessContextMatch: exact
vacmAccessReadViewName: docsisManagerView
vacmAccessWriteViewName: docsisManagerView
vacmAccessNotifyViewName: docsisManagerView
vacmAccessStorageType: permanent
vacmAccessStatus: active

vacmGroupName: docsisOperator
vacmAccessContextPrefix: "
vacmAccessSecurityModel: 3 (USM)
vacmAccessSecurityLevel: AuthNoPriv and AuthPriv
vacmAccessContextMatch: exact
vacmAccessReadViewName: docsisManagerView
vacmAccessWriteViewName: docsisOperatorWriteView
vacmAccessNotifyViewName: docsisManagerView
vacmAccessStorageType: permanent
vacmAccessStatus: active

vacmGroupName: docsisMonitor
vacmAccessContextPrefix: "
vacmAccessSecurityModel: 3 (USM)
vacmAccessSecurityLevel: AuthNoPriv and AuthPriv
vacmAccessContextMatch: exact
vacmAccessReadViewName: docsisMonitorView
vacmAccessWriteViewName: "
vacmAccessNotifyViewName: docsisMonitorView
vacmAccessStorageType: permanent
vacmAccessStatus: active

vacmGroupName: docsisUser
vacmAccessContextPrefix: "
vacmAccessSecurityModel: 3 (USM)
vacmAccessSecurityLevel: AuthNoPriv and AuthPriv
vacmAccessContextMatch: exact
vacmAccessReadViewName: docsisUserView
vacmAccessWriteViewName: "
vacmAccessNotifyViewName: "
vacmAccessStorageType: permanent
vacmAccessStatus: active

```

The CM includes, by default, the following views referred from the VACM entries above:<sup>120</sup>

- docsisManagerView
  - subtree: 1.3.6.1 (internet or entire MIB)
- docsisOperatorWriteView
  - subtree: docsDevBase
  - subtree: docsDevSoftware
  - object: docsDevEvControl
  - object: docsDevEvThrottleAdminStatus

<sup>120</sup> Revised per OSSIV3.0-N-08-0700-4 on 1/7/09 by JS.

- docsisMonitorView
  - subtree: 1.3.6.1.2.1.1 (system)
  - subtree: docsIfBaseObjects
  - subtree: docsIfCmObjects
- docsisUserView
  - subtree: 1.3.6.1.2.1.1 (system)
  - subtree: docsDevBase
  - object: docsDevSwOperStatus
  - object: docsDevSwCurrentVers
  - object:docsDevServerConfigFile
  - subtree: docsDevEventTable
  - subtree: docsDevCpeInetTable
  - subtree: docsIfUpstreamChannelTable
  - subtree: docsIfDownstreamChannelTable
  - subtree: docsIfSignalQualityTable
  - subtree: docsIfCmStatusTable

The CM MUST also support additional VACM users as they are configured via an SNMP-embedded configuration file.

#### **8.5.4.6 SNMPv3 initialization failure**

In case of failure to complete SNMPv3 initialization (i.e., NMS cannot access CM via SNMPv3 PDU), the CM is in the SNMP Coexistence mode and will allow SNMPv1/v2c access if and only if the SNMP-COMMUNITY-MIB entries (and related entries) are configured.

#### **8.5.4.7 SNMPv1v2c Coexistence Configuration config file TLV**

This section specifies CM processing requirements for the SNMPv1v2c Coexistence Configuration TLV [MULPI] when present in the configuration file. The SNMPv1v2c Coexistence Configuration TLV is used to configure SNMPv3 tables for SNMPv1 and v2c access. The CM MUST process SNMPv1v2c Coexistence Configuration TLV in conjunction with SNMP TLV-11 containing SNMPv3 tables, TLV-38, as well as SNMPv3 Access View Configuration TLV (see Section 8.5.4.8).

Based on the SNMPv1v2c Coexistence Configuration TLV, the CM MUST create entries in the following tables in order to cause the desired SNMP Access:

- snmpCommunityTable
- snmpTargetAddrTable
- vacmSecurityToGroupTable
- vacmAccessTable

The mapping from the TLV to these tables is described in the following section.

#### 8.5.4.7.1 Mapping of TLV fields into SNMPv3 tables

The following section describes the mapping of SNMPv1v2c Coexistence Configuration TLV into SNMPv3 entries:

**Table 8-21 - SNMPv1v2c Coexistence Configuration TLV Mapping**

Sub-TLVs	Variable Name	Associated MIB Object
SNMPv1v2c Community Name	CommunityName	snmpCommunityName [RFC 3584]
SNMPv1v2c Transport Address Access		
SNMPv1v2c Transport Address	TAddress	snmpTargetAddrTAddress [RFC 3413]
SNMPv1v2c Transport Address Mask	TMask	snmpTargetAddrTMask [RFC 3584]
SNMPv1v2c Access View Type	AccessViewType	
SNMPv1v2c Access View Name	AccessViewName	vacmAccessReadViewName and vacmAccessWriteViewName [RFC 3415]

The CM is not required to verify the consistency of linkage of tables unless specified. It is intended that the SNMP agent will handle the corresponding configuration problems as part of the normal SNMP incoming requests (e.g., generating internal abstract data elements like noSuchView [RFC 3415]).

Table 8-23 through Table 8-28 describe the CM procedures to populate the SNMP Management Framework Message Processing and Access Control Subsystems [RFC 3412].

In configuring entries in these SNMPv3 tables, note the following:

- The ReadViewName and WriteViewName may correspond to default entries as defined in Section 8.5.4.6, individual entries defined by TLV-11 or entries created using SNMPv3 Access View Configuration (see Section 8.5.4.8).
- Several columnar objects are configured with indexes with the string "@CMconfig". If these tables are configured through other mechanisms, Network operators should not use values beginning with "@CMconfig" to avoid conflicts with the mapping process specified here.

#### 8.5.4.7.2 snmpCommunityTable

The snmpCommunityTable is defined in the "SNMP Community MIB Module" section of [RFC 3584].

The CM MUST create one row in snmpCommunityTable for each SNMPv1v2c Coexistence Configuration TLV in the config file as follows:

- The CM MUST set in snmpCommunityIndex the keyword @CMconfig\_n where 'n' is a sequential number starting at 0 for each TLV processed (e.g., "@CMconfig\_0", "@CMconfig\_1", etc.)
- The CM MUST create space separated tags in snmpCommunityTransportTag for each SNMPv1v2c Community Name sub-TLV of the SNMPv1v2c Coexistence Configuration TLV in the config file.

**Table 8-22 - snmpCommunityTable**

Column Name (* = Part of Index)	Column Value
* snmpCommunityIndex	"@CMconfig_n" where n is 0..m-1 and m is the number of SNMPv1v2c Community Name config file TLVs
snmpCommunityName	<CommunityName>
snmpCommunitySecurityName	"@CMconfig_n"

Column Name (* = Part of Index)	Column Value
snmpCommunityContextEngineID	<the engineID of the cable modem>
snmpCommunityContextName	<Zero-length OCTET STRING>
snmpCommunityTransportTag	"@CMconfigTag_n" where n is 0..m-1 and m is the number of SNMPv1v2c Coexistence Configuration config file TLVs
snmpCommunityStorageType	volatile (2)
snmpCommunityStatus	active (1)

#### 8.5.4.7.3 snmpTargetAddrTable

The snmpTargetAddrTable is defined in the "Definitions" section of [RFC 3413].

The CM MUST create one row in snmpTargetAddrTable for each SNMPv1v2c Transport Address Access sub-TLV of the SNMPv1v2c Coexistence Configuration TLV in the config file.

**Table 8-23 - snmpTargetAddrTable**

Column Name (* = Part of Index)	Column Value
* snmpTargetAddrName	"@CMconfigTag_n_i" where n is 0..m-1 and m is the number of SNMPv1v2c Coexistence Configuration config file TLVs. Where i is 0..p-1 and p is the number of SNMPv1v2c Transport Address Access sub-TLV within the SNMPv1v2c Coexistence Configuration config file TLV n
snmpTargetAddrTDomain	IPv4: snmpUDPPDomain [RFC 3417] IPv6: transportDomainUdpIpv6 [RFC 3419]
snmpTargetAddrTAddress (IP Address and UDP Port)	IPv4: SnmpUDPAddress [RFC 3417] OCTET STRING (6) Octets 1-4: <TAddress> Octets 5-6: <TAddress> IPv6: TransportAddressIPv6 [RFC 3419] OCTET STRING (18) Octets 1-16: <TAddress> Octets 17-18: <TAddress>
snmpTargetAddrTimeout	Default from MIB
snmpTargetAddrRetryCount	Default from MIB
snmpTargetAddrTagList	"@CMconfigTag_n" where n is 0..m-1 and m is the number of SNMPv1v2c Coexistence Configuration config file TLVs
snmpTargetAddrParams	'00'h (null character)
snmpTargetAddrStorageType	volatile (2)
snmpTargetAddrRowStatus	active (1)

#### 8.5.4.7.4 snmpTargetAddrExtTable

The snmpTargetAddrExtTable is defined in the "SNMP Community MIB Module" section of [RFC 3584].

The CM MUST create one row in snmpTargetAddrExtTable for each SNMPv1v2c Transport Address Access sub-TLV of the SNMPv1v2c Coexistence Configuration TLV in the config file.

**Table 8-24 - snmpTargetAddrExtTable**

<b>Column Name (* = Part of Index)</b>	<b>Column Value</b>
* snmpTargetAddrName	"@CMconfigTag_n_i" where n is 0..m-1 and m is the number of SNMPv1v2c Coexistence Configuration config TLVs. Where i is 0..p-1 and p is the number of SNMPv1v2c Transport Address Access sub-TLV within the SNMPv1v2c Coexistence Configuration config file TLV n
snmpTargetAddrTMask	<Zero-length OCTET STRING> when <TMask> is not provided in the i <sup>th</sup> SNMPv1v2c Transport Address Access sub-TLV IPv4: SnmpUDPAddress [RFC 3417] OCTET STRING (6) Octets 1-4: <TMask> Octets 5-6: <UDP Port> IPv6: TransportAddressIPv6 [RFC 3419] OCTET STRING (18) Octets 1-16: <TMask> Octets 17-18: <UDP Port>
snmpTargetAddrMMS	SM Maximum Message Size

#### 8.5.4.7.5 vacmSecurityToGroupTable

The vacmSecurityToGroupTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create two rows in vacmSecurityGroupTable for each SNMPv1v2c Coexistence Configuration TLV in the config file as follows:

The CM MUST set in vacmSecurityName the keyword @CMconfig\_n where 'n' is a sequential number starting at 0 for each SNMPv1v2c Coexistence Configuration TLV processed (e.g., "@CMconfig\_0", "@CMconfig\_1", etc.).

The CM MUST set in vacmGroupName the keyword @CMconfigV1\_n for the first row and @CMconfigV2\_n for the second row where 'n' is a sequential number starting at 0 for each SNMPv1v2c Coexistence Configuration TLV processed (e.g., "@CMconfigV1\_0", "@CMconfigV1\_1", etc.).

**Table 8-25 - vacmSecurityToGroupTable**

<b>Column Name (* = Part of Index)</b>	<b>First Row Column Value</b>	<b>Second Row Column Value</b>
* vacmSecurityModel	SNMPV1 (1)	SNMPV2c (2)
* vacmSecurityName	"@CMconfig_n"	"@CMconfig_n"
vacmGroupName	"@CMconfigV1_n"	"@CMconfigV2_n"
vacmSecurityToGroupStorageType	volatile (2)	volatile (2)
vacmSecurityToGroupStatus	active (1)	active (1)

#### 8.5.4.7.6 vacmAccessTable

The vacmAccessTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create two rows in vacmAccessTable for each SNMPv1v2c Coexistence Configuration TLV in the config file as follows:

The CM MUST set in vacmGroupName the keyword @CMconfigV1\_n for the first row and @CMconfigV2\_n for the second row where 'n' is a sequential number starting at 0 for each SNMPv1v2c Coexistence Configuration TLV processed (e.g., "@CMconfigV1\_0", "@CMconfigV1\_1", etc.).

**Table 8-26 - vacmAccessTable**

<b>Column Name (* = Part of Index)</b>	<b>Column Value</b>	<b>Column Value</b>
* vacmGroupName	"@CMconfigV1_n"	"@CMconfigV2_n"
* vacmAccessContextPrefix	<zero-length string>	<zero-length string>
* vacmAccessSecurityModel	SNMPV1 (1)	SNMPV2c (2)
* vacmAccessSecurityLevel	noAuthNoPriv (1)	noAuthNoPriv (1)
vacmAccessContextMatch	exact (1)	exact (1)
vacmAccessReadViewName	Set <AccessViewName>	Set <AccessViewName>
vacmAccessWriteViewName	When <AccessViewType> == '2' Set <AccessViewName> Otherwise, set <Zero-length OCTET STRING>	When <AccessViewType> == '2' Set <AccessViewName> Otherwise, set <Zero-length OCTET STRING>
vacmAccessNotifyViewName	<Zero-length OCTET STRING>	<Zero-length OCTET STRING>
vacmAccessStorageType	volatile (2)	volatile (2)
vacmAccessStatus	active (1)	active (1)

#### **8.5.4.8 SNMPv3 Access View Configuration config file TLV**

This section specifies CM processing requirements for SNMPv3 Access View Configuration TLVs when present in the configuration file. The SNMPv3 Access View Configuration TLV is used to configure the table vacmViewTreeFamilyTable in a simplified way. The CM MUST process SNMPv3 Access View Configuration TLV in conjunction with SNMP TLV-11 containing SNMPv3 tables, TLV-38 as well as SNMPv1v2c Coexistence Configuration TLV (see Section 8.5.4.7).

The mapping from the TLV to these tables is described in the following section.

##### **8.5.4.8.1 Mapping of TLV fields into SNMPv3 tables**

The following section describes the mapping of SNMPv3 Access View Configuration TLVs into vacmViewTreeFamilyTable:

**Table 8-27 - SNMPv3 Access View Configuration TLV Mapping**

<b>Sub-TLVs</b>	<b>Variable Name</b>	<b>Associated MIB Object [RFC 3415]</b>
SNMPv3 Access View Name	AccessViewName	vacmViewTreeFamilyViewName
SNMPv3 Access View Subtree	AccessViewSubTree	vacmViewTreeFamilySubtree
SNMPv3 Access View Mask	AccessViewMask	vacmViewTreeFamilyMask
SNMPv3 Access View Type	AccessViewType	vacmViewTreeFamilyType

Disconnected entries in the CM SNMP access configuration database are not expected to be detected by the CM as part of the configuration. Eventually, the SNMP agent will not grant access to SNMP requests, for example, to disconnected Security Names and View trees as a result of a TLV configuration mistake.

Table 8-28 describes the CM procedures to populate the SNMP Management Framework Access Control Subsystem [RFC 3412].

In configuring entries for SNMPv3 Access View Configuration TLV, note the following:

One entry is created for each TLV. Some Access Views may have a number of included/excluded OID branches. Only Access View Name will be common for all these OID branches. To support such type of Access

View with multiple included/excluded OID branches a number of multiple SNMPv3 Access View Configuration TLVs need to be defined in configuration file.

#### 8.5.4.8.2 *vacmViewTreeFamilyTable*

The vacmViewTreeFamilyTable is defined in the "Definitions" section of [RFC 3415].

The CM MUST create one row in vacmViewTreeFamilyTable for each SNMPv3 Access View Configuration TLV in the config file. The CM MUST reject the config file if two SNMPv3 Access View Configuration TLVs have identical index components relative to vacmViewTreeFamilyTable. In such instance, the CM would not be able to create an entry for the second TLV containing the duplicate index.

The CM MUST set the object vacmViewTreeFamilySubtree to 1.3.6 when no sub-TLV SNMPv3 Access View Subtree is defined in the config file.

The CM MUST set the object vacmViewTreeFamilyMask to the default zero-length string when no sub-TLV SNMPv3 Access View Mask is defined.

The CM MUST set the object vacmViewTreeFamilyType to the default value 1 (included) when no sub-TLV SNMPv3 Access View Type is defined.

**Table 8-28 - *vacmViewTreeFamilyTable***

Column Name (* = Part of Index)	Column Value
* vacmViewTreeFamilyViewName	<AccessViewName>
* vacmViewTreeFamilySubtree	<AccessViewSubTree>
vacmViewTreeFamilyMask	<AccessViewMask>
vacmViewTreeFamilyType	<AccessViewType>
vacmViewTreeFamilyStorageType	volatile (2)
vacmViewTreeFamilyStatus	active (1)

#### 8.5.4.9 *SNMP CPE Access Control Configuration config file TLV*<sup>121</sup>

The 'SNMP CPE Access Control' config File TLV (See [MULPI]) provides a mechanism to filter SNMP PDU-requests originating from a CMCI interface.

The CM MUST enforce the requirements of 'SNMP CPE Access Control' when configured in SNMP Coexistence mode.

The CM MAY ignore the 'SNMP CPE Access Control' encodings when configured in NmAccess mode.

When applicable, the CM MUST enforce the 'SNMP CPE Access Control' requirements to enable or disable SNMP Access originating from a CMCI interface directed to any CM provisioned IP addresses (See [MULPI]) or any of the CM's CMCI IP addresses defined in Section 9.1, and prior to SNMP protocol specific access control mechanisms such as SNMPv3 Access View, or NmAccess settings.

#### 8.5.5 **IPDR Streaming Protocol Security Model**

Refer to [IPDR/SP] for the IPDR/SP Security recommendations. The IPDR/SP Security Model is out of the scope of this specification.

<sup>121</sup> Section added per OSSIV3.0-N-07.0400-1 by ab on 5/4/07.

## 9 OSS FOR CMCI<sup>122</sup>

This section defines the operational mechanisms needed to support the transmission of data over cable services between a cable modem (CM) and customer premise equipment (CPE). Specifically, this section outlines the following:

- SNMP access via CMCI
- Console Access
- CM diagnostic capabilities
- Protocol Filtering
- Required MIBs

### 9.1 SNMP Access via CMCI<sup>123</sup>

DOCSIS 3.0 CMs have provisions for dual-stack management or management of the CM using SNMP over IPv4 and IPv6. During provisioning, the management of the CM is determined by the MSO. However, SNMP access from the CMCI port(s) for diagnostic purposes prior to the CM being registered needs to operate in a dual-stack management mode and allow access for both IPv4 and IPv6 hosts. CM SNMP access from the CMCI before completing the CMTS registration process MUST comply with the access requirements specified in Section 8.5.4.1. The CM DHCP-acquired IP MUST ignore SNMP requests from CMCI before registration.

CM SNMP access from the CMCI after completing the CMTS registration process MUST comply with the access requirements specified in Section 8.5.4.2. The CM DHCP-acquired IP MUST accept SNMP requests from CMCI after completing registration.

The CM MUST support SNMP access through the following IP addresses regardless of the CM registration state:

- The CM MUST support 192.168.100.1, as the well-known diagnostic IP address accessible only from the CMCI interfaces. The CM MUST support the well-known diagnostic IP address, 192.168.100.1, on all physical interfaces associated with the CMCI. The CM MUST drop SNMP requests coming from the RF interface targeting the well-known IP address.
- The CM MAY also implement alternative IPv4 interfaces like link-local method described in [RFC 3927]. If implemented, the CM MUST restrict the IP address range described in "Address Selection, Defense and Delivery" of [RFC 3927] to 169.254.1.0 to 169.254.254.255 inclusive.
- The CM MAY support an IPv6 EUI-64 link-local scope address in the format FE80::<vendorId>:FFFE:<remainingMacAddress> of the CMCI port. The CM MUST drop SNMP requests coming from the RF interface targeting this IPv6 address. Refer to [RFC 4291] for additional details.

### 9.2 Console Access<sup>124</sup>

The CM MUST NOT allow access to the CM functions by a console port. In this specification, a console port is defined as a communication path, either hardware or software, that allows a user to issue commands to modify the configuration or operational status of the CM. The CM MUST only allow access using DOCSIS defined RF interfaces and operator-controlled SNMP access by the CMCI.

<sup>122</sup> Section revised per OSSIV3.0-07.0403-1, #3 on 5/8/07 by KN.

<sup>123</sup> Revised per OSSIV3.0-N-07.0400-1 by ab on 5/4/07 and OSSIV3.0-N-07.0604-2 on 1/29/08 by KN.

<sup>124</sup> Text revised per OSSIV3.0-07.0403-1, #4 on 5/8/07 by KN.

### 9.3 CM Diagnostic Capabilities

The CM MAY have a diagnostic interface for debugging and troubleshooting purposes. The CM's diagnostic interface MUST be limited by default to the requirements described in Section 8.5.4 before and after registration. The CM's diagnostic interface SHOULD be disabled by default after registration has been completed. The CM MAY provide additional controls that will enable the MSO to alter or customize the diagnostic interface, such as by the configuration process or management through the setting of a proprietary MIB.

### 9.4 Protocol Filtering

The CM MUST be capable of filtering traffic to and from the host CPE as defined in Annex F.<sup>125</sup>

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<sup>125</sup> Section following this deleted per OSSIV3.0-07.0403-1, #5 on 5/8/07 by KN.

## 10 OSSi FOR CM DEVICE<sup>126</sup>

The CM SHOULD support standard front-panel LEDs (Light Emitting Diodes) that present straightforward information about the registration state of the CM so as to facilitate efficient customer support operations.

### 10.1 CM LED Requirements and Operation<sup>127</sup>

A CM SHOULD support LEDs which have three states: 1) unlit, 2) flash, 3) lit solid. A CM LED in the 'flash' state SHOULD turn on and off with a 50% duty cycle at a frequency not less than 2 cycles per second. A CM SHOULD support LEDs which light sequentially, following the normal CM initialization procedure specified in [MULPI]. In this way, the installer can detect a failure that prevents the CM from becoming operational.

A CM SHOULD have a minimum of five externally visible LEDs divided into three functional groups as indicated below:

BOX: This group SHOULD have 1 LED labeled as POWER for the BOX status.

DOCSIS: This group SHOULD have 3 LEDs labeled as DS, US, and ONLINE for the DOCSIS interface status. The LEDs in the DOCSIS group SHOULD be in the order: DS, US, and ONLINE, from left to right, or top to bottom, as appropriate for the orientation of the device.

CPE: This group SHOULD have a minimum of 1 LED labeled as LINK for the LINK status. The CM MAY have multiple LEDs in the CPE group to represent individual CPE interface types and parameters. These CM CPE LEDs MAY be labeled according to their associated interface types.

There is no specific requirement for labeling the functional groups. The overall CM LED distribution SHOULD be in the order: POWER, DS, US, ONLINE, and LINK.

The CM SHOULD use these LEDs to indicate that the following modes of operation are in progress, or have completed successfully:

- Power on, Software Application Image Validation and Self Test
- Scan for Downstream Channel
- Resolve CM-SG and Range
- Operational
- Data Link and Activity

The CM SHOULD operate its LEDs as described in the following sections for each of the above modes of operation.

#### 10.1.1 Power On, Software Application Image Validation and Self Test<sup>128</sup>

The CM SHOULD, when turned on, place the LEDs, or at least the DOCSIS Group LEDs (DS, US, ONLINE), in the 'flash' state while the CM performs the system initialization of the Operational System, CM application load, and any proprietary self-tests. Following the successful completion of the steps above, the CM SHOULD place the LEDs, or at least the DOCSIS Group LEDs, in the 'lit solid' state for one second, after which the CM places the POWER LED in the 'lit solid' state. The CM MAY also place the LINK LED in the 'lit solid' state if a CPE device is properly connected (see Section 10.1.5 below). If the system initialization, described above, results in a failure, the CM SHOULD place the LEDs, or at least the DOCSIS Group LEDs in the 'flash' state, in which they should remain.

<sup>126</sup> Section revised per OSSiV3.0-07.0403-1 on 5/8/07 and OSSiV3.0-N-08.0633-2 on 4/18/08 by KN.

<sup>127</sup> Revised per OSSiV3.0-N-07.0477-2 by ab on 7/12/07.

<sup>128</sup> Revised per OSSiV3.0-N-07.0447-2 by ab on 7/10/07.

### 10.1.2 Scan for Downstream Channel<sup>129</sup>

The CM SHOULD place the DS LED in the 'flash' state as the CM scans for a candidate primary downstream DOCSIS channel. The CM SHOULD place the DS LED in the 'lit solid' state when the CM MAC layer has completed synchronization of MPEG framing of the candidate primary downstream channel, as defined in the "Cable Modem Initialization and Reinitialization" section of [MULPI]. The CM SHOULD maintain the 'lit solid' state of the DS LED as the CM continues the initialization process. The CM SHOULD NOT place the DS LED in the 'flash' state when resolving the CM service groups or performing downstream acquisition of CM receive channels in the registration process as defined in the "Cable Modem Initialization and Reinitialization" section of [MULPI].

Whenever the CM restarts CM initialization (which can include scanning for a downstream channel and attempting to synchronize to a downstream channel), the CM SHOULD place the DS LED in the 'flash' state and the US LED and ONLINE LED in the 'unlit' state.

### 10.1.3 Resolve CM-SG and Range<sup>130</sup>

After the CM places the DS LED in the 'lit solid' state, the CM SHOULD place the US LED in the 'flash' state and the ONLINE LED in the 'unlit' state while the CM is determining CM-SGs and performing initial ranging, until the CM receives a ranging response message with a ranging status of 'success' from the CMTS. When the CM receives a ranging response message with a ranging status of 'success' from the CMTS, the CM SHOULD place the US LED in the 'lit solid' state.

The CM SHOULD maintain the 'lit solid' state of the US LED as the CM continues the initialization process. Unless the channel used to transmit the registration request message is not in the TCC received in the registration response message, the CM SHOULD NOT place the US LED in the 'flash' state when performing upstream acquisition of CM transmit channels in the registration process as defined in the "Cable Modem Initialization and Reinitialization" section of [MULPI]. The CM SHOULD maintain the 'lit solid' state of the US LED when the CM is ranged on one or more upstream channels.

### 10.1.4 Operational<sup>131</sup>

After the CM places the US LED in the 'lit solid' state, the CM SHOULD place the ONLINE LED in the 'flash' state while the CM continues the process towards becoming operational (this includes performing early authentication, establishing IP connectivity, and registering with the CMTS, and performing BPI initialization). When the CM is operational, the CM SHOULD place the ONLINE LED in the 'lit solid' state. Operational is defined according to the section "Cable Modem Initialization and Reinitialization" in [MULPI].

If at any point there is a failure in the registration process that causes the CM to lose its operational state, including but not limited to loss of the primary downstream channel, ranging, DHCP, configuration file download, registration, and Baseline Privacy initialization, the CM SHOULD place the ONLINE LED in the 'flash' state.

If the CM becomes operational and the CM configuration file has the Network Access Control Object (NACO) set to zero (0), the CM SHOULD place the ONLINE LED in the 'unlit' state and place both the 'DS and US LEDs in the 'flash' state. Refer to the Common Radio Frequency Interface Encodings Annex of [MULPI] for details on the Network Access Control Object (NACO).

### 10.1.5 Data Link and Activity

The CM SHOULD place the LINK LED in the 'lit solid' state when a CPE device is connected and the CM is not bridging data. The CM SHOULD place the LINK LED in the 'flash' state ONLY when the CM is bridging data during the CM operational state and NACO set to one (1). The CM SHOULD NOT place the LINK LED in the 'flash' state for data traffic originating or terminating at the CM device itself.

If LINK is detected with a CPE device, the CM MAY set the LINK LED to the 'lit solid' state any time after the power and self test steps are completed.

<sup>129</sup> Revised per OSSIV3.0-N-07.0447-2 by ab on 7/10/07 and OSSIV3.0-N-0633-2 on 4/18/08 by KN.

<sup>130</sup> Revised per OSSIV3.0-N-07.0447-2 by ab on 7/10/07 and OSSIV3.0-N-08.0633-2 on 4/18/08 by KN.

<sup>131</sup> Revised per OSSIV3.0-N-08.0633-2 on 4/18/08 by KN.

## 10.2 Additional CM Operational Status Visualization Features

The CM MAY change the DOCSIS defined LED behavior when the CM is in a vendor proprietary mode of operation. The CM MUST NOT have additional LEDs that reveal DOCSIS specific information about the configuration file content, or otherwise clearly specified (see NACO visualization in Sections 10.1.4 and 10.1.5).

### 10.2.1 Secure Software Download

The CM SHOULD signal that a Secure Software Download [SEC] is in process, by setting the DS LED and the US LED to the 'flash' state, and the ONLINE LED to the 'lit solid' state.

## Annex A Detailed MIB Requirements (Normative)

This Annex defines the SNMP MIB modules and MIB variables required for DOCSIS 3.0 CM and CMTS devices.

**Table A-1 - MIB Implementation Support<sup>132</sup>**

Requirement Type	Table Notation	Description
Deprecated	D	Deprecated objects are optional. 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., 'noSuchObject' for SNMPv2c).
Mandatory	M	The object must be implemented correctly according to the MIB definition.
Not Applicable	NA	Not applicable to the device.
Not Supported	N-Sup	An agent must not instantiate such object and must respond with the appropriate error/exception condition (e.g., 'noSuchObject' for SNMPv2c).
Optional	O	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., 'noSuchObject' for SNMPv2c).
Obsolete	Ob	In SNMP convention, obsolete objects should not be implemented. This specification allows vendors to implement or not implement obsolete objects. If a vendor chooses to implement an obsoleted object, the object must be implemented correctly according to the MIB definition. If a vendor chooses not to implement the obsoleted object, the SNMP agent must not instantiate such object and must respond with the appropriate error/exception condition (e.g., 'noSuchObject' for SNMPv2c).

**Table A-2 - SNMP Access Requirements<sup>133</sup>**

SNMP Access Type	Table Notation	Description
N-Acc	Not Accessible	The object is not accessible and is usually an index in a table
Read Create	RC	The access of the object MUST be implemented as Read-Create
Read Write	RW	The access of the object MUST be implemented as Read-Write
Read Only	RO	The access of the object MUST be implemented as Read-Only
Read Create or Read Only	RC/RO	The access of the object MUST be implemented as either Read-Create or Read-Only as described in the MIB definition
Read Write / Read Only	RW/RO	The access of the object MUST be implemented as either Read-Write or Read-Only as described in the MIB definition
Accessible for SNMP Notifications	Acc-FN	These objects are used for SNMP Notifications by the CMTS and CM SNMP Agents

### A.1 MIB-Object Details<sup>134</sup>

The CM instantiates SNMP MIB objects based on its configuration and operational parameters acquired during registration. Below are denominations for several Table A-3 columns that indicate modes of operation where a CM has specific management requirements for certain MIB object instantiation and syntax.

The CM operates in either "1.0 CoS Mode" or "1.1 QoS Mode" based on the config file style.

<sup>132</sup> Revised per OSSIV3.0-N-07.0512-1 by ab on 10/11/07, OSSIV3.0-N-07.0516-2 by ab on 10/15/07, OSSIV3.0-N-08.0608-1 on 4/10/08, and OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

<sup>133</sup> Revised per OSSIV3.0-N-12-1064-3 on 7/24/12 by JS.

<sup>134</sup> Revised per OSSIV3.0-N-07.0475-3 on 7/12/07, OSSIV3.0-N-07.0522-7 on 11/6/07, OSSIV3.0-N-07.0564-4 by ab on 11/13/07, OSSIV3.0-N-08.0632-3 on 4/18/08 by KN and OSSIV3.0-N-09.0775-3 on 5/8/09 by JB. Revised per OSSIV3.0-N-09.0835-2 and OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

The CM SNMP access control configuration is either NmAccess Mode or SNMP Coexistence Mode.

The CM upstream channel types can be categorized as "TDMA/ATDMA upstream" and "SCDMA upstream".

**Table A-3 - MIB Object Details<sup>135</sup>**

DOCS-IF-MIB [RFC 4546]							
Object			CM	Access	CMTS	Access	
<b>docsIfDownstreamChannelTable</b>			M	N-Acc	M	N-Acc	
<b>docsIfDownstreamChannelEntry</b>			M	N-Acc	M	N-Acc	
docsIfDownChannelId			M	RO	M	RO	
docsIfDownChannelFrequency			M	RO	M	RW/RO	
docsIfDownChannelWidth			M	RO	M	RO	
docsIfDownChannelModulation			M	RO	M	RW	
docsIfDownChannelInterleave			M	RO	M	RW	
docsIfDownChannelPower			M	RO	M	RW/RO	
docsIfDownChannelAnnex			M	RO	M	RO	
docsIfDownChannelStorageType			M	RO	M	RO	
Object	CM TDMA/ATDMA upstream	Access	CM SCDMA upstream	Access	CMTS	Access	
<b>docsIfUpstreamChannelTable</b>	M	N-Acc	M	N-Acc	M	N-Acc	
<b>docsIfUpstreamChannelEntry</b>	M	N-Acc	M	N-Acc	M	N-Acc	
docsIfUpChannelId	M	RO	M	RO	M	RO	
docsIfUpChannelFrequency	M	RO	M	RO	M	RC	
docsIfUpChannelWidth	M	RO	M	RO	M	RC	
docsIfUpChannelModulationProfile	M	RO	M	RO	M	RC	
docsIfUpChannelSlotSize	M	RO	M	RO	M	RC/RO	
docsIfUpChannelTxTimingOffset	M	RO	M	RO	M	RO	
docsIfUpChannelRangingBackoffStart	M	RO	M	RO	M	RC	
docsIfUpChannelRangingBackoffEnd	M	RO	M	RO	M	RC	
docsIfUpChannelTxBackoffStart	M	RO	M	RO	M	RC	
docsIfUpChannelTxBackoffEnd	M	RO	M	RO	M	RC	
docsIfUpChannelScdmaActiveCodes	O	RO	M	RO	M	RC	
docsIfUpChannelScdmaCodesPerSlot	O	RO	M	RO	M	RC	
docsIfUpChannelScdmaFrameSize	O	RO	M	RO	M	RC	

<sup>135</sup> Table replaced per OSSIV3.0-N-07.0475-3 by ab on 7/12/07. Updated per OSSIV3.0-N-07.0511-2 on 10/11/07, per OSSIV3.0-N-07.0528-2 on 10/19/07, per OSSIV3.0-N-07.0522-7 on 11/6/07, per OSSIV3.0-N-07.0553-4 on 11/13/07, and per OSSIV3.0-N-07.0564-4 on 11/13/07 by ab. Modified per OSSIV3.0-N-07.0573-3, OSSIV3.0-N-07.0532-4, OSSIV3.0-N-07.0602-1 on 1/29/08, OSSIV3.0-N-08.0616-2 on 4/11/08, OSSIV3.0-N-08.0618-3 on 4/11/08, OSSIV3.0-N-08.0645-4 on 5/1/08 by KN, OSSIV3.0-N-08.0651-3 on 11/14/08 by JS, OSSIV3.0-N-08.0700-4 on 1/12/09 by JS and OSSIV3.0-N-09.0775-3 on 5/8/09 by JB. Revised per OSSIV3.0-N-09.0881-3 and OSSIV3.0-N-09.0872-4 on 1/5/10 by JB. Revised per OSSIV3.0-N-10.0921-4 on 5/20/10 and per OSSIV3.0-N-10.0962-5 and OSSIV3.0-N-10.0966-2 on 1/21/11 by JB. Revised per OSSIV3.0-N-11.0997-1 on 6/3/11 and by OSSIV3.0-11.1025 on 2/29/12 by JB. Revised per EC N-12-1058-3 on 7/24/12 by JS, updated by OSSIV3.0-12.07303 and OSSIV3.0-N-12.078-4 on 11/2/12 by PO, updated by OSSIV3.0-12.1083-5 and OSSIV3.0-13.1093-3 on 3/20/13 by PO; updated by OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

<b>docsIfUpChannelScdmaHoppingSeed</b>	O	RO	M	RO	M	RC
<b>docsIfUpChannelType</b>	M	RO	M	RO	M	RC
<b>docsIfUpChannelCloneFrom</b>	O	RO	M	RO	M	RC
<b>docsIfUpChannelUpdate</b>	O	RO	M	RO	M	RC
<b>docsIfUpChannelStatus</b>	O	RO	M	RO	M	RC
<b>docsIfUpChannelPreEqEnable</b>	M	RO	M	RO	M	RC
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfQosProfileTable</b>	M	N-Acc	O	N-Acc	O	N-Acc
<b>docsIfQosProfileEntry</b>	M	N-Acc	O	N-Acc	O	N-Acc
<b>docsIfQosProfIndex</b>	M	N-Acc	O	N-Acc	O	N-Acc
<b>docsIfQosProfPriority</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfMaxUpBandwidth</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfGuarUpBandwidth</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfMaxDownBandwidth</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfMaxTxBurst</b>	D	RO	D	RO	D	RC/RO
<b>docsIfQosProfBaselinePrivacy</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfStatus</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfMaxTransmitBurst</b>	M	RO	O	RO	O	RC/RO
<b>docsIfQosProfStorageType</b>	M	RO	O	RO	O	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfSignalQualityTable</b>			M	N-Acc	M	N-Acc
<b>docsIfSignalQualityEntry</b>			M	N-Acc	M	N-Acc
<b>docsIfSigQIncludesContention</b>			M	RO	M	RO
<b>docsIfSigQUnerroreds</b>			M	RO	M	RO
<b>docsIfSigQCorrecteds</b>			M	RO	M	RO
<b>docsIfSigQUncorrectables</b>			M	RO	M	RO
<b>docsIfSigQSignalNoise</b>			D	RO	D	RO
<b>docsIfSigQMicreflections</b>			M	RO	M	RO
<b>docsIfSigQEqualizationData</b>			M	RO	M	RO
<b>docsIfSigQExtUnerroreds</b>			M	RO	M	RO
<b>docsIfSigQExtCorrecteds</b>			M	RO	M	RO
<b>docsIfSigQExtUncorrectables</b>			M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfDocsisBaseCapability</b>			M	RO	M	RO
<b>docsIfCmMacTable</b>			M	N-Acc	NA	
<b>docsIfCmMacEntry</b>			M	N-Acc	NA	
<b>docsIfCmCmtsAddress</b>			M	RO	NA	
<b>docsIfCmCapabilities</b>			M	RO	NA	

docsIfCmRangingRespTimeout			Ob	RW	NA	
docsIfCmRangingTimeout			M	RW	NA	
<b>docsIfCmStatusTable</b>			D	N-Acc	NA	
<b>docsIfCmStatusEntry</b>			D	N-Acc	NA	
docsIfCmStatusValue			D	RO	NA	
docsIfCmStatusCode			D	RO	NA	
docsIfCmStatusTxPower			D	RO	NA	
docsIfCmStatusResets			D	RO	NA	
docsIfCmStatusLostSyncs			D	RO	NA	
docsIfCmStatusInvalidMaps			D	RO	NA	
docsIfCmStatusInvalidUcds			D	RO	NA	
docsIfCmStatusInvalidRangingResponses			D	RO	NA	
docsIfCmStatusInvalidRegistrationResponses			D	RO	NA	
docsIfCmStatusT1Timeouts			D	RO	NA	
docsIfCmStatusT2Timeouts			D	RO	NA	
docsIfCmStatusT3Timeouts			D	RO	NA	
docsIfCmStatusT4Timeouts			D	RO	NA	
docsIfCmStatusRangingAborteds			D	RO	NA	
docsIfCmStatusDocsisOperMode			D	RO	NA	
docsIfCmStatusModulationType			D	RO	NA	
docsIfCmStatusEqualizationData			D	RO	NA	
docsIfCmStatusUCCs			D	RO	NA	
docsIfCmStatusUCCFails			D	RO	NA	
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfCmServiceTable</b>	M	N-Acc	N-Sup		NA	
<b>docsIfCmServiceEntry</b>	M	N-Acc	N-Sup		NA	
docsIfCmServiceId	M	N-Acc	N-Sup		NA	
docsIfCmServiceQosProfile	M	RO	N-Sup		NA	
docsIfCmServiceTxSlotsImmed	M	RO	N-Sup		NA	
docsIfCmServiceTxSlotsDed	M	RO	N-Sup		NA	
docsIfCmServiceTxRetries	M	RO	N-Sup		NA	
docsIfCmServiceTxExceededs	M	RO	N-Sup		NA	
docsIfCmServiceRqRetries	M	RO	N-Sup		NA	
docsIfCmServiceRqExceededs	M	RO	N-Sup		NA	
docsIfCmServiceExtTxSlotsImmed	M	RO	N-Sup		NA	
docsIfCmServiceExtTxSlotsDed	M	RO	N-Sup		NA	
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfCmtsMacTable</b>			NA		M	N-Acc

<b>docsIfCmtsMacEntry</b>			NA		M	N-Acc
<b>docsIfCmtsCapabilities</b>			NA		M	RO
<b>docsIfCmtsSyncInterval</b>			NA		M	RW
<b>docsIfCmtsUcdlInterval</b>			NA		M	RW/RO
<b>docsIfCmtsMaxServiceIds</b>			NA		M	RO
<b>docsIfCmtsInsertionInterval</b>			NA		Ob	RW/RO
<b>docsIfCmtsInvitedRangingAttempts</b>			NA		M	RW/RO
<b>docsIfCmtsInsertInterval</b>			NA		M	RW/RO
<b>docsIfCmtsMacStorageType</b>			NA		M	RW/RO
<b>docsIfCmtsStatusTable</b>			NA		D	N-Acc
<b>docsIfCmtsStatusEntry</b>			NA		D	N-Acc
<b>docsIfCmtsStatusInvalidRangeReqs</b>			NA		D	RO
<b>docsIfCmtsStatusRangingAborteds</b>			NA		D	RO
<b>docsIfCmtsStatusInvalidRegReqs</b>			NA		D	RO
<b>docsIfCmtsStatusFailedRegReqs</b>			NA		D	RO
<b>docsIfCmtsStatusInvalidDataReqs</b>			NA		D	RO
<b>docsIfCmtsStatusT5Timeouts</b>			NA		D	RO
<b>docsIfCmtsCmStatusTable</b>			NA		D	N-Acc
<b>docsIfCmtsCmStatusEntry</b>			NA		D	N-Acc
<b>docsIfCmtsCmStatusIndex</b>			NA		D	N-Acc
<b>docsIfCmtsCmStatusMacAddress</b>			NA		D	RO
<b>docsIfCmtsCmStatusIpAddress</b>			NA		D	RO
<b>docsIfCmtsCmStatusDownChannelIndex</b>			NA		D	RO
<b>docsIfCmtsCmStatusUpChannelIndex</b>			NA		D	RO
<b>docsIfCmtsCmStatusRxPower</b>			NA		D	RO
<b>docsIfCmtsCmStatusTimingOffset</b>			NA		D	RO
<b>docsIfCmtsCmStatusEqualizationData</b>			NA		D	RO
<b>docsIfCmtsCmStatusValue</b>			NA		D	RO
<b>docsIfCmtsCmStatusUnerroreds</b>			NA		D	RO
<b>docsIfCmtsCmStatusCorrecteds</b>			NA		D	RO
<b>docsIfCmtsCmStatusUncorrectables</b>			NA		D	RO
<b>docsIfCmtsCmStatusSignalNoise</b>			NA		D	RO
<b>docsIfCmtsCmStatusMicroreflections</b>			NA		D	RO
<b>docsIfCmtsCmStatusExtUnerroreds</b>			NA		D	RO
<b>docsIfCmtsCmStatusExtCorrecteds</b>			NA		D	RO
<b>docsIfCmtsCmStatusExtUncorrectables</b>			NA		D	RO
<b>docsIfCmtsCmStatusDocsisRegMode</b>			NA		D	RO
<b>docsIfCmtsCmStatusModulationType</b>			NA		D	RO
<b>docsIfCmtsCmStatusInetAddressType</b>			NA		D	RO

<b>docsIfCmtsCmStatusInetAddress</b>			NA		D	RO
<b>docsIfCmtsCmStatusValueLastUpdate</b>			NA		D	RO
<b>docsIfCmtsCmStatusHighResolutionTimingOffset</b>			NA		D	RO
<b>docsIfCmtsServiceTable</b>			NA		M/O	N-Acc
<b>docsIfCmtsServiceEntry</b>			NA		M/O	N-Acc
<b>docsIfCmtsServiceId</b>			NA		M/O	N-Acc
<b>docsIfCmtsServiceCmStatusIndex</b>			NA		D	RO
<b>docsIfCmtsServiceAdminStatus</b>			NA		D	RW/RO
<b>docsIfCmtsServiceQosProfile</b>			NA		M/O	RO
<b>docsIfCmtsServiceCreateTime</b>			NA		D	RO
<b>docsIfCmtsServiceInOctets</b>			NA		D	RO
<b>docsIfCmtsServiceInPackets</b>			NA		D	RO
<b>docsIfCmtsServiceNewCmStatusIndex</b>			NA		D	RO
<b>docsIfCmtsModulationTable</b>			NA		M	N-Acc
<b>docsIfCmtsModulationEntry</b>			NA		M	N-Acc
<b>docsIfCmtsModIndex</b>			NA		M	N-Acc
<b>docsIfCmtsModIntervalUsageCode</b>			NA		M	N-Acc
<b>docsIfCmtsModControl</b>			NA		M	RC
<b>docsIfCmtsModType</b>			NA		M	RC
<b>docsIfCmtsModPreambleLen</b>			NA		M	RC
<b>docsIfCmtsModDifferentialEncoding</b>			NA		M	RC
<b>docsIfCmtsModFECErrorCorrection</b>			NA		M	RC
<b>docsIfCmtsModFECCodewordLength</b>			NA		M	RC
<b>docsIfCmtsModScramblerSeed</b>			NA		M	RC
<b>docsIfCmtsModMaxBurstSize</b>			NA		M	RC
<b>docsIfCmtsModGuardTimeSize</b>			NA		M	RO
<b>docsIfCmtsModLastCodewordShortened</b>			NA		M	RC
<b>docsIfCmtsModScrambler</b>			NA		M	RC
<b>docsIfCmtsModByteInterleaverDepth</b>			NA		M	RC
<b>docsIfCmtsModByteInterleaverBlockSize</b>			NA		M	RC
<b>docsIfCmtsModPreambleType</b>			NA		M	RC
<b>docsIfCmtsModTcmErrorCorrectionOn</b>			NA		M	RC
<b>docsIfCmtsModScdmaInterleaverStepSize</b>			NA		M	RC
<b>docsIfCmtsModScdmaSpreaderEnable</b>			NA		M	RO
<b>docsIfCmtsModScdmaSubframeCodes</b>			NA		M	RC
<b>docsIfCmtsModChannelType</b>			NA		M	RC
<b>docsIfCmtsModStorageType</b>			NA		M	RC
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>

<b>docsIfCmtsQosProfilePermissions</b>			NA		M	RW /RO
<b>docsIfCmtsMacToCmTable</b>			NA		M	N-Acc
<b>docsIfCmtsMacToCmEntry</b>			NA		M	N-Acc
<b>docsIfCmtsCmMac</b>			NA		M	N-Acc
<b>docsIfCmtsCmPtr</b>			NA		M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfCmtsChannelUtilizationInterval</b>			NA	NA	M	RW
<b>DocsIfCmtsChannelUtilizationTable</b>			NA		M	N-Acc
<b>DocsIfCmtsChannelUtilizationEntry</b>			NA		M	N-Acc
<b>docsIfCmtsChannelUtlType</b>			NA		M	N-Acc
<b>docsIfCmtsChannelUtlId</b>			NA		M	N-Acc
<b>docsIfCmtsChannelUtUtilization</b>			NA		M	RO
<b>docsIfCmtsDownChannelCounterTable</b>			NA		M	N-Acc
<b>docsIfCmtsDownChannelCounterEntry</b>			NA		M	N-Acc
<b>docsIfCmtsDownChnlCtrlId</b>			NA		M	RO
<b>docsIfCmtsDownChnlCtrTotalBytes</b>			NA		M	RO
<b>docsIfCmtsDownChnlCtrUsedBytes</b>			NA		M	RO
<b>docsIfCmtsDownChnlCtrExtTotalBytes</b>			NA		M	RO
<b>docsIfCmtsDownChnlCtrExtUsedBytes</b>			NA		M	RO
<b>docsIfCmtsUpChannelCounterTable</b>			NA		M	N-Acc
<b>docsIfCmtsUpChannelCounterEntry</b>			NA		M	N-Acc
<b>docsIfCmtsUpChnlCtrlId</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrTotalMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrUcastGrantedMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrTotalCtnMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrUsedCtnMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrExtTotalMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrExtUcastGrantedMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrExtTotalCtnMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrExtUsedCtnMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrCollCtnMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrTotalCtnReqMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrUsedCtnReqMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrCollCtnReqMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrTotalCtnReqDataMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrUsedCtnReqDataMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrCollCtnReqDataMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrTotalCtnInitMaintMslots</b>			NA		M	RO
<b>docsIfCmtsUpChnlCtrUsedCtnInitMaintMslots</b>			NA		M	RO

docsIfCmtsUpChnlCtrCollCtnlInitMaintMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtCollCtnlMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtTotalCtnlReqMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtUsedCtnlReqMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtCollCtnlReqMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtTotalCtnlReqDataMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtUsedCtnlReqDataMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtCollCtnlReqDataMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtTotalCtnlInitMaintMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtUsedCtnlInitMaintMslots			NA		M	RO
docsIfCmtsUpChnlCtrExtCollCtnlInitMaintMslots			NA		M	RO
<b>DOCS-DRF-MIB [M-OSSI]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsDrfDownstreamTable</b>			NA		M	N-Acc
<b>docsDrfDownstreamEntry</b>			NA		M	N-Acc
docsDrfDownstreamPhyDependencies			NA		M	RO
<b>docsDrfDownstreamCapabilitiesTable</b>			NA		M	N-Acc
<b>docsDrfDownstreamCapabilitiesEntry</b>			NA		M	N-Acc
docsDrfDownstreamCapabFrequency			NA		M	RO
docsDrfDownstreamCapabBandwidth			NA		M	RO
docsDrfDownstreamCapabPower			NA		M	RO
docsDrfDownstreamCapabModulation			NA		M	RO
docsDrfDownstreamCapabInterleaver			NA		M	RO
docsDrfDownstreamCapabJ83Annex			NA		M	RO
docsDrfDownstreamCapabConcurrentServices			NA		NA	
docsDrfDownstreamCapabServicesTransport			NA		NA	
docsDrfDownstreamCapabMuting			NA		M	RO
<b>docsDrfGroupDependencyTable</b>			NA		M	N-Acc
<b>docsDrfGroupDependencyEntry</b>			NA		M	N-Acc
docsDrfGroupDependencyPhyParam			NA		M	N-Acc
docsDrfGroupDependencyPhysicalIndex			NA		M	N-Acc
docsDrfGroupDependencyGroupID			NA		O	RO
docsDrfGroupDependencyType			NA		M	RO
<b>docsDrfChannelBlockTable</b>			NA		M	N-Acc
<b>docsDrfChannelBlockEntry</b>			NA		M	N-Acc

docsDrfChannelBlockPhysicalIndex			NA		M	N-Acc
docsDrfChannelBlockNumberChannels			NA		M	RO
docsDrfChannelBlockCfgNumberChannels			NA		M	RW
docsDrfChannelBlockMute			NA		M	RW
docsDrfChannelBlockTestType			NA		M	RW
docsDrfChannelBlockTestIfIndex			NA		M	RW
<b>IF-MIB [RFC 2863]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
ifNumber			M	RO	M	RO
ifTableLastChange			M	RO	M	RO
<b>ifTable</b>			M	N-Acc	M	N-Acc
<b>Note:</b> The ifTable Counter32 objects are not reflected here, refer to Table A-6 and Table A-7 of Section A.2 for details on these objects.						
<b>ifEntry</b>			M	N-Acc	M	N-Acc
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	RW	M	RW
ifOperStatus			M	RO	M	RO
ifLastChange			M	RO	M	RO
ifOutQLen			D	RO	D	RO
ifSpecific			D	RO	D	RO
<b>ifXTable</b>			M	N-Acc	M	N-Acc
<b>Note:</b> The ifXTable Counter32 and Counter64 objects are not reflected here, refer to Table A-6 and Table A-7 of Section A.2 for details on these objects						
<b>ifXEntry</b>			M	N-Acc	M	N-Acc
ifName			M	RO	M	RO
ifLinkUpDownTrapEnable			M	RW	M	RW
ifHighSpeed			M	RO	M	RO
ifPromiscuousMode			M	RW/RO	M	RW/RO
ifConnectorPresent			M	RO	M	RO
ifAlias			M	RW/RO	M	RW/RO
ifCounterDiscontinuityTime			M	RO	M	RO
<b>ifStackTable</b>			M	N-Acc	M	N-Acc
<b>ifStackEntry</b>			M	N-Acc	M	N-Acc

ifStackHigherLayer			M	N-Acc	M	N-Acc
ifStackLowerLayer			M	N-Acc	M	N-Acc
ifStackStatus			M	RC/RO	M	RC/RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
ifStackLastChange			M	RC/RO	M	RC/RO
<b>ifRcvAddressTable</b>			O	N-Acc	O	N-Acc
<b>ifRcvAddressEntry</b>			O	N-Acc	O	N-Acc
ifRcvAddressAddress			O	N-Acc	O	N-Acc
ifRcvAddressStatus			O	RC	O	RC
IfRcvAddressType			O	RC	O	RC
<b>Notification</b>						
linkUp			M	Acc-FN	M	Acc-FN
linkDown			M	Acc-FN	M	Acc-FN
<b>Note:</b> See Section 7.1.3.3.4for details.						
<b>ifTestTable</b>			D	N-Acc	D	N-Acc
<b>ifTestEntry</b>			D	N-Acc	D	N-Acc
ifTestId			D	RW	D	RW
ifTestStatus			D	RW	D	RW
ifTestType			D	RW	D	RW
ifTestResult			D	RO	D	RO
ifTestCode			D	RO	D	RO
ifTestOwner			D	RW	D	RW
<b>BRIDGE-MIB [RFC 4188]</b>						

**Note:** Implementation of BRIDGE-MIB is required ONLY if device is a bridging device.

<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>dot1dBBase</b>						
dot1dBBaseBridgeAddress			M	RO	M	RO
dot1dBBaseNumPorts			M	RO	M	RO
dot1dBaseType			M	RO	M	RO
<b>dot1dBBasePortTable</b>			M	N-Acc	M	N-Acc
<b>dot1dBBasePortEntry</b>			M	N-Acc	M	N-Acc
dot1dBasePort			M	RO	M	RO
dot1dBasePortIfIndex			M	RO	M	RO
dot1dBasePortCircuit			M	RO	M	RO
dot1dBasePortDelayExceededDiscards			M	RO	M	RO
dot1dBasePortMtuExceededDiscards			M	RO	M	RO
<b>dot1dStp</b>						
dot1dStpProtocolSpecification			M	RO	M	RO
dot1dStpPriority			M	RW	M	RW

dot1dStpTimeSinceTopologyChange			M	RO	M	RO
dot1dStpTopChanges			M	RO	M	RO
dot1dStpDesignatedRoot			M	RO	M	RO
dot1dStpRootCost			M	RO	M	RO
dot1dStpRootPort			M	RO	M	RO
dot1dStpMaxAge			M	RO	M	RO
dot1dStpHelloTime			M	RO	M	RO
dot1dStpHoldTime			M	RO	M	RO
dot1dStpForwardDelay			M	RO	M	RO
dot1dStpBridgeMaxAge			M	RW	M	RW
dot1dStpBridgeHelloTime			M	RW	M	RW
dot1dStpBridgeForwardDelay			M	RW	M	RW
<b>dot1dStpPortTable</b>			O	N-Acc	O	N-Acc
<b>Note:</b> This table is required ONLY if STP is implemented.						
<b>dot1dStpPortEntry</b>			O	N-Acc	O	N-Acc
dot1dStpPort			O	RO	O	RO
dot1dStpPortPriority			O	RW	O	RW
dot1dStpPortState			O	RO	O	RO
dot1dStpPortEnable			O	RW	O	RW
dot1dStpPortPathCost			O	RW	O	RW
dot1dStpPortDesignatedRoot			O	RO	O	RO
dot1dStpPortDesignatedCost			O	RO	O	RO
dot1dStpPortDesignatedBridge			O	RO	O	RO
dot1dStpPortDesignatedPort			O	RO	O	RO
dot1dStpPortForwardTransitions			O	RO	O	RO
dot1dStpPortPathCost32			O	RO	O	RO
<b>dot1dTp</b>						
<b>Note:</b> This group is required ONLY if transparent bridging is implemented.						
dot1dTpLearnedEntryDiscards			M	RO	M	RO
dot1dTpAgingTime			M	RW	M	RW
<b>dot1dTpFdbTable</b>			M	N-Acc	M	N-Acc
<b>dot1dTpFdbEntry</b>			M	N-Acc	M	N-Acc
dot1dTpFdbAddress			M	RO	M	RO
dot1dTpFdbPort			M	RO	M	RO
dot1dTpFdbStatus			M	RO	M	RO
<b>dot1dTpPortTable</b>			M	N-Acc	M	N-Acc
<b>dot1dTpPortEntry</b>			M	N-Acc	M	N-Acc
dot1dTpPort			M	RO	M	RO

dot1dTpPortMaxInfo			M	RO	M	RO
dot1dTpPortInFrames			M	RO	M	RO
dot1dTpPortOutFrames			M	RO	M	RO
dot1dTpPortInDiscards			M	RO	M	RO
<b>dot1dStaticTable</b> <b>Note: Implementation of dot1dStaticTable is OPTIONAL.</b>			O	N-Acc	O	N-Acc
<b>dot1dStaticEntry</b>			O	N-Acc	O	N-Acc
dot1dStaticAddress			O	RW	O	RW
dot1dStaticReceivePort			O	RW	O	RW
dot1dStaticAllowedToGoTo			O	RW	O	RW
dot1dStaticStatus			O	RW	O	RW
<b>Notification</b>						
newRoot			O	Acc-FN	O	Acc-FN
topologyChange			O	Acc-FN	O	Acc-FN
<b>DOCS-CABLE-DEVICE-MIB [RFC 4639]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsDevBase</b>						
docsDevRole			M	RO	O	RO
docsDevDateTime			M	RO/RW	M	RW
docsDevResetNow			M	RW	O	RW
docsDevSerialNumber			M	RO	O	RO
docsDevSTPControl			M	RW/RO	O	RW/RO
docsDevIgmpModeControl			N-Sup		NA	
docsDevMaxCpe			M	RW	NA	
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsDevNmAccessTable</b>	M	N-Acc	N-Sup		O	N-Acc
<b>docsDevNmAccessEntry</b>	M	N-Acc	N-Sup		O	N-Acc
docsDevNmAccessIndex	M	N-Acc	N-Sup		O	N-Acc
docsDevNmAccessIp	M	RC	N-Sup		O	RC
docsDevNmAccessIpMask	M	RC	N-Sup		O	RC
docsDevNmAccessCommunity	M	RC	N-Sup		O	RC
docsDevNmAccessControl	M	RC	N-Sup		O	RC
docsDevNmAccessInterfaces	M	RC	N-Sup		O	RC
docsDevNmAccessStatus	M	RC	N-Sup		O	RC
docsDevNmAccessTrapVersion	M	RC	N-Sup		O	RC
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsDevSoftware</b>						

docsDevSwServer			D	RW	D	RW
docsDevSwFilename			M	RW	O	RW
docsDevSwAdminStatus			M	RW	O	RW
docsDevSwOperStatus			M	RO	O	RO
docsDevSwCurrentVers			M	RO	O	RO
docsDevSwServerAddressType			M	RW	O	RO
docsDevSwServerAddress			M	RW	O	RO
docsDevSwServerTransportProtocol			M	RW	O	RO
<b>docsDevServer</b>						
docsDevServerBootState			D	RO	N-Sup	
docsDevServerDhcp			D	RO	N-Sup	
docsDevServerTime			D	RO	N-Sup	
docsDevServerTftp			D	RO	N-Sup	
docsDevServerConfigFile			M	RO	N-Sup	
docsDevServerDhcpAddressType			M	RO	N-Sup	
docsDevServerDhcpAddress			M	RO	N-Sup	
docsDevServerTimeAddressType			M	RO	N-Sup	
docsDevServerTimeAddress			M	RO	N-Sup	
docsDevServerConfigTftpAddressType			M	RO	N-Sup	
docsDevServerConfigTftpAddress			M	RO	N-Sup	
<b>docsDevEvent</b>						
docsDevEvControl			M	RW	M	RW
docsDevEvSyslog			D	RW	D	RW
docsDevEvThrottleAdminStatus			M	RW	M	RW
docsDevEvThrottleInhibited			D	RO	D	RO
docsDevEvThrottleThreshold			M	RW	M	RW
docsDevEvThrottleInterval			M	RW	M	RW
<b>docsDevEvControlTable</b>			M	N-Acc	M	N-Acc
<b>docsDevEvControlEntry</b>			M	N-Acc	M	N-Acc
docsDevEvPriority			M	N-Acc	M	N-Acc
docsDevEvReporting			M	RW	M	RW
<b>docsDevEventTable</b>			M	N-Acc	M	N-Acc
<b>docsDevEventEntry</b>			M	N-Acc	M	N-Acc
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
docsDevEvSyslogAddressType			M	RW	M	RW
docsDevEvSyslogAddress			M	RW	M	RW
docsDevEvThrottleThresholdExceeded			M	RO	M	RO
<b>docsDevFilter</b>						
docsDevFilterLLCUnmatchedAction			M	RW	O	RW
<b>docsDevFilterLLCTable</b>			M	N-Acc	O	N-Acc
<b>docsDevFilterLLCEntry</b>			M	N-Acc	O	N-Acc
docsDevFilterLLCIndex			M	N-Acc	O	N-Acc
docsDevFilterLLCStatus			M	RC	O	RC
docsDevFilterLLCIflIndex			M	RC	O	RC
docsDevFilterLLCProtocolType			M	RC	O	RC
docsDevFilterLLCProtocol			M	RC	O	RC
docsDevFilterLLCMatches			M	RO	O	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
docsDevFilterIpDefault			M	RW	O	RW
<b>docsDevFilterIpTable</b>			M	N-Acc	D	N-Acc
<b>docsDevFilterIpEntry</b>			M	N-Acc	D	N-Acc
docsDevFilterIpIndex			M	N-Acc	D	N-Acc
docsDevFilterIpStatus			M	RC	D	RC
docsDevFilterIpControl			M	RC	D	RC
docsDevFilterIpIfIndex			M	RC	D	RC
docsDevFilterIpDirection			M	RC	D	RC
docsDevFilterIpBroadcast			M	RC	D	RC
docsDevFilterIpSaddr			M	RC	D	RC
docsDevFilterIpSmask			M	RC	D	RC
docsDevFilterIpDaddr			M	RC	D	RC
docsDevFilterIpDmask			M	RC	D	RC
docsDevFilterIpProtocol			M	RC	D	RC
docsDevFilterIpSourcePortLow			M	RC	D	RC
docsDevFilterIpSourcePortHigh			M	RC	D	RC
docsDevFilterIpDestPortLow			M	RC	D	RC
docsDevFilterIpDestPortHigh			M	RC	D	RC
docsDevFilterIpMatches			M	RO	D	RO
docsDevFilterIpTos			M	RC	D	RC
docsDevFilterIpTosMask			M	RC	D	RC
docsDevFilterIpContinue			D	RC	D	RC
docsDevFilterIpPolicyId			D	RC	D	RC
<b>docsDevFilterPolicyTable</b>			D	N-Acc	D	N-Acc

<b>docsDevFilterPolicyEntry</b>			D	N-Acc	D	N-Acc
docsDevFilterPolicyIndex			D	N-Acc	D	N-Acc
docsDevFilterPolicyId			D	RC	D	RC
docsDevFilterPolicyStatus			D	RC	D	RC
docsDevFilterPolicyPtr			D	RC	D	RC
<b>docsDevFilterTosTable</b>			D	N-Acc	D	N-Acc
<b>docsDevFilterTosEntry</b>			D	N-Acc	D	N-Acc
docsDevFilterTosIndex			D	N-Acc	D	N-Acc
docsDevFilterTosStatus			D	RC	D	RC
docsDevFilterTosAndMask			D	RC	D	RC
docsDevFilterTosOrMask			D	RC	D	RC
<b>docsDevCpe</b>						
docsDevCpeEnroll			O	RW	N-Sup	
docsDevCpelpMax			O	RW	N-Sup	
<b>docsDevCpeTable</b>			Ob	N-Acc	N-Sup	
<b>docsDevCpeEntry</b>			Ob	N-Acc	N-Sup	
docsDevCpelp			Ob	N-Acc	N-Sup	
docsDevCpeSource			Ob	RO	N-Sup	
docsDevCpeStatus			Ob	RC	N-Sup	
<b>docsDevCpelnetTable</b>			O	N-Acc	N-Sup	
<b>docsDevCpelnetEntry</b>			O	N-Acc	N-Sup	
docsDevCpelnetType			O	N-Acc	N-Sup	
docsDevCpelnetAddr			O	RC	N-Sup	
docsDevCpelnetSource			O	RO	N-Sup	
docsDevCpelnetRowStatus			O	RC	N-Sup	
<b>IP-MIB [RFC 4293]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>ipv4GeneralGroup</b>						
ipForwarding			M	RW	M	RW
ipDefaultTTL			M	RW	M	RW
ipReasmTimeout			M	RW	M	RW
<b>ipv6GeneralGroup2</b>						
ipv6IpForwarding			M	RW	M	RW
ipv6IpDefaultHopLimit			M	RW	M	RW
ipv4InterfaceTableLastChange			M	RO	M	RO
<b>ipv4InterfaceTable</b>			M	N-Acc	M	N-Acc
<b>ipv4InterfaceEntry</b>			M	N-Acc	M	N-Acc
ipv4InterfaceIfIndex			M	N-Acc	M	N-Acc
ipv4InterfaceReasmMaxSize			M	RO	M	RO

ipv4InterfaceEnableStatus			M	RW	M	RW
ipv4InterfaceRetransmitTime			M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
ipv6InterfaceTableLastChange			M	RO	M	RO
<b>ipv6InterfaceTable</b>			M	N-Acc	M	N-Acc
<b>ipv6InterfaceEntry</b>			M	N-Acc	M	N-Acc
ipv6InterfaceIndex			M	N-Acc	M	N-Acc
ipv6InterfaceReasmMaxSize			M	RO	M	RO
ipv6InterfaceIdentifier			M	RO	M	RO
ipv6InterfaceEnableStatus			M	RW	M	RW
ipv6InterfaceReachableTime			M	RO	M	RO
ipv6InterfaceRetransmitTime			M	RO	M	RO
ipv6InterfaceForwarding			M	RW	M	RW
<b>ipSystemStatsTable</b>			O	N-Acc	O	N-Acc
<b>ipSystemStatsEntry</b>			O	N-Acc	O	N-Acc
ipSystemStatsIPVersion			O	N-Acc	O	N-Acc
ipSystemStatsInReceives			O	RO	O	RO
ipSystemStatsHCInReceives			O	RO	O	RO
ipSystemStatsInOctets			O	RO	O	RO
ipSystemStatsHCInOctets			O	RO	O	RO
ipSystemStatsInHdrErrors			O	RO	O	RO
ipSystemStatsInNoRoutes			O	RO	O	RO
ipSystemStatsInAddrErrors			O	RO	O	RO
ipSystemStatsInUnknownProtos			O	RO	O	RO
ipSystemStatsInTruncatedPkts			O	RO	O	RO
ipSystemStatsInForwDatagrams			O	RO	O	RO
ipSystemStatsHCInForwDatagrams			O	RO	O	RO
ipSystemStatsReasmReqds			O	RO	O	RO
ipSystemStatsReasmOKs			O	RO	O	RO
ipSystemStatsReasmFails			O	RO	O	RO
ipSystemStatsInDiscards			O	RO	O	RO
ipSystemStatsInDelivers			O	RO	O	RO
ipSystemStatsHCInDelivers			O	RO	O	RO
ipSystemStatsOutRequests			O	RO	O	RO
ipSystemStatsHCOutRequests			O	RO	O	RO
ipSystemStatsOutNoRoutes			O	RO	O	RO
ipSystemStatsOutForwDatagrams			O	RO	O	RO
ipSystemStatsHCOutForwDatagrams			O	RO	O	RO
ipSystemStatsOutDiscards			O	RO	O	RO

ipSystemStatsOutFragReqds			O	RO	O	RO
ipSystemStatsOutFragOKs			O	RO	O	RO
ipSystemStatsOutFragFails			O	RO	O	RO
ipSystemStatsOutFragCreates			O	RO	O	RO
ipSystemStatsOutTransmits			O	RO	O	RO
ipSystemStatsHCOutTransmits			O	RO	O	RO
ipSystemStatsOutOctets			O	RO	O	RO
ipSystemStatsHCOutOctets			O	RO	O	RO
ipSystemStatsInMcastPkts			O	RO	O	RO
ipSystemStatsHCInMcastPkts			O	RO	O	RO
ipSystemStatsInMcastOctets			O	RO	O	RO
ipSystemStatsHCInMcastOctets			O	RO	O	RO
ipSystemStatsOutMcastPkts			O	RO	O	RO
ipSystemStatsHCOutMcastPkts			O	RO	O	RO
ipSystemStatsOutMcastOctets			O	RO	O	RO
ipSystemStatsHCOutMcastOctets			O	RO	O	RO
ipSystemStatsInBcastPkts			O	RO	O	RO
ipSystemStatsHCInBcastPkts			O	RO	O	RO
ipSystemStatsOutBcastPkts			O	RO	O	RO
ipSystemStatsHCOutBcastPkts			O	RO	O	RO
ipSystemStatsDiscontinuityTime			O	RO	O	RO
ipSystemStatsRefreshRate			O	RO	O	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
ipIfStatsTableLastChange			O	RO	O	RO
<b>ipIfStatsTable</b> <b>Note:</b> This table is required ONLY if routing is implemented.			O	N-Acc	M	N-Acc
<b>ipIfStatsEntry</b>			O	N-Acc	M	N-Acc
ipIfStatsIPVersion			O	N-Acc	M	N-Acc
ipIfStatsIfIndex			O	N-Acc	M	N-Acc
ipIfStatsInReceives			O	RO	M	RO
ipIfStatsHCInReceives			O	RO	M	RO
ipIfStatsInOctets			O	RO	M	RO
ipIfStatsHCInOctets			O	RO	M	RO
ipIfStatsInHdrErrors			O	RO	M	RO
ipIfStatsInNoRoutes			O	RO	M	RO
ipIfStatsInAddrErrors			O	RO	M	RO
ipIfStatsInUnknownProtos			O	RO	M	RO
ipIfStatsInTruncatedPkts			O	RO	M	RO

ipIfStatsInForwDatagrams			O	RO	M	RO
ipIfStatsHCInForwDatagrams			O	RO	M	RO
ipIfStatsReasmReqds			O	RO	M	RO
ipIfStatsReasmOKs			O	RO	M	RO
ipIfStatsReasmFails			O	RO	M	RO
ipIfStatsInDiscards			O	RO	M	RO
ipIfStatsInDelivers			O	RO	M	RO
ipIfStatsHCInDelivers			O	RO	M	RO
ipIfStatsOutRequests			O	RO	M	RO
ipIfStatsHCOutRequests			O	RO	M	RO
ipIfStatsOutForwDatagrams			O	RO	M	RO
ipIfStatsHCOutForwDatagrams			O	RO	M	RO
ipIfStatsOutDiscards			O	RO	M	RO
ipIfStatsOutFragReqds			O	RO	M	RO
ipIfStatsOutFragOKs			O	RO	M	RO
ipIfStatsOutFragFails			O	RO	M	RO
ipIfStatsOutFragCreates			O	RO	M	RO
ipIfStatsOutTransmits			O	RO	M	RO
ipIfStatsHCOutTransmits			O	RO	M	RO
ipIfStatsOutOctets			O	RO	M	RO
ipIfStatsHCOutOctets			O	RO	M	RO
ipIfStatsInMcastPkts			O	RO	M	RO
ipIfStatsHCInMcastPkts			O	RO	M	RO
ipIfStatsInMcastOctets			O	RO	M	RO
ipIfStatsHCInMcastOctets			O	RO	M	RO
ipIfStatsOutMcastPkts			O	RO	M	RO
ipIfStatsHCOutMcastPkts			O	RO	M	RO
ipIfStatsOutMcastOctets			O	RO	M	RO
ipIfStatsHCOutMcastOctets			O	RO	M	RO
ipIfStatsInBcastPkts			O	RO	M	RO
ipIfStatsHCInBcastPkts			O	RO	M	RO
ipIfStatsOutBcastPkts			O	RO	M	RO
ipIfStatsHCOutBcastPkts			O	RO	M	RO
ipIfStatsDiscontinuityTime			O	RO	M	RO
ipIfStatsRefreshRate			O	RO	M	RO
<b>ipAddressPrefixTable</b> <b>Note:</b> This table is required ONLY if routing is implemented.			O	N-Acc	M	N-Acc
<b>ipAddressPrefixEntry</b>			O	N-Acc	M	N-Acc

ipAddressPrefixIfIndex			O	N-Acc	M	N-Acc
ipAddressPrefixType			O	N-Acc	M	N-Acc
ipAddressPrefixPrefix			O	N-Acc	M	N-Acc
ipAddressPrefixLength			O	N-Acc	M	N-Acc
ipAddressPrefixOrigin			O	RO	M	RO
ipAddressPrefixOnLinkFlag			O	RO	M	RO
ipAddressPrefixAutonomousFlag			O	RO	M	RO
ipAddressPrefixAdvPreferredLifetime			O	RO	M	RO
ipAddressPrefixAdvValidLifetime			O	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
ipAddressSpinLock			O	RW	M	RW
<b>ipAddressTable</b>			O	N-Acc	M	N-Acc
<b>ipAddressEntry</b>			O	N-Acc	M	N-Acc
ipAddressAddrType			O	N-Acc	M	N-Acc
ipAddressAddr			O	N-Acc	M	N-Acc
ipAddressIfIndex			O	RC	M	RO
ipAddressType			O	RC	M	RO
ipAddressPrefix			O	RO	M	RO
ipAddressOrigin			O	RO	M	RO
ipAddressStatus			O	RC	M	RO
ipAddressCreated			O	RC	M	RO
ipAddressLastChanged			O	RC	M	RO
ipAddressRowStatus			O	RC	M	RO
ipAddressStorageType			O	RC	M	RO
<b>ipNetToPhysicalTable</b>			O	N-Acc	M	N-Acc
<b>Note:</b> This table is required ONLY if routing is implemented.						
<b>ipNetToPhysicalEntry</b>			O	N-Acc	M	N-Acc
ipNetToPhysicalIfIndex			O	N-Acc	M	N-Acc
ipNetToPhysicalNetAddressType			O	N-Acc	M	N-Acc
ipNetToPhysicalNetAddress			O	N-Acc	M	N-Acc
ipNetToPhysicalPhysAddress			O	RC	M	RC
ipNetToPhysicalLastUpdated			O	RO	M	RO
ipNetToPhysicalType			O	RC	M	RC
ipNetToPhysicalState			O	RO	M	RO
ipNetToPhysicalRowStatus			O	RC	M	RC
<b>ipDefaultRouterTable</b>			O	N-Acc	M	N-Acc
<b>Note:</b> This table is required ONLY if routing is implemented.						
<b>ipDefaultRouterEntry</b>			O	N-Acc	M	N-Acc

ipDefaultRouterAddressType			O	N-Acc	M	N-Acc
ipDefaultRouterAddress			O	N-Acc	M	N-Acc
ipDefaultRouterIfIndex			O	N-Acc	M	N-Acc
ipDefaultRouterLifetime			O	RC	M	RC
ipDefaultRouterPreference			O	RO	M	RO
<b>ipv6RouterAdvertGroup</b>						
ipv6RouterAdvertSpinLock			N-Sup		O	RW
<b>ipv6RouterAdvertTable</b>			N-Sup		M	N-Acc
<b>Note:</b> This table is required ONLY if routing is implemented.						
<b>ipv6RouterAdvertEntry</b>			N-Sup		M	N-Acc
ipv6RouterAdvertIfIndex			N-Sup		M	N-Acc
ipv6RouterAdvertSendAdverts			N-Sup		M	RC
ipv6RouterAdvertMaxInterval			N-Sup		M	RC
ipv6RouterAdvertMinInterval			N-Sup		M	RC
ipv6RouterAdvertManagedFlag			N-Sup		M	RC
ipv6RouterAdvertOtherConfigFlag			N-Sup		M	RC
ipv6RouterAdvertLinkMTU			N-Sup		M	RC
ipv6RouterAdvertReachableTime			N-Sup		M	RC
ipv6RouterAdvertRetransmitTime			N-Sup		M	RC
ipv6RouterAdvertCurHopLimit			N-Sup		M	RC
ipv6RouterAdvertDefaultLifetime			N-Sup		M	RC
ipv6RouterAdvertRowStatus			N-Sup		M	RC
<b>icmpStatsTable</b>			M	N-Acc	M	N-Acc
<b>icmpStatsEntry</b>			M	N-Acc	M	N-Acc
icmpStatsIPVersion			M	N-Acc	M	N-Acc
icmpStatsInMsgs			M	RO	M	RO
icmpStatsInErrors			M	RO	M	RO
icmpStatsOutMsgs			M	RO	M	RO
icmpStatsOutErrors			M	RO	M	RO
<b>icmpMsgStatsTable</b>			M	N-Acc	M	N-Acc
<b>icmpMsgStatsEntry</b>			M	N-Acc	M	N-Acc
icmpMsgStatsIPVersion			M	N-Acc	M	N-Acc
icmpMsgStatsType			M	N-Acc	M	N-Acc
icmpMsgStatsInPkts			M	RO	M	RO
icmpMsgStatsOutPkts			M	RO	M	RO
<b>UDP-MIB [RFC 4113]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>UDPGroup</b>						

udpInDatagrams			O	RO	O	RO
udpNoPorts			O	RO	O	RO
udpInErrors			O	RO	O	RO
udpOutDatagrams			O	RO	O	RO
<b>udpEndpointTable</b>			O	N-Acc	O	N-Acc
<b>udpEndpointEntry</b>			O	N-Acc	O	N-Acc
udpEndpointLocalAddressType			O	N-Acc	O	N-Acc
udpEndpointLocalAddress			O	N-Acc	O	N-Acc
udpEndpointLocalPort			O	N-Acc	O	N-Acc
udpEndpointRemoteAddressType			O	N-Acc	O	N-Acc
udpEndpointRemoteAddress			O	N-Acc	O	N-Acc
udpEndpointRemotePort			O	N-Acc	O	N-Acc
udpEndpointInstance			O	N-Acc	O	N-Acc
udpEndpointProcess			O	RO	O	RO
<b>TCP-MIB [RFC 4022]</b>						
Object			CM	Access	CMTS	Access
<b>tcpBaseGroup</b>						
tcpRtoAlgorithm			O	RO	O	RO
tcpRtoMin			O	RO	O	RO
tcpRtoMax			O	RO	O	RO
tcpMaxConn			O	RO	O	RO
tcpActiveOpens			O	RO	O	RO
tcpPassiveOpens			O	RO	O	RO
tcpAttemptFails			O	RO	O	RO
tcpEstabResets			O	RO	O	RO
tcpCurrEstab			O	RO	O	RO
tcpInSegs			O	RO	O	RO
tcpOutSegs			O	RO	O	RO
tcpRetransSegs			O	RO	O	RO
tcpInErrs			O	RO	O	RO
tcpOutRsts			O	RO	O	RO
<b>tcpHCGroup</b>						
tcpHCInSegs			O	RO	O	RO
tcpHCOutSegs			O	RO	O	RO
<b>tcpConnectionTable</b>			O	N-Acc	O	N-Acc
<b>tcpConnectionEntry</b>			O	N-Acc	O	N-Acc
tcpConnectionLocalAddressType			O	N-Acc	O	N-Acc
tcpConnectionLocalAddress			O	N-Acc	O	N-Acc
tcpConnectionLocalPort			O	N-Acc	O	N-Acc

<b>tcpConnectionRemAddressType</b>			O	N-Acc	O	N-Acc
<b>tcpConnectionRemAddress</b>			O	N-Acc	O	N-Acc
<b>tcpConnectionRemPort</b>			O	N-Acc	O	N-Acc
<b>tcpConnectionState</b>			O	RW	O	RW
<b>tcpConnectionProcess</b>			O	RO	O	RO
<b>tcpListenerTable</b>			O	N-Acc	O	N-Acc
<b>tcpListenerEntry</b>			O	N-Acc	O	N-Acc
<b>tcpListenerLocalAddressType</b>			O	N-Acc	O	N-Acc
<b>tcpListenerLocalAddress</b>			O	N-Acc	O	N-Acc
<b>tcpListenerLocalPort</b>			O	N-Acc	O	N-Acc
<b>tcpListenerProcess</b>			O	RO	O	RO
<b>SNMPv2-MIB [RFC 3418]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>SystemGroup</b>						
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
<b>sysORTable</b>			M	N-Acc	M	N-Acc
<b>sysOREntry</b>			M	N-Acc	M	N-Acc
sysORIndex			M	N-Acc	M	N-Acc
sysORID			M	RO	M	RO
sysORDescr			M	RO	M	RO
sysORUpTime			M	RO	M	RO
<b>SNMPGroup</b>						
snmpInPkts			M	RO	M	RO
snmpInBadVersions			M	RO	M	RO
snmpOutPkts			Ob	RO	Ob	RO
snmpInBadCommunityNames			M	RO	M	RO
snmpInBadCommunityUses			M	RO	M	RO
snmpInASNParseErrs			M	RO	M	RO
snmpInTooBigs			Ob	RO	Ob	RO
snmpInNoSuchNames			Ob	RO	Ob	RO
snmpInBadValues			Ob	RO	Ob	RO
snmpInReadOnlys			Ob	RO	Ob	RO

snmpInGenErrs			Ob	RO	Ob	RO
snmpInTotalReqVars			Ob	RO	Ob	RO
snmpInTotalSetVars			Ob	RO	Ob	RO
snmpInGetRequests			Ob	RO	Ob	RO
snmpInGetNexts			Ob	RO	Ob	RO
snmpInSetRequests			Ob	RO	Ob	RO
snmpInGetResponses			Ob	RO	Ob	RO
snmpInTraps			Ob	RO	Ob	RO
snmpOutTooBigs			Ob	RO	Ob	RO
snmpOutNoSuchNames			Ob	RO	Ob	RO
snmpOutBadValues			Ob	RO	Ob	RO
snmpOutGenErrs			Ob	RO	Ob	RO
snmpOutGetRequests			Ob	RO	Ob	RO
snmpOutGetNexts			Ob	RO	Ob	RO
snmpOutSetRequests			Ob	RO	Ob	RO
snmpOutGetResponses			Ob	RO	Ob	RO
snmpOutTraps			Ob	RO	Ob	RO
snmpEnableAuthenTraps			M	RW	M	RW
snmpSilentDrops			M	RO	M	RO
snmpProxyDrops			M	RO	M	RO
<b>snmpTrapsGroup</b>						
coldStart			O	Acc-FN	M	Acc-FN
warmStart			O	Acc-FN	O	Acc-FN
authenticationFailure			M	Acc-FN	M	Acc-FN
<b>snmpSetGroup</b>						
snmpSetSerialNo			M	RW	M	RW
<b>Etherlike-MIB [RFC 3635]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>dot3StatsTable</b>			O	N-Acc	M	N-Acc
<b>dot3StatsEntry</b>			O	N-Acc	M	N-Acc
dot3StatsIndex			O	RO	M	RO
dot3StatsAlignmentErrors			O	RO	M	RO
dot3StatsFCSErrors			O	RO	M	RO
dot3StatsInternalMacTransmitErrors			O	RO	M	RO
dot3StatsFrameTooLongs			O	RO	M	RO
dot3StatsInternalMacReceiveErrors			O	RO	M	RO
dot3StatsSymbolErrors			O	RO	M	RO
dot3StatsSingleCollisionFrames			O	RO	O	RO
dot3StatsMultipleCollisionFrames			O	RO	O	RO

dot3StatsDeferredTransmissions			O	RO	O	RO
dot3StatsLateCollisions			O	RO	O	RO
dot3StatsExcessiveCollisions			O	RO	O	RO
dot3StatsCarrierSenseErrors			O	RO	O	RO
dot3StatsDuplexStatus			O	RO	O	RO
dot3StatsSQETestErrors			O	RO	N-Sup	
<b>dot3CollTable</b>			O	N-Acc	O	N-Acc
<b>dot3CollEntry</b>			O	N-Acc	O	N-Acc
dot3CollCount			O	NA	O	NA
dot3CollFrequencies			O	RO	O	RO
<b>dot3ControlTable</b>			O	N-Acc	O	N-Acc
<b>dot3ControlEntry</b>			O	N-Acc	O	N-Acc
dot3ControlFunctionsSupported			O	RO	O	RO
dot3ControlInUnknownOpcodes			O	RO	O	RO
<b>dot3PauseTable</b>			O	N-Acc	O	N-Acc
<b>dot3PauseEntry</b>			O	N-Acc	O	N-Acc
dot3PauseAdminMode			O	RW	O	RW
dot3PauseOperMode			O	RO	O	RO
dot3InPauseFrames			O	RO	O	RO
dot3OutPauseFrames			O	RO	O	RO
<b>DOCS-BPI-MIB [RFC 3083]</b>						
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsBpiCmBaseTable</b>	M	N-Acc	N-Sup		NA	
<b>docsBpiCmBaseEntry</b>	M	N-Acc	N-Sup		NA	
docsBpiCmPrivacyEnable	M	RO	N-Sup		NA	
docsBpiCmPublicKey	M	RO	N-Sup		NA	
docsBpiCmAuthState	M	RO	N-Sup		NA	
docsBpiCmAuthKeySequenceNumber	M	RO	N-Sup		NA	
docsBpiCmAuthExpires	M	RO	N-Sup		NA	
docsBpiCmAuthReset	M	RW	N-Sup		NA	
docsBpiCmAuthGraceTime	M	RO	N-Sup		NA	
docsBpiCmTEKGraceTime	M	RO	N-Sup		NA	
docsBpiCmAuthWaitTimeout	M	RO	N-Sup		NA	
docsBpiCmReauthWaitTimeout	M	RO	N-Sup		NA	
docsBpiCmOpWaitTimeout	M	RO	N-Sup		NA	
docsBpiCmRekeyWaitTimeout	M	RO	N-Sup		NA	
docsBpiCmAuthRejectWaitTimeout	M	RO	N-Sup		NA	
docsBpiCmAuthRequests	M	RO	N-Sup		NA	

docsBpiCmAuthReplies	M	RO	N-Sup		NA	
docsBpiCmAuthRejects	M	RO	N-Sup		NA	
docsBpiCmAuthInvalids	M	RO	N-Sup		NA	
docsBpiCmAuthRejectErrorCode	M	RO	N-Sup		NA	
docsBpiCmAuthRejectErrorString	M	RO	N-Sup		NA	
docsBpiCmAuthInvalidErrorCode	M	RO	N-Sup		NA	
docsBpiCmAuthInvalidErrorString	M	RO	N-Sup		NA	
<b>docsBpiCmTEKTable</b>	M	N-Acc	N-Sup		NA	
<b>docsBpiCmTEKEntry</b>	M	N-Acc	N-Sup		NA	
docsBpiCmTEKPrivacyEnable	M	RO	N-Sup		NA	
docsBpiCmTEKState	M	RO	N-Sup		NA	
docsBpiCmTEKExpiresOld	M	RO	N-Sup		NA	
docsBpiCmTEKExpiresNew	M	RO	N-Sup		NA	
docsBpiCmTEKKeyRequests	M	RO	N-Sup		NA	
docsBpiCmTEKKeyReplies	M	RO	N-Sup		NA	
docsBpiCmTEKKeyRejects	M	RO	N-Sup		NA	
docsBpiCmTEKInvalids	M	RO	N-Sup		NA	
docsBpiCmTEKAAuthPends	M	RO	N-Sup		NA	
docsBpiCmTEKKeyRejectErrorCode	M	RO	N-Sup		NA	
docsBpiCmTEKKeyRejectErrorString	M	RO	N-Sup		NA	
docsBpiCmTEKInvalidErrorCode	M	RO	N-Sup		NA	
docsBpiCmTEKInvalidErrorString	M	RO	N-Sup		NA	
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsBpiCmtsBaseTable</b>			NA		N-Sup	
<b>docsBpiCmtsBaseEntry</b>			NA		N-Sup	
docsBpiCmtsDefaultAuthLifetime			NA		N-Sup	
docsBpiCmtsDefaultTEKLifetime			NA		N-Sup	
docsBpiCmtsDefaultAuthGraceTime			NA		N-Sup	
docsBpiCmtsDefaultTEKGraceTime			NA		N-Sup	
docsBpiCmtsAuthRequests			NA		N-Sup	
docsBpiCmtsAuthReplies			NA		N-Sup	
docsBpiCmtsAuthRejects			NA		N-Sup	
docsBpiCmtsAuthInvalids			NA		N-Sup	
<b>docsBpiCmtsAuthTable</b>			NA		N-Sup	
<b>docsBpiCmtsAuthEntry</b>			NA		N-Sup	
docsBpiCmtsAuthCmMacAddress			NA		N-Sup	
docsBpiCmtsAuthCmPublicKey			NA		N-Sup	
docsBpiCmtsAuthCmKeySequenceNumber			NA		N-Sup	
docsBpiCmtsAuthCmExpires			NA		N-Sup	

docsBpiCmtsAuthCmLifetime			NA		N-Sup	
docsBpiCmtsAuthCmGraceTime			NA		N-Sup	
docsBpiCmtsAuthCmReset			NA		N-Sup	
docsBpiCmtsAuthCmRequests			NA		N-Sup	
docsBpiCmtsAuthCmReplies			NA		N-Sup	
docsBpiCmtsAuthCmRejects			NA		N-Sup	
docsBpiCmtsAuthCmInvalids			NA		N-Sup	
docsBpiCmtsAuthRejectErrorCode			NA		N-Sup	
docsBpiCmtsAuthRejectErrorString			NA		N-Sup	
docsBpiCmtsAuthInvalidErrorCode			NA		N-Sup	
docsBpiCmtsAuthInvalidErrorString			NA		N-Sup	
<b>docsBpiCmtsTEKTable</b>			NA		N-Sup	
<b>docsBpiCmtsTEKEEntry</b>			NA		N-Sup	
docsBpiCmtsTEKLifetime			NA		N-Sup	
docsBpiCmtsTEKGraceTime			NA		N-Sup	
docsBpiCmtsTEKExpiresOld			NA		N-Sup	
docsBpiCmtsTEKExpiresNew			NA		N-Sup	
docsBpiCmtsTEKReset			NA		N-Sup	
docsBpiCmtsKeyRequests			NA		N-Sup	
docsBpiCmtsKeyReplies			NA		N-Sup	
docsBpiCmtsKeyRejects			NA		N-Sup	
docsBpiCmtsTEKInvalids			NA		N-Sup	
docsBpiCmtsKeyRejectErrorCode			NA		N-Sup	
docsBpiCmtsKeyRejectErrorString			NA		N-Sup	
docsBpiCmtsTEKInvalidErrorCode			NA		N-Sup	
docsBpiCmtsTEKInvalidErrorString			NA		N-Sup	
<b>docsBpilpMulticastMapTable</b>			NA		N-Sup	
<b>docsBpilpMulticastMapEntry</b>			NA		N-Sup	
docsBpilpMulticastAddress			NA		N-Sup	
docsBpilpMulticastprefixLength			NA		N-Sup	
docsBpilpMulticastServiceId			NA		N-Sup	
docsBpilpMulticastMapControl			NA		N-Sup	
<b>docsBpiMulticastAuthTable</b>			NA		N-Sup	
<b>docsBpiMulticastAuthEntry</b>			NA		N-Sup	
docsBpiMulticastServiceId			NA		N-Sup	
docsBpiMulticastCmMacAddress			NA		N-Sup	
docsBpiMulticastAuthControl			NA		N-Sup	

<b>DOCS-IETF-BPI2-MIB [RFC 4131]</b>						
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsBpi2CmBaseTable</b>	O	N-Acc	M	N-Acc	NA	
<b>docsBpi2CmBaseEntry</b>	O	N-Acc	M	N-Acc	NA	
docsBpi2CmPrivacyEnable	O	RO	M	RO	NA	
docsBpi2CmPublicKey	O	RO	M	RO	NA	
docsBpi2CmAuthState	O	RO	M	RO	NA	
docsBpi2CmAuthKeySequenceNumber	O	RO	M	RO	NA	
docsBpi2CmAuthExpiresOld	O	RO	M	RO	NA	
docsBpi2CmAuthExpiresNew	O	RO	M	RO	NA	
docsBpi2CmAuthReset	O	RW	M	RW	NA	
docsBpi2CmAuthGraceTime	O	RO	M	RO	NA	
docsBpi2CmTEKGraceTime	O	RO	M	RO	NA	
docsBpi2CmAuthWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmReauthWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmOpWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmRekeyWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmAuthRejectWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmSAMapWaitTimeout	O	RO	M	RO	NA	
docsBpi2CmSAMapMaxRetries	O	RO	M	RO	NA	
docsBpi2CmAuthentInfos	O	RO	M	RO	NA	
docsBpi2CmAuthRequests	O	RO	M	RO	NA	
docsBpi2CmAuthReplies	O	RO	M	RO	NA	
docsBpi2CmAuthRejects	O	RO	M	RO	NA	
docsBpi2CmAuthInvalids	O	RO	M	RO	NA	
docsBpi2CmAuthRejectErrorCode	O	RO	M	RO	NA	
docsBpi2CmAuthRejectErrorString	O	RO	M	RO	NA	
docsBpi2CmAuthInvalidErrorCode	O	RO	M	RO	NA	
docsBpi2CmAuthInvalidErrorString	O	RO	M	RO	NA	
<b>docsBpi2CmTEKTable</b>	O	N-Acc	M	N-Acc	NA	
<b>docsBpi2CmTEKEntry</b>	O	N-Acc	M	N-Acc	NA	
docsBpi2CmTEKSAlt	O	N-Acc	M	N-Acc	NA	
docsBpi2CmTEKSAType	O	RO	M	RO	NA	
docsBpi2CmTEKDataEncryptAlg	O	RO	M	RO	NA	
docsBpi2CmTEKDataAuthentAlg	O	RO	M	RO	NA	
docsBpi2CmTEKState	O	RO	M	RO	NA	
docsBpi2CmTEKKeySequenceNumber	O	RO	M	RO	NA	
docsBpi2CmTEKExpiresOld	O	RO	M	RO	NA	

docsBpi2CmTEKExpiresNew	O	RO	M	RO	NA	
docsBpi2CmTEKKeyRequests	O	RO	M	RO	NA	
docsBpi2CmTEKKeyReplies	O	RO	M	RO	NA	
docsBpi2CmTEKKeyRejects	O	RO	M	RO	NA	
docsBpi2CmTEKInvalids	O	RO	M	RO	NA	
docsBpi2CmTEKAuthPends	O	RO	M	RO	NA	
docsBpi2CmTEKKeyRejectErrorCode	O	RO	M	RO	NA	
docsBpi2CmTEKKeyRejectErrorString	O	RO	M	RO	NA	
docsBpi2CmTEKInvalidErrorCode	O	RO	M	RO	NA	
docsBpi2CmTEKInvalidErrorString	O	RO	M	RO	NA	
<b>docsBpi2CmlpMulticastMapTable</b>	O	N-Acc	M	N-Acc	NA	
<b>docsBpi2CmlpMulticastMapEntry</b>	O	N-Acc	M	N-Acc	NA	
docsBpi2CmlpMulticastIndex	O	N-Acc	M	N-Acc	NA	
docsBpi2CmlpMulticastAddressType	O	RO	M	RO	NA	
docsBpi2CmlpMulticastAddress	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAId	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapState	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapRequests	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapReplies	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapRejects	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapRejectErrorCode	O	RO	M	RO	NA	
docsBpi2CmlpMulticastSAMapRejectErrorString	O	RO	M	RO	NA	
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsBpi2CmDeviceCertTable</b>			M	N-Acc	NA	
<b>docsBpi2CmDeviceCertEntry</b>			M	N-Acc	NA	
docsBpi2CmDeviceCmCert			M	RW/RO	NA	
docsBpi2CmDeviceManufCert			M	RO	NA	
<b>docsBpi2CmCryptoSuiteTable</b>			M	N-Acc	NA	
<b>docsBpi2CmCryptoSuiteEntry</b>			M	N-Acc	NA	
docsBpi2CmCryptoSuiteIndex			M	N-Acc	NA	
docsBpi2CmCryptoSuiteDataEncryptAlg			M	RO	NA	
docsBpi2CmCryptoSuiteDataAuthentAlg			M	RO	NA	
<b>docsBpi2CmtsBaseEntryTable</b>			NA		M	N-Acc
<b>docsBpi2CmtsBaseEntryEntry</b>			NA		M	N-Acc
docsBpi2CmtsDefaultAuthLifetime			NA		M	RW
docsBpi2CmtsDefaultTEKLifetime			NA		M	RW
docsBpi2CmtsDefaultSelfSignedManufCertTrust			NA		M	RW
docsBpi2CmtsCheckCertValidityPeriods			NA		M	RW
docsBpi2CmtsAuthentInfos			NA		M	RO

docsBpi2CmtsAuthRequests			NA		M	RO
docsBpi2CmtsAuthReplies			NA		M	RO
docsBpi2CmtsAuthRejects			NA		M	RO
docsBpi2CmtsAuthInvalids			NA		M	RO
docsBpi2CmtsSAMapRequests			NA		M	RO
docsBpi2CmtsSAMapReplies			NA		M	RO
docsBpi2CmtsSAMapRejects			NA		M	RO
<b>docsBpi2CmtsAuthEntryTable</b>			NA		M	N-Acc
<b>docsBpi2CmtsAuthEntryEntry</b>			NA		M	N-Acc
docsBpi2CmtsAuthCmMacAddress			NA		M	N-Acc
docsBpi2CmtsAuthCmBpiVersion			NA		M	RO
docsBpi2CmtsAuthCmPublicKey			NA		M	RO
docsBpi2CmtsAuthCmKeySequenceNumber			NA		M	RO
docsBpi2CmtsAuthCmExpiresOld			NA		M	RO
docsBpi2CmtsAuthCmExpiresNew			NA		M	RO
docsBpi2CmtsAuthCmLifetime			NA		M	RW
docsBpi2CmtsAuthCmReset			NA		M	RW
docsBpi2CmtsAuthCmInfos			NA		M	RO
docsBpi2CmtsAuthCmRequests			NA		M	RO
docsBpi2CmtsAuthCmReplies			NA		M	RO
docsBpi2CmtsAuthCmRejects			NA		M	RO
docsBpi2CmtsAuthCmInvalids			NA		M	RO
docsBpi2CmtsAuthRejectErrorCode			NA		M	RO
docsBpi2CmtsAuthRejectErrorString			NA		M	RO
docsBpi2CmtsAuthInvalidErrorCode			NA		M	RO
docsBpi2CmtsAuthInvalidErrorString			NA		M	RO
docsBpi2CmtsAuthPrimarySAId			NA		M	RO
docsBpi2CmtsAuthBpkmcnCertValid			NA		M	RO
docsBpi2CmtsAuthBpkmcnCert			NA		M	RO
docsBpi2CmtsAuthCACertIndexPtr			NA		M	RO
<b>docsBpi2CmtsTEKTable</b>			NA		M	N-Acc
<b>docsBpi2CmtsTEKEEntry</b>			NA		M	N-Acc
docsBpi2CmtsTEKSAAId			NA		M	N-Acc
docsBpi2CmtsTEKSAType			NA		M	RO
docsBpi2CmtsTEKDataEncryptAlg			NA		M	RO
docsBpi2CmtsTEKDataAuthentAlg			NA		M	RO
docsBpi2CmtsTEKLifetime			NA		M	RW
docsBpi2CmtsTEKKeySequenceNumber			NA		M	RO
docsBpi2CmtsTEKExpiresOld			NA		M	RO

docsBpi2CmtsTEKExpiresNew			NA		M	RO
docsBpi2CmtsTEKReset			NA		M	RW
docsBpi2CmtsKeyRequests			NA		M	RO
docsBpi2CmtsKeyReplies			NA		M	RO
docsBpi2CmtsKeyRejects			NA		M	RO
docsBpi2CmtsTEKInvalids			NA		M	RO
docsBpi2CmtsKeyRejectErrorCode			NA		M	RO
docsBpi2CmtsKeyRejectErrorString			NA		M	RO
docsBpi2CmtsTEKInvalidErrorCode			NA		M	RO
docsBpi2CmtsTEKInvalidErrorString			NA		M	RO
<b>docsBpi2CmtslpMulticastMapTable</b>			NA		M	N-Acc
<b>docsBpi2CmtslpMulticastMapEntry</b>			NA		M	N-Acc
docsBpi2CmtslpMulticastIndex			NA		M	N-Acc
docsBpi2CmtslpMulticastAddressType			NA		M	RO
docsBpi2CmtslpMulticastAddress			NA		M	RO
docsBpi2CmtslpMulticastMask			NA		M	RO
docsBpi2CmtslpMulticastSAId			NA		M	RO
docsBpi2CmtslpMulticastSAType			NA		M	RO
docsBpi2CmtslpMulticastDataEncryptAlg			NA		M	RO
docsBpi2CmtslpMulticastDataAuthentAlg			NA		M	RO
docsBpi2CmtslpMulticastSAMapRequests			NA		M	RO
docsBpi2CmtslpMulticastSAMapReplies			NA		M	RO
docsBpi2CmtslpMulticastSAMapRejects			NA		M	RO
docsBpi2CmtslpMulticastSAMapRejectErrorCode			NA		M	RO
docsBpi2CmtslpMulticastSAMapRejectErrorString			NA		M	RO
docsBpi2CmtslpMulticastMapControl			NA		M	RO
docsBpi2CmtslpMulticastMapStorageType			NA		M	RO
<b>docsBpi2CmtsMulticastAuthTable</b>			NA		D	N-Acc
<b>docsBpi2CmtsMulticastAuthEntry</b>			NA		D	N-Acc
docsBpi2CmtsMulticastAuthSAId			NA		D	N-Acc
docsBpi2CmtsMulticastAuthCmMacAddress			NA		D	N-Acc
docsBpi2CmtsMulticastAuthControl			NA		D	RC/RO
<b>docsBpi2CmtsProvisionedCmCertTable</b>			NA		M	N-Acc
<b>docsBpi2CmtsProvisionedCmCertEntry</b>			NA		M	N-Acc
docsBpi2CmtsProvisionedCmCertMacAddress			NA		M	N-Acc
docsBpi2CmtsProvisionedCmCertTrust			NA		M	RC
docsBpi2CmtsProvisionedCmCertSource			NA		M	RO

docsBpi2CmtsProvisionedCmCertStatus			NA		M	RC
docsBpi2CmtsProvisionedCmCert			NA		M	RC
<b>docsBpi2CmtsCACertTable</b>			NA		M	N-Acc
<b>docsBpi2CmtsCACertEntry</b>			NA		M	N-Acc
docsBpi2CmtsCACertIndex			NA		M	N-Acc
docsBpi2CmtsCACertSubject			NA		M	RO
docsBpi2CmtsCACertIssuer			NA		M	RO
docsBpi2CmtsCACertSerialNumber			NA		M	RO
docsBpi2CmtsCACertTrust			NA		M	RC
docsBpi2CmtsCACertSource			NA		M	RO
docsBpi2CmtsCACertStatus			NA		M	RC
docsBpi2CmtsCACert			NA		M	RC
docsBpi2CmtsCACertThumbprint			NA		M	RO
<b>docsBpi2CodeDownloadGroup</b>						
docsBpi2CodeDownloadStatusCode			M	RO	O	RO
docsBpi2CodeDownloadStatusString			M	RO	O	RO
docsBpi2CodeMfgOrgName			M	RO	O	RO
docsBpi2CodeMfgCodeAccessStart			M	RO	O	RO
docsBpi2CodeMfgCvcAccessStart			M	RO	O	RO
docsBpi2CodeCoSignerOrgName			M	RO	O	RO
docsBpi2CodeCoSignerCodeAccessStart			M	RO	O	RO
docsBpi2CodeCoSignerCvcAccessStart			M	RO	O	RO
docsBpi2CodeCvcUpdate			M	RW	O	RW
<b>DOCS-LOADBAL3-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsLoadbal3System</b>						
docsLoadbal3SystemEnable			NA		M	RW
docsLoadbal3SystemEnableError			NA		M	RO
<b>docsLoadbal3ChgOverGroup</b>						
docsLoadbal3ChgOverGroupMacAddress			NA		M	RW
docsLoadbal3ChgOverGroupInitTech			NA		M	RW
docsLoadbal3ChgOverGroupForceUCC			NA		M	RW
docsLoadbal3ChgOverGroupdownFrequency			NA		M	RW
docsLoadbal3ChgOverGroupMdifIndex			NA		M	RW
docsLoadbal3ChgOverGroupRpclId			NA		M	RW
docsLoadbal3ChgOverGroupRccId			NA		M	RW
docsLoadbal3ChgOverGroupUsChSet			NA		M	RW
docsLoadbal3ChgOverGroupServiceFlowInfo			NA		M	RW
docsLoadbal3ChgOverGroupTransactionId			NA		M	RW

docsLoadbal3ChgOverGroupCommit			NA		M	RW
docsLoadbal3ChgOverGroupLastCommit			NA		M	RO
<b>docsLoadbal3ChgOverStatusTable</b>			NA		M	N-Acc
<b>docsLoadbal3ChgOverStatusEntry</b>			NA		M	N-Acc
docsLoadbal3ChgOverStatusId			NA		M	RO
docsLoadbal3ChgOverStatusMacAddr			NA		M	RO
docsLoadbal3ChgOverStatusInitTech			NA		M	RO
docsLoadbal3ChgOverStatusDownFrequency			NA		M	RO
docsLoadbal3ChgOverStatusMdIndex			NA		M	RO
docsLoadbal3ChgOverStatusRpId			NA		M	RO
docsLoadbal3ChgOverStatusRcId			NA		M	RO
docsLoadbal3ChgOverStatusUsChSet			NA		M	RO
docsLoadbal3ChgOverStatusServiceFlowInfo			NA		M	RO
docsLoadbal3ChgOverStatusCmd			NA		M	RO
docsLoadbal3ChgOverStatusTransactionId			NA		M	RO
docsLoadbal3ChgOverStatusValue			NA		M	RO
docsLoadbal3ChgOverStatusUpdate			NA		M	RO
<b>docsLoadbal3CmtsCmParamsTable</b>			NA		M	N-Acc
<b>docsLoadbal3CmtsCmParamsEntry</b>			NA		M	N-Acc
docsLoadbal3CmtsCmParamsProvGrpId			NA		M	RW/RO
docsLoadbal3CmtsCmParamsCurrentGrpId			NA		M	RO
docsLoadbal3CmtsCmParamsProvServiceType1D			NA		M	RW/RO
docsLoadbal3CmtsCmParamsCurrentServiceType1D			NA		M	RO
docsLoadbal3CmtsCmParamsPolicyId			NA		M	RW/RO
docsLoadbal3CmtsCmParamsPriority			NA		M	RW/RO
<b>docsLoadbal3GeneralGrpDefaults</b>						
docsLoadbal3GeneralGrpDefaultsEnable			NA		M	RW
docsLoadbal3GeneralGrpDefaultsPolicyId			NA		M	RW
docsLoadbal3GeneralGrpDefaultsInitTech			NA		M	RW
<b>docsLoadbal3GeneralGrpCfgTable</b>			NA		M	N-Acc
<b>docsLoadbal3GeneralGrpCfgEntry</b>			NA		M	N-Acc
docsLoadbal3GeneralGrpCfgNodeName			NA		M	N-Acc
docsLoadbal3GeneralGrpCfgEnable			NA		M	RW
docsLoadbal3GeneralGrpCfgPolicyId			NA		M	RW
docsLoadbal3GeneralGrpCfgInitTech			NA		M	RW
<b>docsLoadbal3ResGrpCfgTable</b>			NA		M	N-Acc
<b>docsLoadbal3ResGrpCfgEntry</b>			NA		M	N-Acc

docsLoadbal3ResGrpCfgId			NA		M	N-Acc
docsLoadbal3ResGrpCfgMdIfIndex			NA		M	RC
docsLoadbal3ResGrpCfgDsChList			NA		M	RC
docsLoadbal3ResGrpCfgUsChList			NA		M	RC
docsLoadbal3ResGrpCfgEnable			NA		M	RC
docsLoadbal3ResGrpCfgInitTech			NA		M	RC
docsLoadbal3ResGrpCfgPolicyId			NA		M	RC
docsLoadbal3ResGrpCfgServiceTypeid			NA		M	RC
docsLoadbal3ResGrpCfgStatus			NA		M	RC
<b>docsLoadbal3GrpStatusTable</b>			NA		M	N-Acc
<b>docsLoadbal3GrpStatusEntry</b>			NA		M	N-Acc
docsLoadbal3GrpStatusId			NA		M	N-Acc
docsLoadbal3GrpStatusCfgIdOrZero			NA		M	RO
docsLoadbal3GrpStatusMdIfIndex			NA		M	RO
docsLoadbal3GrpStatusMdCmSgId			NA		M	RO
docsLoadbal3GrpStatusDsChList			NA		M	RO
docsLoadbal3GrpStatusUsChList			NA		M	RO
docsLoadbal3GrpStatusEnable			NA		M	RO
docsLoadbal3GrpStatusInitTech			NA		M	RO
docsLoadbal3GrpStatusPolicyId			NA		M	RO
docsLoadbal3GrpStatusChgOverSuccess			NA		M	RO
docsLoadbal3GrpStatusChgOverFails			NA		M	RO
<b>docsLoadbal3RestrictCmCfgTable</b>			NA		M	N-Acc
<b>docsLoadbal3RestrictCmCfgEntry</b>			NA		M	N-Acc
docsLoadbal3RestrictCmCfgId			NA		M	N-Acc
docsLoadbal3RestrictCmCfgMacAddr			NA		M	RC
docsLoadbal3RestrictCmCfgMacAddrMask			NA		M	RC
docsLoadbal3RestrictCmCfgGrpId			NA		M	RC
docsLoadbal3RestrictCmCfgServiceTypeid			NA		M	RC
docsLoadbal3RestrictCmCfgStatus			NA		M	RC
<b>docsLoadbal3PolicyTable</b>			NA		M	N-Acc
<b>docsLoadbal3PolicyEntry</b>			NA		M	N-Acc
docsLoadbal3PolicyId			NA		M	N-Acc
docsLoadbal3PolicyRuleId			NA		M	N-Acc
docsLoadbal3PolicyPtr			NA		M	RC
docsLoadbal3PolicyRowStatus			NA		M	RC
<b>docsLoadbal3BasicRuleTable</b>			NA		M	N-Acc
<b>docsLoadbal3BasicRuleEntry</b>			NA		M	N-Acc
docsLoadbal3BasicRuleId			NA		M	N-Acc

docsLoadbal3BasicRuleEnable			NA		M	RC
docsLoadbal3BasicRuleDisStart			NA		M	RC
docsLoadbal3BasicRuleDisPeriod			NA		M	RC
docsLoadbal3BasicRuleRowStatus			NA		M	RC
<b>DOCS-IFEXT2-MIB (Annex H)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIfExt2CmMscStatusTable</b>			M	N-Acc	NA	
<b>docsIfExt2CmMscStatusEntry</b>			M	N-Acc	NA	
docsIfExt2CmMscStatusState			M	RO	NA	
docsIfExt2CmMscStatusPowerShortfall			M	RO	NA	
docsIfExt2CmMscStatusCodeRatio			M	RO	NA	
docsIfExt2CmMscStatusMaximumScheduledCodes			M	RO	NA	
docsIfExt2CmMscStatusPowerHeadroom			M	RO	NA	
docsIfExt2CmMscStatusEffectivePower			M	RO	NA	
docsIfExt2CmMscStatusIUC2Control			M	RW	NA	
docsIfExt2CmClearLearnedMacAddresses			M	RW	NA	
<b>docsIfExt2CmtsObjects</b>						
docsIfExt2CmtsMscGlobalEnable			NA		M	RW
<b>docsIfExt2CmtsCmMscStatusTable</b>			NA		O	N-Acc
<b>docsIfExt2CmtsCmMscStatusEntry</b>			NA		O	N-Acc
docsIfExt2CmtsCmMscStatusPowerShortfall			NA		O	RO
docsIfExt2CmtsCmMscStatusCodeRatio			NA		O	RO
docsIfExt2CmtsCmMscStatusMaximumScheduledCodes			NA		O	RO
docsIfExt2CmtsCmMscStatusPowerHeadroom			NA		O	RO
docsIfExt2CmtsCmMscStatusMeasuredSNR			NA		O	RO
docsIfExt2CmtsCmMscStatusEffectiveSNR			NA		O	RO
<b>docsIfExt2CmtsUpChannelMscTable</b>			NA		O	N-Acc
<b>docsIfExt2CmtsUpChannelMscEntry</b>			NA		O	N-Acc
docsIfExt2CmtsUpChannelMscState			NA		O	RW
docsIfExt2CmtsUpChannelMSCTotalCMs			NA		O	RO
docsIfExt2CmtsUpChannelMSCLimitIUC1			NA		O	RO
docsIfExt2CmtsUpChannelMSCMinimumValue			NA		O	RW
<b>docsIfExt2CmtsUpChannelTable</b>			NA		O	N-Acc
<b>docsIfExt2CmtsUpChannelEntry</b>			NA		O	N-Acc
docsIfExt2CmtsUpChannelTotalCMs			NA		O	RO

<b>HOST-RESOURCES-MIB [RFC 2790]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>hrDeviceTable</b>			O	N-Acc	O	N-Acc
<b>hrDeviceEntry</b>			O	N-Acc	O	N-Acc
hrDeviceIndex			O	RO	O	RO
hrDeviceType			O	RO	O	RO
hrDeviceDescr			O	RO	O	RO
hrDeviceID			O	RO	O	RO
hrDeviceStatus			O	RO	O	RO
hrDeviceErrors			O	RO	O	RO
<b>hrSystem</b>						
hrMemorySize			O	RO	O	RO
<b>hrStorageTable</b>			O	N-Acc	O	N-Acc
<b>hrStorageEntry</b>			O	N-Acc	O	N-Acc
hrStorageIndex			O	RO	O	RO
hrStorageType			O	RO	O	RO
hrStorageDescr			O	RO	O	RO
hrStorageAllocationUnits			O	RO	O	RO
hrStorageSize			O	RO	O	RO
hrStorageUsed			O	RO	O	RO
hrStorageAllocationFailures			O	RO	O	RO
<b>hrSWRunTable</b>			O	N-Acc	O	N-Acc
<b>hrSWRunEntry</b>			O	N-Acc	O	N-Acc
hrSWRunIndex			O	RO	O	RO
hrSWRunName			O	RO	O	RO
hrSWRunID			O	RO	O	RO
hrSWRunPath			O	RO	O	RO
hrSWRunParameters			O	RO	O	RO
hrSWRunType			O	RO	O	RO
hrSWRunStatus			O	RO	O	RO
<b>hrSWRunPerfTable</b>			O	N-Acc	O	N-Acc
<b>hrSWRunPerfEntry</b>			O	N-Acc	O	N-Acc
hrSWRunIndex			O	N-Acc	O	N-Acc
hrSWRunPerfCPU			O	RO	O	RO
hrSWRunPerfMem			O	RO	O	RO
<b>hrProcessorTable</b>			O	N-Acc	O	N-Acc
<b>hrProcessorEntry</b>			O	N-Acc	O	N-Acc
hrProcessorFwID			O	RO	O	RO
hrProcessorLoad			O	RO	O	RO

<b>ENTITY-MIB [RFC 4133]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>entPhysicalTable</b>			O		O	N-Acc
<b>entPhysicalEntry</b>			O		O	N-Acc
entPhysicalIndex			O		O	N-Acc
entPhysicalDescr			O		O	RO
entPhysicalVendorType			O		O	RO
entPhysicalContainedIn			O		O	RO
entPhysicalClass			O		O	RO
entPhysicalParentRelPos			O		O	RO
entPhysicalName			O		O	RO
entPhysicalHardwareRev			O		O	RO
entPhysicalFirmwareRev			O		O	RO
entPhysicalSoftwareRev			O		O	RO
entPhysicalSerialNum			O		O	RO/RW
entPhysicalMfgName			O		O	RO
entPhysicalModelName			O		O	RO
entPhysicalAlias			O		O	RO/RW
entPhysicalAssetID			O		O	RO/RW
entPhysicalIsFRU			O		O	RO
entPhysicalMfgDate			O		O	RO
entPhysicalUrIs			O		O	RW
<b>entLogicalTable</b>			NA		O	N-Acc
<b>entLogicalEntry</b>			NA		O	N-Acc
entLogicalIndex			NA		O	N-Acc
entLogicalDescr			NA		O	RO
entLogicalType			NA		O	RO
entLogicalCommunity			NA		D	RO
entLogicalTAddress			NA		O	RO
entLogicalTDomain			NA		O	RO
entLogicalContextEngineID			NA		O	RO
entLogicalContextName			NA		O	RO
<b>entLPMappingTable</b>			NA		O	N-Acc
<b>entLPMappingEntry</b>			NA		O	N-Acc
entLPPhysicalIndex			NA		O	RO
<b>entAliasMappingTable</b>			NA		O	N-Acc
<b>entAliasMappingEntry</b>			NA		O	N-Acc
entAliasLogicalIndexOrZero			NA		O	N-Acc
entAliasMappingIdentifier			NA		O	RO

<b>entPhysicalContainsTable</b>			NA		O	N-Acc
<b>entPhysicalContainsEntry</b>			NA		O	N-Acc
entPhysicalChildIndex			NA		O	RO
<b>General Group</b>						
entLastChangeTime			NA		O	RO
<b>Notification</b>						
entConfigChange			NA		O	Acc-FN
<b>ENTITY-SENSOR-MIB [RFC 3433]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>entPhySensorTable</b>			O	N-Acc	O	N-Acc
<b>entPhySensorEntry</b>			O	N-Acc	O	N-Acc
entPhySensorType			O	RO	O	RO
entPhySensorScale			O	RO	O	RO
entPhySensorPrecision			O	RO	O	RO
entPhySensorValue			O	RO	O	RO
entPhySensorOperStatus			O	RO	O	RO
entPhySensorUnitsDisplay			O	RO	O	RO
entPhySensorValueTimeStamp			O	RO	O	RO
entPhySensorValueUpdateRate			O	RO	O	RO
<b>SNMP-USM-DH-OBJECTS-MIB [RFC 2786]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
usmDHParameters	N-Sup		M	RW	O	RW
<b>usmDHUserKeyTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>usmDHUserKeyEntry</b>	N-Sup		M	N-Acc	O	N-Acc
usmDHUserAuthKeyChange	N-Sup		M	RC	O	RC
usmDHUserOwnAuthKeyChange	N-Sup		M	RC	O	RC
usmDHUserPrivKeyChange	N-Sup		M	RC	O	RC
usmDHUserOwnPrivKeyChange	N-Sup		M	RC	O	RC
<b>usmDHKickstartTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>usmDHKickstartEntry</b>	N-Sup		M	N-Acc	O	N-Acc
usmDHKickstartIndex	N-Sup		M	N-Acc	O	N-Acc
usmDHKickstartMyPublic	N-Sup		M	RO	O	RO
usmDHKickstartMgrPublic	N-Sup		M	RO	O	RO
usmDHKickstartSecurityName	N-Sup		M	RO	O	RO

<b>SNMP-VIEW-BASED-ACM-MIB [RFC 3415]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>vacmContextTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmContextEntry</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmContextName</b>	N-Sup		M	RO	O	RO
<b>vacmSecurityToGroupTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmSecurityToGroupEntry</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmSecurityModel</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmSecurityName</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmGroupName</b>	N-Sup		M	RC	O	RC
<b>vacmSecurityToGroupStorageType</b>	N-Sup		M	RC	O	RC
<b>vacmSecurityToGroupStatus</b>	N-Sup		M	RC	O	RC
<b>vacmAccessTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmAccessEntry</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmAccessContextPrefix</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmAccessSecurityModel</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmAccessSecurityLevel</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmAccessContextMatch</b>	N-Sup		M	RC	O	RC
<b>vacmAccessReadViewName</b>	N-Sup		M	RC	O	RC
<b>vacmAccessWriteViewName</b>	N-Sup		M	RC	O	RC
<b>vacmAccessNotifyViewName</b>	N-Sup		M	RC	O	RC
<b>vacmAccessStorageType</b>	N-Sup		M	RC	O	RC
<b>vacmAccessStatus</b>	N-Sup		M	RC	O	RC
<b>vacmViewSpinLock</b>	N-Sup		M	RW	O	RW
<b>vacmViewTreeFamilyTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmViewTreeFamilyEntry</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmViewTreeFamilyViewName</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmViewTreeFamilySubtree</b>	N-Sup		M	N-Acc	O	N-Acc
<b>vacmViewTreeFamilyMask</b>	N-Sup		M	RC	O	RC
<b>vacmViewTreeFamilyType</b>	N-Sup		M	RC	O	RC
<b>vacmViewTreeFamilyStorageType</b>	N-Sup		M	RC	O	RC
<b>vacmViewTreeFamilyStatus</b>	N-Sup		M	RC	O	RC
<b>SNMP-COMMUNITY-MIB [RFC 3584]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>snmpCommunityTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpCommunityEntry</b>	N-Sup		M	N-Acc	M	N-Acc

<b>snmpCommunityIndex</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpCommunityName</b>	N-Sup		M	RC	M	RC
<b>snmpCommunitySecurityName</b>	N-Sup		M	RC	M	RC
<b>snmpCommunityContextEngineID</b>	N-Sup		M	RC	M	RC
<b>snmpCommunityContextName</b>	N-Sup		M	RC	M	RC
<b>snmpCommunityTransportTag</b>	N-Sup		M	RC	M	RC
<b>snmpCommunityStorageType</b>	N-Sup		M	RC	M	RC
<b>snmpCommunityStatus</b>	N-Sup		M	RC	M	RC
<b>snmpTargetAddrExtTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetAddrExtEntry</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetAddrTMask</b>	N-Sup		M	RC	M	RC
<b>snmpTargetAddrMMS</b>	N-Sup		M	RC	M	RC
<b>snmpTrapAddress</b>	N-Sup		O	ACC-FN	O	ACC-FN
<b>snmpTrapCommunity</b>	N-Sup		O	ACC-FN	O	ACC-FN
<b>SNMP-FRAMEWORK-MIB [RFC 3411]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>snmpEngineGroup</b>						
<b>snmpEngineID</b>	N-Sup		M	RO	M	RO
<b>snmpEngineBoots</b>	N-Sup		M	RO	M	RO
<b>snmpEngineTime</b>	N-Sup		M	RO	M	RO
<b>snmpEngineMaxMessageSize</b>	N-Sup		M	RO	M	RO
<b>SNMP-MPD-MIB [RFC 3412]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>snmpMPDStats</b>						
<b>snmpUnknownSecurityModels</b>	N-Sup		M	RO	M	RO
<b>snmpInvalidMsgs</b>	N-Sup		M	RO	M	RO
<b>snmpUnknownPDUHandlers</b>	N-Sup		M	RO	M	RO
<b>SNMP Applications [RFC 3413]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>snmpTargetSpinLock</b>	N-Sup		M	RW	M	RW
<b>snmpTargetAddrTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetAddrEntry</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetAddrName</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetAddrTDomain</b>	N-Sup		M	RC	M	RC
<b>snmpTargetAddrTAddress</b>	N-Sup		M	RC	M	RC

snmpTargetAddrTimeout	N-Sup		M	RC	M	RC
snmpTargetAddrRetryCount	N-Sup		M	RC	M	RC
snmpTargetAddrTagList	N-Sup		M	RC	M	RC
snmpTargetAddrParams	N-Sup		M	RC	M	RC
snmpTargetAddrStorageType	N-Sup		M	RC	M	RC
snmpTargetAddrRowStatus	N-Sup		M	RC	M	RC
<b>snmpTargetParamsTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpTargetParamsEntry</b>	N-Sup		M	N-Acc	M	N-Acc
snmpTargetParamsName	N-Sup		M	N-Acc	M	N-Acc
snmpTargetParamsMPModel	N-Sup		M	RC	M	RC
snmpTargetParamsSecurityModel	N-Sup		M	RC	M	RC
snmpTargetParamsSecurityName	N-Sup		M	RC	M	RC
snmpTargetParamsSecurityLevel	N-Sup		M	RC	M	RC
snmpTargetParamsStorageType	N-Sup		M	RC	M	RC
snmpTargetParamsRowStatus	N-Sup		M	RC	M	RC
snmpUnavailableContexts	N-Sup		M	RO	M	RO
snmpUnknownContexts	N-Sup		M	RO	M	RO
<b>snmpNotifyTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpNotifyEntry</b>	N-Sup		M	N-Acc	M	N-Acc
snmpNotifyName	N-Sup		M	N-Acc	M	N-Acc
snmpNotifyTag	N-Sup		M	RC	M	RC
snmpNotifyType	N-Sup		M	RC	M	RC
snmpNotifyStorageType	N-Sup		M	RC	M	RC
snmpNotifyRowStatus	N-Sup		M	RC	M	RC
<b>snmpNotifyFilterProfileTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpNotifyFilterProfileEntry</b>	N-Sup		M	N-Acc	M	N-Acc
snmpNotifyFilterProfileName	N-Sup		M	RC	M	RC
snmpNotifyFilterProfileStorType	N-Sup		M	RC	M	RC
snmpNotifyFilterProfileRowStatus	N-Sup		M	RC	M	RC
<b>snmpNotifyFilterTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>snmpNotifyFilterEntry</b>	N-Sup		M	N-Acc	M	N-Acc
snmpNotifyFilterSubtree	N-Sup		M	N-Acc	M	N-Acc
snmpNotifyFilterMask	N-Sup		M	RC	M	RC
snmpNotifyFilterType	N-Sup		M	RC	M	RC
snmpNotifyFilterStorageType	N-Sup		M	RC	M	RC
snmpNotifyFilterRowStatus	N-Sup		M	RC	M	RC

<b>SNMP-USER-BASED-SM-MIB [RFC 3414]</b>						
<b>Object</b>	<b>CM in NmAccess Mode</b>	<b>Access</b>	<b>CM in SNMP Coexistence Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>usmStats</b>						
usmStatsUnsupportedSecLevels	N-Sup		M	RO	O	RO
usmStatsNotInTimeWindows	N-Sup		M	RO	O	RO
usmStatsUnknownUserNames	N-Sup		M	RO	O	RO
usmStatsUnknownEngineIDs	N-Sup		M	RO	O	RO
usmStatsWrongDigests	N-Sup		M	RO	O	RO
usmStatsDecryptionErrors	N-Sup		M	RO	O	RO
<b>usmUser</b>						
usmUserSpinLock	N-Sup		M	RW	O	RW
<b>usmUserTable</b>	N-Sup		M	N-Acc	O	N-Acc
<b>usmUserEntry</b>	N-Sup		M	N-Acc	O	N-Acc
usmUserEngineID	N-Sup		M	N-Acc	O	N-Acc
usmUserName	N-Sup		M	N-Acc	O	N-Acc
usmUserSecurityName	N-Sup		M	RO	O	RO
usmUserCloneFrom	N-Sup		M	RC	O	RC
usmUserAuthProtocol	N-Sup		M	RC	O	RC
usmUserAuthKeyChange	N-Sup		M	RC	O	RC
usmUserOwnAuthKeyChange	N-Sup		M	RC	O	RC
usmUserPrivProtocol	N-Sup		M	RC	O	RC
usmUserPrivKeyChange	N-Sup		M	RC	O	RC
usmUserOwnPrivKeyChange	N-Sup		M	RC	O	RC
usmUserPublic	N-Sup		M	RC	O	RC
usmUserStorageType	N-Sup		M	RC	O	RC
usmUserStatus	N-Sup		M	RC	O	RC
<b>IGMP-STD-MIB [RFC 2933]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>igmplInterfaceTable</b>			M	N-Acc	NA	
<b>igmplInterfaceEntry</b>			M	N-Acc	NA	
igmplInterfaceIndex			M	N-Acc	NA	
igmplInterfaceQueryInterval			M	RC	NA	
igmplInterfaceStatus			M	RC	NA	
igmplInterfaceVersion			M	RO	NA	
igmplInterfaceQuerier			M	RO	NA	
igmplInterfaceQueryMaxResponseTime			M	RC	NA	
igmplInterfaceQuerierUpTime			M	RO	NA	

igmpInterfaceQuerierExpiryTime			M	RO	NA	
igmpInterfaceVersion1QuerierTimer			M	RO	NA	
igmpInterfaceWrongVersionQueries			M	RO	NA	
igmpInterfaceJoins			M	RO	NA	
igmpInterfaceProxyIfIndex			M	RO	NA	
igmpInterfaceGroups			M	RO	NA	
igmpInterfaceRobustness			M	RC	NA	
igmpInterfaceLastMembQueryIntvl			M	RC	NA	
<b>igmpCacheTable</b>			M	N-Acc	NA	
<b>igmpCacheEntry</b>			M	N-Acc	NA	
igmpCacheAddress			M	N-Acc	NA	
igmpCacheIfIndex			M	N-Acc	NA	
igmpCacheSelf			M	RC	NA	
igmpCacheLastReporter			M	RO	NA	
igmpCacheUpTime			M	RO	NA	
igmpCacheExpiryTime			M	RO	NA	
igmpCacheStatus			M	RO	NA	
igmpCacheVersion1HostTimer			M	RO	NA	
<b>MGMD-STD-MIB [RFC 5519]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>mgmdRouterInterfaceTable</b>			NA		M	N-Acc
<b>mgmdRouterInterfaceEntry</b>			NA		M	N-Acc
mgmdRouterInterfaceIfIndex			NA		M	N-Acc
mgmdRouterInterfaceQuerierType			NA		M	N-Acc
mgmdRouterInterfaceQuerier			NA		M	RO
mgmdRouterInterfaceQueryInterval			NA		M	RC
mgmdRouterInterfaceStatus			NA		M	RC
mgmdRouterInterfaceVersion			NA		M	RC
mgmdRouterInterfaceQueryMaxResponseTime			NA		M	RC
mgmdRouterInterfaceQuerierUpTime			NA		M	RO
mgmdRouterInterfaceQuerierExpiryTime			NA		M	RO
mgmdRouterInterfaceWrongVersionQueries			NA		M	RO
mgmdRouterInterfaceJoins			NA		M	RO
mgmdRouterInterfaceProxyIfIndex			NA		M	RO/RC
mgmdRouterInterfaceGroups			NA		M	RO
mgmdRouterInterfaceRobustness			NA		M	RC
mgmdRouterInterfaceLastMemberQueryInterval			NA		M	RC
mgmdRouterInterfaceLastMemberQueryCount			NA		M	RO
mgmdRouterInterfaceStartupQueryCount			NA		M	RO

<b>mgmdRouterInterfaceStartupQueryInterval</b>			NA		M	RO
<b>mgmdRouterCacheTable</b>			NA		M	N-Acc
<b>mgmdRouterCacheEntry</b>			NA		M	N-Acc
<b>mgmdRouterCacheAddressType</b>			NA		M	N-Acc
<b>mgmdRouterCacheAddress</b>			NA		M	N-Acc
<b>mgmdRouterCacheIfIndex</b>			NA		M	N-Acc
<b>mgmdRouterCacheLastReporter</b>			NA		M	RO
<b>mgmdRouterCacheUpTime</b>			NA		M	RO
<b>mgmdRouterCacheExpiryTime</b>			NA		M	RO
<b>mgmdRouterCacheExcludeModeExpiryTimer</b>			NA		M	RO
<b>mgmdRouterCacheVersion1HostTimer</b>			NA		M	RO
<b>mgmdRouterCacheVersion2HostTimer</b>			NA		M	RO
<b>mgmdRouterCacheSourceFilterMode</b>			NA		M	RO
<b>mgmDIverseRouterCacheTable</b>			NA		M	N-Acc
<b>mgmDIverseRouterCacheEntry</b>			NA		M	N-Acc
<b>mgmDIverseRouterCacheIfIndex</b>			NA		M	N-Acc
<b>mgmDIverseRouterCacheAddressType</b>			NA		M	N-Acc
<b>mgmDIverseRouterCacheAddress</b>			NA		M	RO
<b>mgmdRouterSrcListTable</b>			NA		M	N-Acc
<b>mgmdRouterSrcListEntry</b>			NA		M	N-Acc
<b>mgmdRouterSrcListAddressType</b>			NA		M	N-Acc
<b>mgmdRouterSrcListAddress</b>			NA		M	N-Acc
<b>mgmdRouterSrcListIfIndex</b>			NA		M	N-Acc
<b>mgmdRouterSrcListHostAddress</b>			NA		M	N-Acc
<b>mgmdRouterSrcListExpire</b>			NA		M	RO
<b>DOCS-DIAG-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsDiagLogGlobal</b>						
docsDiagLogMaxSize			NA		M	RW
docsDiagLogCurrentSize			NA		M	RO
docsDiagLogNotifyLogSizeHighThrshld			NA		M	RW
docsDiagLogNotifyLogSizeLowThrshld			NA		M	RW
docsDiagLogAging			NA		M	RW
docsDiagLogResetAll			NA		M	RW
docsDiagLogLastResetTime			NA		M	RO
docsDiagLogClearAll			NA		M	RW
docsDiagLogLastClearTime			NA		M	RO
docsDiagLogNotifCtrl			NA		M	RW
<b>docsDiagLogTriggersCfg</b>						

<b>docsDiagLogIncludeTriggers</b>			NA		M	RW
<b>docsDiagLogEnableAgingTriggers</b>			NA		M	RW
<b>docsDiagLogRegTimeInterval</b>			NA		M	RW
<b>docsDiagLogRegDetail</b>			NA		M	RW
<b>docsDiagLogRangingRetryType</b>			NA		M	RW
<b>docsDiagLogRangingRetryThrlId</b>			NA		M	RW
<b>docsDiagLogRangingRetryStationMaintNum</b>			NA		M	RW
<b>docsDiagLogTable</b>			NA		M	N-Acc
<b>docsDiagLogEntry</b>			NA		M	N-Acc
<b>docsDiagLogCmMacAddr</b>			NA		M	RO
<b>docsDiagLogLastUpdateTime</b>			NA		M	RO
<b>docsDiagLogCreateTime</b>			NA		M	RO
<b>docsDiagLogLastRegTime</b>			NA		M	RO
<b>docsDiagLogRegCount</b>			NA		M	RO
<b>docsDiagLogRangingRetryCount</b>			NA		M	RO
<b>docsDiagLogDetailTable</b>			NA		M	N-Acc
<b>docsDiagLogDetailEntry</b>			NA		M	N-Acc
<b>docsDiagLogDetailTypeValue</b>			NA		M	N-Acc
<b>docsDiagLogDetailCount</b>			NA		M	RO
<b>docsDiagLogDetailLastUpdate</b>			NA		M	RO
<b>docsDiagLogDetailLastErrorText</b>			NA		M	RO
<b>Notifications</b>						
<b>docsDiagLogSizeHighThrshldReached</b>			NA		M	Notif
<b>docsDiagLogSizeLowThrshldReached</b>			NA		M	Notif
<b>docsDiagLogSizeFull</b>			NA		M	Notif
<b>DOCS-QOS3-MIB (Annex Q)</b>						
Object	CM in DOCSIS 1.0 CoS mode	Access	CM in DOCSIS 1.1 QoS Mode	Access	CMTS	Access
<b>docsQosPktClassTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosPktClassEntry</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosPktClassId</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosPktClassDirection</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassPriority</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpTosLow</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpTosHigh</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpTosMask</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpProtocol</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpSourceAddr</b>	N-Sup		M	RO	M	RO
<b>docsQosPktClassIpSourceMask</b>	N-Sup		M	RO	M	RO

docsQosPktClassIpDestAddr	N-Sup		M	RO	M	RO
docsQosPktClassIpDestMask	N-Sup		M	RO	M	RO
docsQosPktClassSourcePortStart	N-Sup		M	RO	M	RO
docsQosPktClassSourcePortEnd	N-Sup		M	RO	M	RO
docsQosPktClassDestPortStart	N-Sup		M	RO	M	RO
docsQosPktClassDestPortEnd	N-Sup		M	RO	M	RO
docsQosPktClassDestMacAddr	N-Sup		M	RO	M	RO
docsQosPktClassDestMacMask	N-Sup		M	RO	M	RO
docsQosPktClassSourceMacAddr	N-Sup		M	RO	M	RO
docsQosPktClassEnetProtocolType	N-Sup		M	RO	M	RO
docsQosPktClassEnetProtocol	N-Sup		M	RO	M	RO
docsQosPktClassUserPriLow	N-Sup		M	RO	M	RO
docsQosPktClassUserPriHigh	N-Sup		M	RO	M	RO
docsQosPktClassVlanId	N-Sup		M	RO	M	RO
docsQosPktClassState	N-Sup		M	RO	M	RO
docsQosPktClassPkts	N-Sup		M	RO	M	RO
docsQosPktClassBitMap	N-Sup		M	RO	M	RO
docsQosPktClassIpAddrType	N-Sup		M	RO	M	RO
docsQosPktClassFlowLabel	N-Sup		M	RO	M	RO
docsQosPktClassIcmpTypeHigh	N-Sup		M	RO	M	RO
docsQosPktClassIcmpTypeLow	N-Sup		M	RO	M	RO
docsQosPktClassCmInterfaceMask	N-Sup		M	RO	M	RO
<b>docsQosParamSetTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosParamSetEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosParamSetServiceClassName	N-Sup		M	RO	M	RO
docsQosParamSetPriority	N-Sup		M	RO	M	RO
docsQosParamSetMaxTrafficRate	N-Sup		M	RO	M	RO
docsQosParamSetMaxTrafficBurst	N-Sup		M	RO	M	RO
docsQosParamSetMinReservedRate	N-Sup		M	RO	M	RO
docsQosParamSetMinReservedPkt	N-Sup		M	RO	M	RO
docsQosParamSetActiveTimeout	N-Sup		M	RO	M	RO
docsQosParamSetAdmittedTimeout	N-Sup		M	RO	M	RO
docsQosParamSetMaxConcatBurst	N-Sup		M	RO	M	RO
docsQosParamSetSchedulingType	N-Sup		M	RO	M	RO
docsQosParamSetNomPollInterval	N-Sup		M	RO	M	RO
docsQosParamSetTolPollJitter	N-Sup		M	RO	M	RO
docsQosParamSetUnsolicitGrantSize	N-Sup		M	RO	M	RO
docsQosParamSetNomGrantInterval	N-Sup		M	RO	M	RO
docsQosParamSetTolGrantJitter	N-Sup		M	RO	M	RO

docsQosParamSetGrantsPerInterval	N-Sup		M	RO	M	RO
docsQosParamSetTosAndMask	N-Sup		M	RO	M	RO
docsQosParamSetTosOrMask	N-Sup		M	RO	M	RO
docsQosParamSetMaxLatency	N-Sup		M	RO	M	RO
docsQosParamSetType	N-Sup		M	N-Acc	M	N-Acc
docsQosParamSetRequestPolicyOct	N-Sup		M	RO	M	RO
docsQosParamSetBitMap	N-Sup		M	RO	M	RO
docsQosParamSetServiceFlowId	N-Sup		M	N-Acc	M	N-Acc
docsQosParamSetRequiredAttrMask	N-Sup		M	RO	M	RO
docsQosParamSetForbiddenAttrMask	N-Sup		M	RO	M	RO
docsQosParamSetAttrAggrRuleMask	N-Sup		M	RO	M	RO
docsQosParamSetAppId	N-Sup		M	RO	M	RO
docsQosParamSetMultiplierContentionReqWindow	N-Sup		M	RO	M	RO
docsQosParamSetMultiplierBytesReq	N-Sup		M	RO	M	RO
docsQosParamSetMaxReqPerSidCluster	N-Sup		D	RO	D	RO
docsQosParamSetMaxOutstandingBytesPerSidCluster	N-Sup		D	RO	D	RO
docsQosParamSetMaxTotBytesReqPerSidCluster	N-Sup		D	RO	D	RO
docsQosParamSetMaxTimeInSidCluster	N-Sup		D	RO	D	RO
docsQosParamSetPeakTrafficRate	N-Sup		M	RO	M	RO
docsQosParamSetDsResequencing	N-Sup		M	RO	M	RO
docsQosParamSetMinimumBuffer	N-Sup		M	RO	M	RO
docsQosParamSetTargetBuffer	N-Sup		M	RO	M	RO
docsQosParamSetMaximumBuffer	N-Sup		M	RO	M	RO
<b>docsQosServiceFlowTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosServiceFlowEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowId	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowSID	N-Sup		M	RO	M	RO
docsQosServiceFlowDirection	N-Sup		M	RO	M	RO
docsQosServiceFlowPrimary	N-Sup		M	RO	M	RO
docsQosServiceFlowParamSetTypeStatus	N-Sup		M	RO	M	RO
docsQosServiceFlowChSetId	N-Sup		M	RO	M	RO
docsQosServiceFlowAttrAssignSuccess	N-Sup		M	RO	M	RO
docsQosServiceFlowDsid	N-Sup		M	RO	M	RO
docsQosServiceFlowMaxReqPerSidCluster	N-Sup		M	RO	M	RO
docsQosServiceFlowMaxOutstandingBytesPerSidCluster	N-Sup		M	RO	M	RO
docsQosServiceFlowMaxTotBytesReqPerSidCluster	N-Sup		M	RO	M	RO

docsQosServiceFlowMaxTimeInSidCluster	N-Sup		M	RO	M	RO
docsQosServiceFlowBufferSize	N-Sup		M	RO	O	RO
<b>docsQosServiceFlowStatsTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosServiceFlowStatsEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowPkts	N-Sup		M	RO	M	RO
docsQosServiceFlowOctets	N-Sup		M	RO	M	RO
docsQosServiceFlowTimeCreated	N-Sup		M	RO	M	RO
docsQosServiceFlowTimeActive	N-Sup		M	RO	M	RO
docsQosServiceFlowPHSUnknowns	N-Sup		M	RO	M	RO
docsQosServiceFlowPolicedDropPkts	N-Sup		M	RO	M	RO
docsQosServiceFlowPolicedDelayPkts	N-Sup		M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosUpstreamStatsTable</b>			NA		M	N-Acc
<b>docsQosUpstreamStatsEntry</b>			NA		M	N-Acc
docsQoSID			NA		M	N-Acc
docsQosUpstreamFragments			NA		M	RO
docsQosUpstreamFragDiscards			NA		M	RO
docsQosUpstreamConcatBursts			NA		M	RO
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosDynamicServiceStatsTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosDynamicServiceStatsEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosIfDirection	N-Sup		M	N-Acc	M	N-Acc
docsQosDSAReqs	N-Sup		M	RO	M	RO
docsQosDSARspS	N-Sup		M	RO	M	RO
docsQosDSAAcks	N-Sup		M	RO	M	RO
docsQosDSCReqs	N-Sup		M	RO	M	RO
docsQosDSCRspS	N-Sup		M	RO	M	RO
docsQosDSCAcks	N-Sup		M	RO	M	RO
docsQosDSDReqs	N-Sup		M	RO	M	RO
docsQosDSDRspS	N-Sup		M	RO	M	RO
docsQosDynamicAdds	N-Sup		M	RO	M	RO
docsQosDynamicAddFails	N-Sup		M	RO	M	RO
docsQosDynamicChanges	N-Sup		M	RO	M	RO
docsQosDynamicChangeFails	N-Sup		M	RO	M	RO
docsQosDynamicDeletes	N-Sup		M	RO	M	RO
docsQosDynamicDeleteFails	N-Sup		M	RO	M	RO
docsQosDCCReqs	N-Sup		M	RO	M	RO
docsQosDCCRspS	N-Sup		M	RO	M	RO

docsQosDCCAcks	N-Sup		M	RO	M	RO
docsQosDCCCs	N-Sup		M	RO	M	RO
docsQosDCCFails	N-Sup		M	RO	M	RO
docsQosDCCRspDeparts	N-Sup		M	RO	M	RO
docsQosDCCRspArrives	N-Sup		M	RO	M	RO
docsQosDbcReqs	N-Sup		M	RO	M	RO
docsQosDbcRspS	N-Sup		M	RO	M	RO
docsQosDbcAcks	N-Sup		M	RO	M	RO
docsQosDbcSuccesses	N-Sup		M	RO	M	RO
docsQosDbcFails	N-Sup		M	RO	M	RO
docsQosDbcPartial	N-Sup		M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosServiceFlowLogTable</b>			NA		M	N-Acc
<b>docsQosServiceFlowLogEntry</b>			NA		M	N-Acc
docsQosServiceFlowLogIndex			NA		M	N-Acc
docsQosServiceFlowLogIfIndex			NA		M	RO
docsQosServiceFlowLogSFID			NA		M	RO
docsQosServiceFlowLogCmMac			NA		M	RO
docsQosServiceFlowLogPkts			NA		M	RO
docsQosServiceFlowLogOctets			NA		M	RO
docsQosServiceFlowLogTimeDeleted			NA		M	RO
docsQosServiceFlowLogTimeCreated			NA		M	RO
docsQosServiceFlowLogTimeActive			NA		M	RO
docsQosServiceFlowLogDirection			NA		M	RO
docsQosServiceFlowLogPrimary			NA		M	RO
docsQosServiceFlowLogServiceClassName			NA		M	RO
docsQosServiceFlowLogPolicedDropPkts			NA		M	RO
docsQosServiceFlowLogPolicedDelayPkts			NA		M	RO
docsQosServiceFlowLogControl			NA		M	RW
<b>docsQosServiceClassTable</b>			NA		M	N-Acc
<b>docsQosServiceClassEntry</b>			NA		M	N-Acc
docsQosServiceClassName			NA		M	N-Acc
docsQosServiceClassStatus			NA		M	RC
docsQosServiceClassPriority			NA		M	RC
docsQosServiceClassMaxTrafficRate			NA		M	RC
docsQosServiceClassMaxTrafficBurst			NA		M	RC
docsQosServiceClassMinReservedRate			NA		M	RC
docsQosServiceClassMinReservedPkt			NA		M	RC
docsQosServiceClassMaxConcatBurst			NA		M	RC

docsQosServiceClassNomPollInterval			NA		M	RC
docsQosServiceClassTolPollJitter			NA		M	RC
docsQosServiceClassUnsolicitGrantSize			NA		M	RC
docsQosServiceClassNomGrantInterval			NA		M	RC
docsQosServiceClassTolGrantJitter			NA		M	RC
docsQosServiceClassGrantsPerInterval			NA		M	RC
docsQosServiceClassMaxLatency			NA		M	RC
docsQosServiceClassActiveTimeout			NA		M	RC
docsQosServiceClassAdmittedTimeout			NA		M	RC
docsQosServiceClassSchedulingType			NA		M	RC
docsQosServiceClassRequestPolicy			NA		M	RC
docsQosServiceClassTosAndMask			NA		M	RC
docsQosServiceClassTosOrMask			NA		M	RC
docsQosServiceClassDirection			NA		M	RC
docsQosServiceClassStorageType			NA		M	RC
docsQosServiceClassDSCPOverwrite			NA		M	RC
docsQosServiceClassRequiredAttrMask			NA		M	RC
docsQosServiceClassForbiddenAttrMask			NA		M	RC
docsQosServiceClassAttrAggrRuleMask			NA		M	RC
docsQosServiceClassAppld			NA		M	RC
docsQosServiceClassMultiplierContentionReqWindow			NA		M	RC
docsQosServiceClassMultiplierBytesReq			NA		M	RC
docsQosServiceClassMaxReqPerSidCluster			NA		D	RC
docsQosServiceClassMaxOutstandingBytesPerSidCluster			NA		D	RC
docsQosServiceClassMaxTotBytesReqPerSidCluster			NA		D	RC
docsQosServiceClassMaxTimeInSidCluster			NA		D	RC
docsQosServiceClassPeakTrafficRate			NA		M	RC
docsQosServiceClassDsResequencing			NA		M	RC
docsQosServiceClassMinimumBuffer			N/A		M	RC
docsQosServiceClassTargetBuffer			N/A		M	RC
docsQosServiceClassMaximumBuffer			N/A		M	RC
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosPHSTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosPHSEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosPHSField	N-Sup		M	RO	M	RO
docsQosPHSMask	N-Sup		M	RO	M	RO
docsQosPHSSize	N-Sup		M	RO	M	RO

docsQosPHSVerify	N-Sup		M	RO	M	RO
docsQosPHSIndex	N-Sup		M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosCmtsMacToSrvFlowTable</b>			NA		M	N-Acc
<b>docsQosCmtsMacToSrvFlowEntry</b>			NA		M	N-Acc
docsQosCmtsCmMac			NA		M	N-Acc
docsQosCmtsServiceFlowId			NA		M	N-Acc
docsQosCmtsIfIndex			NA		M	RO
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosServiceFlowSidClusterTable</b>	N-Sup		M	N-Acc	M	N-Acc
<b>docsQosServiceFlowSidClusterEntry</b>	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowSidClusterId	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowSidClusterUcid	N-Sup		M	N-Acc	M	N-Acc
docsQosServiceFlowSidClusterSid	N-Sup		M	RO	M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosGrpServiceFlowTable</b>			NA		M	N-Acc
<b>docsQosGrpServiceFlowEntry</b>			NA		M	N-Acc
docsQosGrpServiceFlowIsDef			NA		M	RO
docsQosGrpServiceFlowQosConfigId			NA		M	RO
docsQosGrpServiceFlowNumSess			NA		M	RO
docsQosGrpServiceFlowSrcAddr			NA		M	RO
docsQosGrpServiceFlowGrpAddr			NA		M	RO
<b>docsQosGrpPktClassTable</b>			NA		M	N-Acc
<b>docsQosGrpPktClassEntry</b>			NA		M	N-Acc
docsQosGrpPktClassGrpConfigId			NA		M	RO
<b>docsQosUpChCounterExtTable</b>			NA		M	N-Acc
<b>docsQosUpChCounterExtEntry</b>			NA		M	N-Acc
docsQosUpChCounterExtSgmtValids			NA		M	RO
docsQosUpChCounterExtSgmtDiscards			NA		M	RO
<b>docsQosServiceFlowCcfStatsTable</b>			NA		M	N-Acc
<b>docsQosServiceFlowCcfStatsEntry</b>			NA		M	N-Acc
docsQosServiceFlowCcfStatsSgmtValids			NA		M	RO
docsQosServiceFlowCcfStatsSgmtLost			NA		M	RO
<b>Object</b>	<b>CM in DOCSIS 1.0 CoS mode</b>	<b>Access</b>	<b>CM in DOCSIS 1.1 QoS Mode</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosCmServiceUsStatsTable</b>	N-Sup		M	N-Acc	NA	
<b>docsQosCmServiceUsStatsEntry</b>	N-Sup		M	N-Acc	NA	
docsQosCmServiceUsStatsTxSlotsImmed	N-Sup		M	RO	NA	
docsQosCmServiceUsStatsTxSlotsDed	N-Sup		M	RO	NA	

docsQosCmServiceUsStatsTxRetries	N-Sup		M	RO	NA	
docsQosCmServiceUsStatsTxExceedededs	N-Sup		M	RO	NA	
docsQosCmServiceUsStatsRqRetries	N-Sup		M	RO	NA	
docsQosCmServiceUsStatsRqExceedededs	N-Sup		M	RO	NA	
docsQosCmServiceUsStatsSgmts	N-Sup		M	RO	NA	
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosCmtsDsidTable</b>			NA		M	N-Acc
<b>docsQosCmtsDsidEntry</b>			NA		M	N-Acc
docsQosCmtsDsidDsid			NA		M	N-Acc
docsQosCmtsDsidUsage			NA		M	RO
docsQosCmtsDsidDsChSet			NA		M	RO
docsQosCmtsDsidReseqWaitTime			NA		M	RO
docsQosCmtsDsidReseqWarnThrshld			NA		M	RO
docsQosCmtsDsidStatusHoldOffTimerSeqOutOfRng			NA		M	RO
docsQosCmtsDsidCurrentSeqNum			NA		M	RO
<b>docsQosCmtsDebugDsidTable</b>			NA		M	N-Acc
<b>docsQosCmtsDebugDsidEntry</b>			NA		M	N-Acc
docsQosCmtsDebugDsidDsid			NA		M	N-Acc
docsQosCmtsDebugDsidRowStatus			NA		M	RC
<b>docsQosCmtsDebugDsidStatsTable</b>			NA		M	N-Acc
<b>docsQosCmtsDebugDsidStatsEntry</b>			NA		M	N-Acc
docsQosCmtsDebugDsidStatsDsidIndex			NA		M	N-Acc
docsQosCmtsDebugDsidStatsDsidPackets			NA		M	RO
docsQosCmtsDebugDsidStatsDsidOctets			NA		M	RO
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsQosCmDsidTable</b>			M	N-Acc	NA	
<b>docsQosCmDsidEntry</b>			M	N-Acc	NA	
docsQosCmDsidDsid			M	N-Acc	NA	
docsQosCmDsidUsage			M	RO	NA	
docsQosCmDsidNumReseqChs			M	RO	NA	
docsQosCmDsidReseqChList			M	RO	NA	
docsQosCmDsidReseqWaitTime			M	RO	NA	
docsQosCmDsidReseqWarnThrshld			M	RO	NA	
docsQosCmDsidStatusHoldOffTimerSeqOutOfRng			M	RO	NA	
docsQosCmDsidOutOfRangeDiscards			M	RO	NA	
docsQosCmDsidNextExpectedSeqNum			M	RO	NA	
docsQosCmDsidCmlInterfaceMask			M	RO	NA	

<b>docsQosCmDsidFwdCmInterfaceMask</b>			M	RO	NA	
<b>docsQosCmDsidStatsTable</b>			M	N-Acc	NA	
<b>docsQosCmDsidStatsEntry</b>			M	N-Acc	NA	
docsQosCmDsidStatsDsid			M	N-Acc	NA	
docsQosCmDsidStatsSeqNumMissing			M	RO	NA	
docsQosCmDsidStatsSkewThreshExceeds			M	RO	NA	
docsQosCmDsidStatsOutOfRangePackets			M	RO	NA	
docsQosCmDsidStatsNumPackets			M	RO	NA	
<b>docsQosCmDsidClientTable</b>			M	N-Acc	NA	
<b>docsQosCmDsidClientEntry</b>			M	N-Acc	NA	
docsQosCmDsidClientDsid			M	N-Acc	NA	
docsQosCmDsidClientClientMacId			M	N-Acc	NA	
docsQosCmDsidClientClientMacAddr			M	RO	NA	
<b>DOCS-IF3-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsIf3MdNodeStatusTable</b>			NA		M	N-Acc
<b>docsIf3MdNodeStatusEntry</b>			NA		M	N-Acc
docsIf3MdNodeStatusNodeName			NA		M	N-Acc
docsIf3MdNodeStatusMdCmSgId			NA		M	N-Acc
docsIf3MdNodeStatusMdDsSgId			NA		M	RO
docsIf3MdNodeStatusMdUsSgId			NA		M	RO
<b>docsIf3MdDsSgStatusTable</b>			NA		M	N-Acc
<b>docsIf3MdDsSgStatusEntry</b>			NA		M	N-Acc
docsIf3MdDsSgStatusMdDsSgId			NA		M	N-Acc
docsIf3MdDsSgStatusChSetId			NA		M	RO
<b>docsIf3MdUsSgStatusTable</b>			NA		M	N-Acc
<b>docsIf3MdUsSgStatusEntry</b>			NA		M	N-Acc
docsIf3MdUsSgStatusMdUsSgId			NA		M	N-Acc
docsIf3MdUsSgStatusChSetId			NA		M	RO
<b>docsIf3CmStatusTable</b>			M	N-Acc	NA	
<b>docsIf3CmStatusEntry</b>			M	N-Acc	NA	
docsIf3CmStatusValue			M	RO	NA	
docsIf3CmStatusCode			M	RO	NA	
docsIf3CmStatusResets			M	RO	NA	
docsIf3CmStatusLostSyncs			M	RO	NA	
docsIf3CmStatusInvalidMaps			M	RO	NA	
docsIf3CmStatusInvalidUcds			M	RO	NA	
docsIf3CmStatusInvalidRangingRsp			M	RO	NA	
docsIf3CmStatusInvalidRegRsp			M	RO	NA	

docsIf3CmStatusT1Timeouts			M	RO	NA	
docsIf3CmStatusT2Timeouts			M	RO	NA	
docsIf3CmStatusUCCsSuccesses			M	RO	NA	
docsIf3CmStatusUCCFails			M	RO	NA	
docsIf3CmStatusEnergyMgt1x1OperStatus			M	RO	NA	
<b>docsIf3CmStatusUsTable</b>			M	N-Acc	NA	
<b>docsIf3CmStatusUsEntry</b>			M	N-Acc	NA	
docsIf3CmStatusUsTxPower			M	RO	NA	
docsIf3CmStatusUsT3Timeouts			M	RO	NA	
docsIf3CmStatusUsT4Timeouts			M	RO	NA	
docsIf3CmStatusUsRangingAborteds			M	RO	NA	
docsIf3CmStatusUsModulationType			M	RO	NA	
docsIf3CmStatusUsEqData			M	RO	NA	
docsIf3CmStatusUsT3Exceededs			M	RO	NA	
docsIf3CmStatusUsIsMuted			M	RO	NA	
docsIf3CmStatusUsRangingStatus			M	RO	NA	
<b>docsIf3CmCapabilities</b>						
docsIf3CmCapabilitiesReq			M	RO	NA	
docsIf3CmCapabilitiesRsp			M	RO	NA	
<b>docsIf3CmtsCmRegStatusTable</b>			NA		M	N-Acc
<b>docsIf3CmtsCmRegStatusEntry</b>			NA		M	N-Acc
docsIf3CmtsCmRegStatusId			NA		M	N-Acc
docsIf3CmtsCmRegStatusMacAddr			NA		M	RO
docsIf3CmtsCmRegStatusIPv6Addr			NA		M	RO
docsIf3CmtsCmRegStatusIPv6LinkLocal			NA		M	RO
docsIf3CmtsCmRegStatusIPv4Addr			NA		M	RO
docsIf3CmtsCmRegStatusValue			NA		M	RO
docsIf3CmtsCmRegStatusMdIfIndex			NA		M	RO
docsIf3CmtsCmRegStatusMdCmSgId			NA		M	RO
docsIf3CmtsCmRegStatusRpId			NA		M	RO
docsIf3CmtsCmRegStatusRccStatusId			NA		M	RO
docsIf3CmtsCmRegStatusRcsId			NA		M	RO
docsIf3CmtsCmRegStatusTcsId			NA		M	RO
docsIf3CmtsCmRegStatusQosVersion			NA		M	RO
docsIf3CmtsCmRegStatusLastRegTime			NA		M	RO
docsIf3CmtsCmRegStatusAddrResolutionReqs			NA		M	RO
docsIf3CmtsCmRegStatusEnergyMgtEnabled			NA		M	RO
docsIf3CmtsCmRegStatusEnergyMgtOperStatus			NA		M	RO

<b>docsIf3CmtsCmUsStatusTable</b>			NA		M	N-Acc
<b>docsIf3CmtsCmUsStatusEntry</b>			NA		M	N-Acc
docsIf3CmtsCmUsStatusChIndex			NA		M	N-Acc
docsIf3CmtsCmUsStatusModulationType			NA		M	RO
docsIf3CmtsCmUsStatusRxPower			NA		M	RO
docsIf3CmtsCmUsStatusSignalNoise			NA		M	RO
docsIf3CmtsCmUsStatusMicroreflections			NA		M	RO
docsIf3CmtsCmUsStatusEqData			NA		M	RO
docsIf3CmtsCmUsStatusUnerroreds			NA		M	RO
docsIf3CmtsCmUsStatusCorrecteds			NA		M	RO
docsIf3CmtsCmUsStatusUncorrectables			NA		M	RO
docsIf3CmtsCmUsStatusHighResolutionTimingOffset			NA		M	RO
docsIf3CmtsCmUsStatusIsMuted			NA		M	RO
docsIf3CmtsCmUsStatusRangingStatus			NA		M	RO
<b>docsIf3MdCfgTable</b>			NA		M	N-Acc
<b>docsIf3MdCfgEntry</b>			NA		M	N-Acc
docsIf3MdCfgMdInterval			NA		M	RW
docsIf3MdCfgIpProvMode			NA		M	RW
docsIf3MdCfgCmStatusEvCtlEnabled			NA		M	RW
docsIf3MdCfgUsFreqRange			NA		M	RW
docsIf3MdCfgMcastDsidFwdEnabled			NA		O	RW
docsIf3MdCfgMultRxChModeEnabled			NA		M	RW
docsIf3MdCfgMultTxChModeEnabled			NA		M	RW
docsIf3MdCfgEarlyAuthEncrCtrl			NA		M	RW
docsIf3MdCfgTftpProxyEnabled			NA		M	RW
docsIf3MdCfgSrcAddrVerifEnabled			NA		M	RW
docsIf3MdCfgDownChannelAnnex			NA		M	RW
docsIf3MdCfgCmUdcEnabled			NA		M	RW
docsIf3MdCfgSendUdcRulesEnabled			NA		O	RW
docsIf3MdCfgServiceTypeList			NA		M	RW
docsIf3MdCfgBpi2EnforceCtrl			N/A		M	RW
docsIf3MdCfgEnergyMgt1x1Enabled			N/A		M	RW
<b>docsIf3MdChCfgTable</b>			NA		M	N-Acc
<b>docsIf3MdChCfgEntry</b>			NA		M	N-Acc
docsIf3MdChCfgChIndex			NA		M	N-Acc
docsIf3MdChCfgIsPriCapableDs			NA		M	RC
docsIf3MdChCfgChId			NA		M	RC
docsIf3MdChCfgSfProvAttrMask			NA		M	RC

<b>docsIf3MdChCfgRowStatus</b>			NA		M	RC
<b>docsIf3MdUsToDsChMappingTable</b>			NA		M	N-Acc
<b>docsIf3MdUsToDsChMappingEntry</b>			NA		M	N-Acc
<b>docsIf3MdUsToDsChMappingUsIfIndex</b>			NA		M	N-Acc
<b>docsIf3MdUsToDsChMappingDsIfIndex</b>			NA		M	N-Acc
<b>docsIf3MdUsToDsChMappingMdIfIndex</b>			NA		M	RO
<b>docsIf3DsChSetTable</b>			NA		M	N-Acc
<b>docsIf3DsChSetEntry</b>			NA		M	N-Acc
<b>docsIf3DsChSetId</b>			NA		M	N-Acc
<b>docsIf3DsChSetChList</b>			NA		M	RO
<b>docsIf3UsChSetTable</b>			NA		M	N-Acc
<b>docsIf3UsChSetEntry</b>			NA		M	N-Acc
<b>docsIf3UsChSetId</b>			NA		M	N-Acc
<b>docsIf3UsChSetChList</b>			NA		M	RO
<b>docsIf3BondingGrpCfgTable</b>			NA		M	N-Acc
<b>docsIf3BondingGrpCfgEntry</b>			NA		M	N-Acc
<b>docsIf3BondingGrpCfgDir</b>			NA		M	N-Acc
<b>docsIf3BondingGrpCfgCfgId</b>			NA		M	N-Acc
<b>docsIf3BondingGrpCfgChList</b>			NA		M	RC
<b>docsIf3BondingGrpCfgSfProvAttrMask</b>			NA		M	RC
<b>docsIf3BondingGrpCfgDsidReseqWaitTime</b>			NA		M	RC
<b>docsIf3BondingGrpCfgDsidReseqWarnThrshld</b>			NA		M	RC
<b>docsIf3BondingGrpCfgRowStatus</b>			NA		M	RC
<b>docsIf3DsBondingGrpStatusTable</b>			NA		M	N-Acc
<b>docsIf3DsBondingGrpStatusEntry</b>			NA		M	N-Acc
<b>docsIf3DsBondingGrpStatusChSetId</b>			NA		M	N-Acc
<b>docsIf3DsBondingGrpStatusMdDsSgId</b>			NA		M	RO
<b>docsIf3DsBondingGrpStatusCfgId</b>			NA		M	RO
<b>docsIf3UsBondingGrpStatusTable</b>			NA		M	N-Acc
<b>docsIf3UsBondingGrpStatusEntry</b>			NA		M	N-Acc
<b>docsIf3UsBondingGrpStatusChSetId</b>			NA		M	N-Acc
<b>docsIf3UsBondingGrpStatusMdUsSgId</b>			NA		M	RO
<b>docsIf3UsBondingGrpStatusCfgId</b>			NA		M	RO
<b>docsIf3RccCfgTable</b>			NA		M	N-Acc
<b>docsIf3RccCfgEntry</b>			NA		M	N-Acc
<b>docsIf3RccCfgRpclId</b>			NA		M	N-Acc
<b>docsIf3RccCfgRccCfgId</b>			NA		M	N-Acc
<b>docsIf3RccCfgVendorSpecific</b>			NA		M	RC
<b>docsIf3RccCfgDescription</b>			NA		M	RC

docsIf3RccCfgRowStatus			NA		M	RC
<b>docsIf3RxChCfgTable</b>			NA		M	N-Acc
<b>docsIf3RxChCfgEntry</b>			NA		M	N-Acc
docsIf3RxChCfgRclId			NA		M	N-Acc
docsIf3RxChCfgChIndex			NA		M	RO
docsIf3RxChCfgPrimaryDsIndicator			NA		M	RC
docsIf3RxChCfgRcRmConnectivityId			NA		M	RC
docsIf3RxChCfgRowStatus			NA		M	RC
<b>docsIf3RxModuleCfgTable</b>			NA		M	N-Acc
<b>docsIf3RxModuleCfgEntry</b>			NA		M	N-Acc
docsIf3RxModuleCfgRmId			NA		M	N-Acc
docsIf3RxModuleCfgRmRmConnectivityId			NA		M	RC
docsIf3RxModuleCfgFirstCenterFrequency			NA		M	RC
docsIf3RxModuleCfgRowStatus			NA		M	RC
<b>docsIf3RccStatusTable</b>			NA		M	N-Acc
<b>docsIf3RccStatusEntry</b>			NA		M	N-Acc
docsIf3RccStatusRpId			NA		M	N-Acc
docsIf3RccStatusRccStatusId			NA		M	N-Acc
docsIf3RccStatusRccCfgId			NA		M	RO
docsIf3RccStatusValidityCode			NA		M	RO
docsIf3RccStatusValidityCodeText			NA		M	RO
<b>docsIf3RxChStatusTable</b>			M	N-Acc	M	N-Acc
<b>docsIf3RxChStatusEntry</b>			M	N-Acc	M	N-Acc
docsIf3RxChStatusRclId			M	N-Acc	M	N-Acc
docsIf3RxChStatusChIndex			M	RO	M	RO
docsIf3RxChStatusPrimaryDsIndicator			M	RO	M	RO
docsIf3RxChStatusRcRmConnectivityId			M	RO	M	RO
<b>docsIf3RxModuleStatusTable</b>			M	N-Acc	M	N-Acc
<b>docsIf3RxModuleStatusEntry</b>			M	N-Acc	M	N-Acc
docsIf3RxModuleStatusRpId			M	N-Acc	M	N-Acc
docsIf3RxModuleStatusRmRmConnectivityId			M	RO	M	RO
docsIf3RxModuleStatusFirstCenterFrequency			M	RO	M	RO
<b>docsIf3SignalQualityExtTable</b>			M	N-Acc	M	N-Acc
<b>docsIf3SignalQualityExtEntry</b>			M	N-Acc	M	N-Acc
docsIf3SignalQualityExtRxMER			M	RO	M	RO
docsIf3SignalQualityExtRxMerSamples			M	RO	M	RO
<b>docsIf3CmtsSignalQualityExtTable</b>			NA		M	N-Acc
<b>docsIf3CmtsSignalQualityExtEntry</b>			NA		M	N-Acc
docsIf3CmtsSignalQualityExtCNIR			NA		M	RO

<b>docsIf3CmtsSignalQualityExtExpectedRxSignalPower</b>			NA		M	RW
<b>docsIf3CmtsSpectrumAnalysisMeasTable</b>			NA		M	N-Acc
<b>docsIf3CmtsSpectrumAnalysisMeasEntry</b>			NA		M	N-Acc
<b>docsIf3CmtsSpectrumAnalysisMeasAmplitudeData</b>			NA		M	RO
<b>docsIf3CmtsSpectrumAnalysisMeasTimeInterval</b>			NA		M	RO
<b>docsIf3CmtsSpectrumAnalysisMeasRowStatus</b>			NA		M	RC
<b>docsIf3UsChExtTable</b>			M	N-Acc	M	N-Acc
<b>docsIf3UsChExtEntry</b>			M	N-Acc	M	N-Acc
<b>docsIf3UsChExtSacCodeHoppingSelectionMode</b>			M	RO	M	RO
<b>docsIf3UsChExtScdmaSelectionStringActiveCodes</b>			M	RO	M	RO
<b>docsIf3CmtsCmCtrlCmd</b>						
<b>docsIf3CmtsCmCtrlCmdMacAddr</b>			NA		M	RW
<b>docsIf3CmtsCmCtrlCmdMuteUsChld</b>			NA		M	RW
<b>docsIf3CmtsCmCtrlCmdMuteInterval</b>			NA		M	RW
<b>docsIf3CmtsCmCtrlCmdDisableForwarding</b>			NA		M	RW
<b>docsIf3CmtsCmCtrlCmdCommit</b>			NA		M	RW
<b>docsIf3CmDpvStatsTable</b>			M	N-Acc	NA	
<b>docsIf3CmDpvStatsEntry</b>			M	N-Acc	NA	
<b>docsIf3CmDpvStatsGrpld</b>			M	N-Acc	NA	
<b>docsIf3CmDpvStatsLastMeasLatency</b>			M	RO	NA	
<b>docsIf3CmDpvStatsLastMeasTime</b>			M	RO	NA	
<b>docsIf3CmDpvStatsMinLatency</b>			M	RO	NA	
<b>docsIf3CmDpvStatsMaxLatency</b>			M	RO	NA	
<b>docsIf3CmDpvStatsAvgLatency</b>			M	RO	NA	
<b>docsIf3CmDpvStatsNumMeas</b>			M	RO	NA	
<b>docsIf3CmDpvStatsLastClearTime</b>			M	RO	NA	
<b>docsIf3CmEventCtrlTable</b>			M	N-Acc	NA	
<b>docsIf3CmEventCtrlEntry</b>			M	N-Acc	NA	
<b>docsIf3CmEventCtrlEventId</b>			M	N-Acc	NA	
<b>docsIf3CmEventCtrlStatus</b>			M	RC	NA	
<b>docsIf3CmtsEventCtrlTable</b>			NA		M	N-Acc
<b>docsIf3CmtsEventCtrlEntry</b>			NA		M	N-Acc
<b>docsIf3CmtsEventCtrlEventId</b>			NA		M	N-Acc
<b>docsIf3CmtsEventCtrlStatus</b>			NA		M	RC
<b>docsIf3CmMdCfgTable</b>			M	N-Acc	NA	
<b>docsIf3CmMdCfgEntry</b>			M	N-Acc	NA	

<b>docsIf3CmMdCfgIpProvMode</b>			M	RW	NA	
<b>docsIf3CmMdCfgIpProvModeResetOnChange</b>			M	RW	NA	
<b>docsIf3CmMdCfgIpProvModeResetOnChangeHoldOffTimer</b>			M	RW	NA	
<b>docsIf3CmMdCfgIpProvModeStorageType</b>			M	RW	NA	
<b>docsIf3CmEnergyMgtCfg</b>						
<b>docsIf3CmEnergyMgtCfgFeatureEnabled</b>			M	RO	NA	
<b>docsIf3CmEnergyMgtCfgCyclePeriod</b>			M	RO	NA	
<b>docsIf3CmEnergyMgt1x1CfgTable</b>			M	N-Acc	NA	
<b>docsIf3CmEnergyMgt1x1CfgEntry</b>			M	N-Acc	NA	
<b>docsIf3CmEnergyMgt1x1CfgDirection</b>			M	N-Acc	NA	
<b>docsIf3CmEnergyMgt1x1CfgEntryBitrateThrshld</b>			M	RW	NA	
<b>docsIf3CmEnergyMgt1x1CfgEntryTimeThrshld</b>			M	RW	NA	
<b>docsIf3CmEnergyMgt1x1CfgExitBitrateThrshld</b>			M	RW	NA	
<b>docsIf3CmEnergyMgt1x1CfgExitTimeThrshld</b>			M	RW	NA	
<b>docsIf3CmSpectrumAnalysisCtrlCmd</b>						
<b>docsIf3CmSpectrumAnalysisCtrlCmdEnable</b>			O	RW	NA	
<b>docsIf3CmSpectrumAnalysisInactivityTimeout</b>			O	RW	NA	
<b>docsIf3CmSpectrumAnalysisFirstSegmentCenterFrequency</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisLastSegmentCenterFrequency</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisSegmentFrequencySpan</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisNumBinsPerSegment</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisEquivalentNoiseBandwidth</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisWindowFunction</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisNumberOfAverages</b>			O	RO/RW	NA	
<b>docsIf3CmSpectrumAnalysisMeasTable</b>			O	N-Acc	NA	
<b>docsIf3CmSpectrumAnalysisMeasEntry</b>			O	N-Acc	NA	
<b>docsIf3CmSpectrumAnalysisMeasFrequency</b>			O	N-Acc	NA	
<b>docsIf3CmSpectrumAnalysisMeasAmplitudeData</b>			O	RO	NA	
<b>docsIf3CmSpectrumAnalysisMeasTotalSegmentPower</b>			O	RO	NA	
<b>docsIf3CmtsCmEmStatsTable</b>					M	N-Acc
<b>docsIf3CmtsCmEmStatsEntry</b>					M	N-Acc
<b>docsIf3CmtsCmEmStatsEm1x1ModeTotalDuration</b>					M	RO
<b>docsIf3CmEm1x1StatsTable</b>			M	N-Acc		

<b>docsIf3CmEm1x1StatsEntry</b>			M	N-Acc		
docsIf3CmEm1x1StatsNumberTimesCrossedBelowUsEntryThrshlds			M	RO		
docsIf3CmEm1x1StatsNumberTimesCrossedBelowDsEntryThrshlds			M	RO		
docsIf3CmEm1x1StatsTotalDuration			M	RO		
docsIf3CmEm1x1StatsTotalDurationBelowUsThrslds			M	RO		
docsIf3CmEm1x1StatsTotalDurationBelowDsThrslds			M	RO		
docsIf3CmEm1x1StatsTotalDurationBelowUsDsThrslds			M	RO		
<b>Notifications</b>						
docsIf3CmtsEventNotif			N-Sup		M	Notif
docsIf3CmEventNotif			M	Notif	N-Sup	
<b>DOCS-SUBMGT3-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsSubmgt3Base</b>						
docsSubmgt3BaseCpeMaxIpv4Def			NA		M	RW
docsSubmgt3BaseCpeMaxIpv6AddressesDef			NA		M	RW
docsSubmgt3BaseCpeActiveDef			NA		M	RW
docsSubmgt3BaseCpeLearnableDef			NA		M	RW
docsSubmgt3BaseSubFilterDownDef			NA		M	RW
docsSubmgt3BaseSubFilterUpDef			NA		M	RW
docsSubmgt3BaseCmFilterDownDef			NA		M	RW
docsSubmgt3BaseCmFilterUpDef			NA		M	RW
docsSubmgt3BasePsFilterDownDef			NA		M	RW
docsSubmgt3BasePsFilterUpDef			NA		M	RW
docsSubmgt3BaseMtaFilterDownDef			NA		M	RW
docsSubmgt3BaseMtaFilterUpDef			NA		M	RW
docsSubmgt3BaseStbFilterDownDef			NA		M	RW
docsSubmgt3BaseStbFilterUpDef			NA		M	RW
<b>docsSubmgt3CpeCtrlTable</b>			NA		M	N-Acc
<b>docsSubmgt3CpeCtrlEntry</b>			NA		M	N-Acc
docsSubmgt3CpeCtrlMaxCpeIpv4			NA		M	RW
docsSubmgt3CpeCtrlMaxCpeIpv6Addresses			NA		M	RW
docsSubmgt3CpeCtrlActive			NA		M	RW
docsSubmgt3CpeCtrlLearnable			NA		M	RW
docsSubmgt3CpeCtrlReset			NA		M	RW
docsSubmgt3CpeCtrlLastReset			NA		M	RW
<b>docsSubmgt3CpeIpTable</b>			NA		M	N-Acc

<b>docsSubmgt3CpelpEntry</b>			NA		M	N-Acc
docsSubmgt3CpelpId			NA		M	N-Acc
docsSubmgt3CpelpAddrType			NA		M	RO
docsSubmgt3CpelpAddr			NA		M	RO
docsSubmgt3CpelpAddrPrefixLen			NA		M	RO
docsSubmgt3CpelpLearned			NA		M	RO
docsSubmgt3CpelpType			NA		M	RO
<b>docsSubmgt3GrpTable</b>			NA		M	N-Acc
<b>docsSubmgt3GrpEntry</b>			NA		M	N-Acc
docsSubMgt3GrpUdcGroupIds			NA		M	RW
docsSubMgt3GrpUdcSentInRegRsp			NA		M	RW
docsSubmgt3GrpSubFilterDs			NA		M	RW
docsSubmgt3GrpSubFilterUs			NA		M	RW
docsSubmgt3GrpCmFilterDs			NA		M	RW
docsSubmgt3GrpCmFilterUs			NA		M	RW
docsSubmgt3GrpPsFilterDs			NA		M	RW
docsSubmgt3GrpPsFilterUs			NA		M	RW
docsSubmgt3GrpMtaFilterDs			NA		M	RW
docsSubmgt3GrpMtaFilterUs			NA		M	RW
docsSubmgt3GrpStbFilterDs			NA		M	RW
docsSubmgt3GrpStbFilterUs			NA		M	RW
<b>docsSubmgt3FilterGrpTable</b>			NA		M	N-Acc
<b>docsSubmgt3FilterGrpEntry</b>			NA		M	N-Acc
docsSubmgt3FilterGrpGrpld			NA		M	N-Acc
docsSubmgt3FilterGrpRuleId			NA		M	N-Acc
docsSubmgt3FilterGrpAction			NA		M	RC
docsSubmgt3FilterGrpPriority			NA		M	RC
docsSubmgt3FilterGrpIpTosLow			NA		M	RC
docsSubmgt3FilterGrpIpTosHigh			NA		M	RC
docsSubmgt3FilterGrpIpTosMask			NA		M	RC
docsSubmgt3FilterGrpIpProtocol			NA		M	RC
docsSubmgt3FilterGrpNetAddrType			NA		M	RC
docsSubmgt3FilterGrpNetSrcAddr			NA		M	RC
docsSubmgt3FilterGrpNetSrcMask			NA		M	RC
docsSubmgt3FilterGrpNetDestAddr			NA		M	RC
docsSubmgt3FilterGrpNetDestMask			NA		M	RC
docsSubmgt3FilterGrpSrcPortStart			NA		M	RC
docsSubmgt3FilterGrpSrcPortEnd			NA		M	RC
docsSubmgt3FilterGrpDestPortStart			NA		M	RC

docsSubmgt3FilterGrpDestPortEnd			NA		M	RC
docsSubmgt3FilterGrpDestMacAddr			NA		M	RC
docsSubmgt3FilterGrpDestMacMask			NA		M	RC
docsSubmgt3FilterGrpSrcMacAddr			NA		M	RC
docsSubmgt3FilterGrpEnetProtocolType			NA		M	RC
docsSubmgt3FilterGrpEnetProtocol			NA		M	RC
docsSubmgt3FilterGrpUserPriLow			NA		M	RC
docsSubmgt3FilterGrpUserPriHigh			NA		M	RC
docsSubmgt3FilterGrpVlanId			NA		M	RC
docsSubmgt3FilterGrpClassPkts			NA		M	RO
docsSubmgt3FilterGrpFlowLabel			NA		M	RC
docsSubmgt3FilterGrpCmlInterfaceMask			NA		M	RC
docsSubmgt3FilterGrpRowStatus			NA		M	RC
<b>CLAB-TOPO-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>clabTopoFiberNodeCfgTable</b>			NA		M	N-Acc
<b>clabTopoFiberNodeCfgEntry</b>			NA		M	N-Acc
clabTopoFiberNodeCfgNodeName			NA		M	N-Acc
clabTopoFiberNodeCfgNodeDescr			NA		M	RC
clabTopoFiberNodeCfgRowStatus			NA		M	RC
<b>clabTopoChFnCfgTable</b>			NA		M	N-Acc
<b>clabTopoChFnCfgEntry</b>			NA		M	N-Acc
clabTopoChFnCfgNodeName			NA		M	N-Acc
clabTopoChFnCfgChIfIndex			NA		M	N-Acc
clabTopoChFnCfgRowStatus			NA		M	RC
<b>DOCS-MCAST-AUTH-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsMcastAuthCtrl</b>						
docsMcastAuthCtrlEnable			NA		M	RW
docsMcastAuthCtrlDefProfileNameList			NA		M	RW
docsMcastAuthCtrlDefAction			NA		M	RW
docsMcastAuthCtrlDefMaxNumSess			NA		M	RW
<b>docsMcastAuthCmtsCmStatusTable</b>			NA		M	N-Acc
<b>docsMcastAuthCmtsCmStatusEntry</b>			NA		M	N-Acc
docsMcastAuthCmtsCmStatusCfgProfileNameList			NA		M	RO
docsMcastAuthCmtsCmStatusCfgListId			NA		M	RO
docsMcastAuthCmtsCmStatusMaxNumSess			NA		M	RO
docsMcastAuthCmtsCmStatusCfgParamFlag			NA		M	RO

<b>docsMcastAuthProfileSessRuleTable</b>			NA		M	N-Acc
<b>docsMcastAuthProfileSessRuleEntry</b>			NA		M	N-Acc
docsMcastAuthProfileSessRuleId			NA		M	N-Acc
docsMcastAuthProfileSessRulePriority			NA		M	RC
docsMcastAuthProfileSessRulePrefixAddrType			NA		M	RC
docsMcastAuthProfileSessRuleSrcPrefixAddr			NA		M	RC
docsMcastAuthProfileSessRuleSrcPrefixLen			NA		M	RC
docsMcastAuthProfileSessRuleGrpPrefixAddr			NA		M	RC
docsMcastAuthProfileSessRuleGrpPrefixLen			NA		M	RC
docsMcastAuthProfileSessRuleAction			NA		M	RC
docsMcastAuthProfileSessRuleRowStatus			NA		M	RC
<b>docsMcastAuthStaticSessRuleTable</b>			NA		O	N-Acc
<b>docsMcastAuthStaticSessRuleEntry</b>			NA		O	N-Acc
docsMcastAuthStaticSessRuleCfgListId			NA		O	N-Acc
docsMcastAuthStaticSessRuleId			NA		O	N-Acc
docsMcastAuthStaticSessRulePriority			NA		O	RO
docsMcastAuthStaticSessRulePrefixAddrType			NA		O	RO
docsMcastAuthStaticSessRuleSrcPrefixAddr			NA		O	RO
docsMcastAuthStaticSessRuleSrcPrefixLen			NA		O	RO
docsMcastAuthStaticSessRuleGrpPrefixAddr			NA		O	RO
docsMcastAuthStaticSessRuleGrpPrefixLen			NA		O	RO
docsMcastAuthStaticSessRuleAction			NA		O	RO
<b>docsMcastAuthProfilesTable</b>			NA		M	N-Acc
<b>docsMcastAuthProfilesEntry</b>			NA		M	N-Acc
docsMcastAuthProfilesName			NA		M	N-Acc
docsMcastAuthProfilesDescription			NA		M	RC
docsMcastAuthProfilesRowStatus			NA		M	RC
<b>DOCS-MCAST-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsMcastCmtsGrpCfgTable</b>			NA		M	N-Acc
<b>docsMcastCmtsGrpCfgEntry</b>			NA		M	N-Acc
docsMcastCmtsGrpCfgId			NA		M	N-Acc
docsMcastCmtsGrpCfgRulePriority			NA		M	RC
docsMcastCmtsGrpCfgPrefixAddrType			NA		M	RC
docsMcastCmtsGrpCfgSrcPrefixAddr			NA		M	RC
docsMcastCmtsGrpCfgSrcPrefixLen			NA		M	RC
docsMcastCmtsGrpCfgGrpPrefixAddr			NA		M	RC
docsMcastCmtsGrpCfgGrpPrefixLen			NA		M	RC
docsMcastCmtsGrpCfgTosLow			NA		M	RC

docsMcastCmtsGrpCfgTosHigh			NA		M	RC
docsMcastCmtsGrpCfgTosMask			NA		M	RC
docsMcastCmtsGrpCfgQosConfigId			NA		M	RC
docsMcastCmtsGrpCfgEncryptConfigId			NA		M	RC
docsMcastCmtsGrpCfgPhsConfigId			NA		M	RC
docsMcastCmtsGrpCfgRowStatus			NA		M	RC
<b>docsMcastCmtsGrpEncryptCfgTable</b>			NA		M	N-Acc
<b>docsMcastCmtsGrpEncryptCfgEntry</b>			NA		M	N-Acc
docsMcastCmtsGrpEncryptCfgId			NA		M	N-Acc
docsMcastCmtsGrpEncryptCfgCtrl			NA		M	RC
docsMcastCmtsGrpEncryptCfgAlg			NA		M	RC
docsMcastCmtsGrpEncryptCfgRowStatus			NA		M	RC
<b>docsMcastCmtsGrpPhsCfgTable</b>			NA		M	N-Acc
<b>docsMcastCmtsGrpPhsCfgEntry</b>			NA		M	N-Acc
docsMcastCmtsGrpPhsCfgId			NA		M	N-Acc
docsMcastCmtsGrpPhsCfgPhsField			NA		M	RC
docsMcastCmtsGrpPhsCfgPhsMask			NA		M	RC
docsMcastCmtsGrpPhsCfgPhsSize			NA		M	RC
docsMcastCmtsGrpPhsCfgPhsVerify			NA		M	RC
docsMcastCmtsGrpPhsCfgRowStatus			NA		M	RC
<b>docsMcastCmtsGrpQosCfgTable</b>			NA		M	N-Acc
<b>docsMcastCmtsGrpQosCfgEntry</b>			NA		M	N-Acc
docsMcastCmtsGrpQosCfgId			NA		M	N-Acc
docsMcastCmtsGrpQosCfgServiceClassName			NA		M	RC
docsMcastCmtsGrpQosCfgQosCtrl			NA		M	RC
docsMcastCmtsGrpQosCfgAggSessLimit			NA		M	RC
docsMcastCmtsGrpQosCfgAppId			NA		M	RC
docsMcastCmtsGrpQosCfgRowStatus			NA		M	RC
<b>docsMcastCmtsReplSessTable</b>			NA		M	N-Acc
<b>docsMcastCmtsReplSessEntry</b>			NA		M	N-Acc
docsMcastCmtsReplSessPrefixAddrType			NA		M	N-Acc
docsMcastCmtsReplSessGrpPrefix			NA		M	N-Acc
docsMcastCmtsReplSessSrcPrefix			NA		M	N-Acc
docsMcastCmtsReplSessMdIfIndex			NA		M	N-Acc
docsMcastCmtsReplSessDcsId			NA		M	N-Acc
docsMcastCmtsReplSessServiceFlowId			NA		M	N-Acc
docsMcastCmtsReplSessDsid			NA		M	RO
docsMcastCmtsReplSessSaid			NA		M	RO
<b>docsMcastDefGrpSvcClass</b>						

<b>docsMcastDefGrpSvcClassDef</b>			NA		M	RW
<b>docsMcastDsidPhsTable</b>			M	N-Acc	M	N-Acc
<b>docsMcastDsidPhsEntry</b>			M	N-Acc	M	N-Acc
docsMcastDsidPhsDsid			M	N-Acc	M	N-Acc
docsMcastDsidPhsPhsField			M	RO	M	RO
docsMcastDsidPhsPhsMask			M	RO	M	RO
docsMcastDsidPhsPhsSize			M	RO	M	RO
docsMcastDsidPhsPhsVerify			M	RO	M	RO
<b>docsMcastStatsTable</b>					M	N-Acc
<b>docsMcastStatsEntry</b>					M	N-Acc
docsMcastStatsGrpAddrType					M	N-Acc
docsMcastStatsGrpAddr					M	N-Acc
docsMcastStatsGrpPrefixLen					M	N-Acc
docsMcastStatsSrcAddrType					M	N-Acc
docsMcastStatsSrcAddr					M	N-Acc
docsMcastStatsSrcPrefixLen					M	N-Acc
docsMcastStatsDroppedPkts					M	RO
docsMcastStatsDroppedOctets					M	RO
<b>docsMcastCpeListTable</b>					M	N-Acc
<b>docsMcastCpeListEntry</b>					M	N-Acc
docsMcastCpeListGrpAddrType					M	N-Acc
docsMcastCpeListGrpAddr					M	N-Acc
docsMcastCpeListGrpPrefixLen					M	N-Acc
docsMcastCpeListSrcAddrType					M	N-Acc
docsMcastCpeListSrcAddr					M	N-Acc
docsMcastCpeListSrcPrefixLen					M	N-Acc
docsMcastCpeListCmMacAddr					M	N-Acc
docsMcastCpeListDsid					M	RO
docsMcastCpeListCpeMacAddr					M	RO
docsMcastCpeListCpelpAddrType					M	RO
docsMcastCpeListCpelpAddr					M	RO
<b>DOCS-SEC-MIB (Annex Q)</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>docsSecCmtsCertRevocationList</b>						
docsSecCmtsCertRevocationListUrl			NA		M	RW
docsSecCmtsCertRevocationListRefreshInterval			NA		M	RW
docsSecCmtsCertRevocationListLastUpdate			NA		M	RO
<b>docsSecCmtsOnlineCertStatusProtocol</b>						
docsSecCmtsOnlineCertStatusProtocolUrl			NA		M	RW

docsSecCmtsOnlineCertStatusProtocolSignatureBypass			NA		M	RW
<b>docsSecCmtsServerCfg</b>						
docsSecCmtsServerCfgTftpOptions			NA		M	RW
docsSecCmtsServerCfgConfigFileLearningEnable			NA		M	RW
<b>docsSecCmtsEncrypt</b>						
docsSecCmtsEncryptEncryptAlgPriority			NA		M	RW
<b>docsSecCmtsSavControl</b>						
docsSecCmtsSavControlCmAuthEnable			NA		M	RW
<b>docsSecCmtsCmEaeExclusionTable</b>			NA		M	N-Acc
<b>docsSecCmtsCmEaeExclusionEntry</b>			NA		M	N-Acc
docsSecCmtsCmEaeExclusionId			NA		M	N-Acc
docsSecCmtsCmEaeExclusionMacAddr			NA		M	RC
docsSecCmtsCmEaeExclusionMacAddrMask			NA		M	RC
docsSecCmtsCmEaeExclusionRowStatus			NA		M	RC
<b>docsSecSavCmAuthTable</b>			NA		M	N-Acc
<b>docsSecSavCmAuthEntry</b>			NA		M	N-Acc
docsSecSavCmAuthGrpName			NA		M	RO
docsSecSavCmAuthStaticPrefixListId			NA		M	RO
<b>docsSecSavCfgListTable</b>			NA		M	N-Acc
<b>docsSecSavCfgListEntry</b>			NA		M	N-Acc
docsSecSavCfgListName			NA		M	N-Acc
docsSecSavCfgListRuleId			NA		M	N-Acc
docsSecSavCfgListPrefixAddrType			NA		M	RC
docsSecSavCfgListPrefixAddr			NA		M	RC
docsSecSavCfgListPrefixLen			NA		M	RC
docsSecSavCfgListRowStatus			NA		M	RC
<b>docsSecSavStaticListTable</b>			NA		M	N-Acc
<b>docsSecSavStaticListEntry</b>			NA		M	N-Acc
docsSecSavStaticListId			NA		M	N-Acc
docsSecSavStaticListRuleId			NA		M	N-Acc
docsSecSavStaticListPrefixAddrType			NA		M	RO
docsSecSavStaticListPrefixAddr			NA		M	RO
docsSecSavStaticListPrefixLen			NA		M	RO
<b>docsSecCmtsCmSavStatsTable</b>			NA		M	N-Acc
<b>docsSecCmtsCmSavStatsEntry</b>			NA		M	N-Acc
docsSecCmtsCmSavStatsSavDiscards			NA		M	RO
<b>docsSecCmtsCertificate</b>						

docsSecCmtsCertificateCertRevocationMethod			NA		M	RW
<b>docsSecCmtsCmBpi2EnforceExclusionTable</b>			N/A		M	N-Acc
<b>docsSecCmtsCmBpi2EnforceExclusionEntry</b>			N/A		M	N-Acc
docsSecCmtsCmBpi2EnforceExclusionMacAddr			N/A		M	N-Acc
docsSecCmtsCmBpi2EnforceExclusionTable			N/A		M	RC
docsSecCmtsCmBpi2EnforceExclusionMacAddrMask			N/A		M	RC
docsSecCmtsCmBpi2EnforceExclusionRowStatus			N/A		M	RC
<b>IPMCAST-MIB [RFC 5132]</b>						
<b>Object</b>			<b>CM</b>	<b>Access</b>	<b>CMTS</b>	<b>Access</b>
<b>ipMcast Group</b>						
ipMcastEnabled			NA		M	RO
ipMcastRouteEntryCount			NA		M	RO
<b>ipMcastRouteTable</b>			NA		M	N-Acc
<b>ipMcastRouteEntry</b>			NA		M	N-Acc
ipMcastRouteGroupAddressType			NA		M	N-Acc
ipMcastRouteGroup			NA		M	N-Acc
ipMcastRouteGroupPrefixLength			NA		M	N-Acc
ipMcastRouteSourceAddressType			NA		M	N-Acc
ipMcastRouteSource			NA		M	N-Acc
ipMcastRouteSourcePrefixLength			NA		M	N-Acc
ipMcastRouteUpstreamNeighborType			NA		M	RO
ipMcastRouteUpstreamNeighbor			NA		M	RO
ipMcastRouteInIfIndex			NA		M	RO
ipMcastRouteTimeStamp			NA		M	RO
ipMcastRouteExpiryTime			NA		M	RO
ipMcastRouteProtocol			NA		M	RO
ipMcastRouteRtProtocol			NA		M	RO
ipMcastRouteRtAddressType			NA		M	RO
ipMcastRouteRtPrefixLength			NA		M	RO
ipMcastRouteRtType			NA		M	RO
ipMcastRouteOctets			NA		M	RO
ipMcastRoutePkts			NA		M	RO
ipMcastRouteTtlDropOctets			NA		M	RO
ipMcastRouteTtlDropPackets			NA		M	RO
ipMcastRouteDifferentInIfOctets			NA		M	RO
ipMcastRouteDifferentInIfPackets			NA		M	RO
ipMcastRouteBps			NA		M	RO

## A.2 [RFC 2863] ifTable/ifXTable MIB-Object Details<sup>136</sup>

Refer to [RFC 2863] for MIB object descriptions. Table A-1 includes DOCSIS 3.0 specific object information.

The following tables detail the specific ifTable and ifXTable MIB objects and values that are expected for the interfaces on the CMTS and CM.

Section 7.1.3.3.5 has defined the requirements for the [RFC 2863] ifTable and ifXTable MIB objects. This section applies these general requirements to each of the CMTS and CM interfaces. Table A-4 defines the specific requirements for the CMTS ethernet (NSI) and CM ethernet, USB and other interfaces. Table A-5 defines the specific requirements for the CM and CMTS upstream, downstream and MAC interfaces. Table A-4 and Table A-5 exclude the Counter32 and Counter64 MIB objects as these counter objects are defined in Table A-6 and Table A-7.

In order to simplify and compile all the requirements for the Counter32 and Counter64 MIB objects in a single location, the specific SNMP Access requirements and MIB implementation details that are normally detailed in Annex A.1 are reflected in Table A-6 and Table A-7. The nomenclature for the MIB implementation details can be found in Table A-1 and the SNMP Access Requirements are detailed in

Table A-2 of Annex A.1. Please refer to these tables for the values found for each of the interfaces in Table A-6 and Table A-7.

In addition to the requirements for Ethernet and USB detailed in Table A-6 below, note that the various packet and octet counters from the ifTable and ifXTable MAY exclude LAN-LAN traffic which is not bridged upstream or downstream. From the ifTable, these counters include the following: ifInOctets, ifInUcastPkts, ifOutOctets, and ifOutUcastPkts. From the ifXTable, included counters are ifInMulticastPkts, ifInBroadcastPkts, ifOutMulticastPkts, ifOutBroadcastPkts, ifHCInOctets, ifHCInUcastPkts, ifHCInMulticastPkts, ifHCInBroadcastPkts, ifHCOutOctets, ifHCOutUcastPkts, ifHCOutMulticastPkts, and ifHCOutBroadcastPkts.

**Table A-4 - [RFC 2863] ifTable/ifXTable MIB-Object Details for Ethernet and USB Interfaces<sup>137</sup>**

MIB Objects	CMTS-Ethernet	CM-Ethernet	CM USB CDC Ethernet	CM-CPE Other Type
IfTable				
ifIndex	(n)	1 or [4+(n)]	1 or [4+(n)]	1 or [4+(n)]
ifDescr			See 7.1.3.3.7.1	
ifType	6	6	160	(IANA num)
ifMtu	1500	1500	1500	Media dependent
ifSpeed	10,000,000, 100,000,000, ...	10,000,000, 100,000,000, ...	12,000,000, 480,000,000	speed
ifPhysAddress	MAC Address of this interface	MAC Address of this interface	MAC Address of this interface	Media dependent

<sup>136</sup> Section revised per OSSIV3.0-N-07.0540-4 by ab on 11/8/07 and OSSIV3.0-N-08.0632-3 on 4/18/08 by KN.

<sup>137</sup> Table revised per OSSIV3.0-N-07.0397-2 by ab on 5/4/07, per OSSIV3.0-N-07.0402-1 on 5/7/07, OSSIV3.0-N-07.0410-4, and #18 & 19 of OSSIV3.0-N-0395-3. Further revised per OSSIV3.0-N-07.0514-2 by ab on 10/15/07 and OSSIV3.0-N-08.0700-4 on 1/12/09 by JS.

MIB Objects	CMTS-Ethernet	CM-Ethernet	CM USB CDC Ethernet	CM-CPE Other Type
ifAdminStatus For CM: When a managed system initializes, all interfaces start with ifAdminStatus in the up(1) state. As a result of explicit management action, ifAdminStatus is then changed to either the down(2) or testing(3) states (or remains in the up(1) state). For CMTS: When a managed system initializes, all interface start with ifAdminStatus in the up(1) state. As a result of either explicit management or configuration information saved via other non-SNMP method (i.e., CLI commands) retained by the managed system, ifAdminStatus is then changed to either the down(2) or testing(3) states (or remains in the up(1) state).	up(1), down(2), testing(3)	up(1), down(2), testing(3)	up(1), down(2), testing(3)	up(1), down(2), testing(3)
ifOperStatus	up(1), down(2), testing(3), dormant(5), notPresent(6)	up(1), down(2), testing(3), dormant(5), notPresent(6)	See 7.1.3.3.2.2	up(1), down(2), testing(3), dormant(5), notPresent(6)
ifLastChange				
<b>ifXTable</b>				
ifName				
ifLinkUpDownTrapEnable				
<b>Note:</b> See Section 7.1.3.3.4 for details				
ifHighSpeed	10, 100, ...	10, 100, ...	12, 480	speed
ifPromiscuousMode	true, false	true, false	true, false	true, false
ifConnectorPresent				
ifAlias				
ifCounterDiscontinuityTime				

**Note:** Refer to Table A-6 for Counter32 and Counter64 MIB object details.

**Table A-5 - [RFC 2863] ifTable/ifXTable MIB-Object Details for MAC and RF Interfaces**<sup>138</sup>

MIB Objects	CMTS-MAC	CMTS-Downstream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Downstream	CM-Upstream
IfTable							
ifIndex	(n)	(n)	(n)	(n)	2	3	4

<sup>138</sup> Table reformatted per OSSIV3.0-N-07.0397-2 by ab on 5/4/07 and revised per OSSIV3.0-N-07.0402-1 on 5/7/07 by KN. Revised per OSSIV3.0-N-07.0514-2 by ab on 10/15/07 and OSSIV3.0-N-08.0700-4 on 1/12/09 by JS.

MIB Objects	CMTS-MAC	CMTS-Downstream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Downstream	CM-Upstream
ifDescr							
ifType	127	128	129	205	127	128	129
ifMtu [For RF Upstream/Downstream; the value includes the length of the MAC header.]	1500	1764	1764	1764	1500	1764	1764
ifSpeed [For RF Downstream; This is the symbol rate multiplied by the number of bits per symbol. For RF Upstream; This is the raw band-width in bits per second of this interface, regarding the highest speed modulation profile that is defined. This is the symbol rate multiplied with the number of bits per symbol for this modulation profile.]	0	~64-QAM=30,341,646 ~256-QAM=42,884,296	(n)	(n)	0	~64-QAM=30,341,646 ~256-QAM=42,884,296	(n)
ifPhysAddress:	MAC Address of this interface	Empty-String	Empty-String	Empty-String	MAC Address of this interface	Empty-String	Empty-String
ifAdminStatus: [For CM: When a managed system initializes, all interfaces start with ifAdminStatus in the up(1) state. As a result of explicit management action, ifAdminStatus is then changed to either the down(2) or testing(3) states (or remains in the up(1) state). For CMTS: When a managed system initializes, all interface start with ifAdminStatus in the up(1) state. As a result of either explicit management or configuration information saved via other non SNMP method (i.e., CLI commands) retained by the managed system, ifAdminStatus is then changed to either the down(2) or testing(3) states (or remains in the up(1) state).]	up(1), down(2), testing(3)	up(1), down(2), testing(3)					
ifOperStatus:	up(1), down(2), testing(3), dormant(5), notPresent(6)	up(1), down(2), testing(3), dormant(5), notPresent(6)					
ifLastChange:							
ifXTable							
ifName							

MIB Objects	CMTS-MAC	CMTS-Downstream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Downstream	CM-Upstream
ifLinkUpDownTrapEnable See Section 7.1.3.3.5.							
ifHighSpeed For RF Downstream; This is the symbol rate multiplied with the number of bits per symbol. For RF Upstream; This is the raw bandwidth in bits per second of this interface, regarding the highest speed modulation profile that is defined. This is the symbol rate multiplied with the number of bits per symbol for this modulation profile.]	0	~64-QAM=30,~256-QAM=43	(n)*	(n)**	0	~64-QAM=30,~256-QAM=43	(n)
ifPromiscuousMode	true, false	false	true, false	true	true	true	false
ifConnectorPresent							
ifAlias							
ifCounterDiscontinuityTime							

**Note:** Refer to Table A-7 for Counter32 and Counter64 MIB object details.

**Table A-6 - [RFC 2863] ifTable/ifXTable Counter32 and Counter64 MIB-Object Details for Ethernet and USB Interfaces<sup>139</sup>**

MIB Counter Objects	ACCESS	CMTS-Ethernet	CM-Ethernet	CM-USB	CM-CPE Other Type
<b>ifTable</b>					
ifInOctets	RO	M	M	M	M
ifInUcastPkts	RO	M	M	M	M
ifInDiscards	RO	M	M	M	M
ifInErrors	RO	M	O	O	M
ifInUnknownProtos	RO	M	M	M	M
ifOutOctets	RO	M	M	M	M
ifOutUcastPkts	RO	M	M	M	M
ifOutDiscards	RO	M	M	M	M
ifOutErrors	RO	M	M	M	M

<sup>139</sup> Table modified per OSSIV3.0-N-08.0632-3 on 4/18/08 by KN.

MIB Counter Objects	ACCESS	CMTS-Ethernet	CM-Ethernet	CM-USB	CM-CPE Other Type
<b>ifXTable</b>					
ifInMulticastPkts	RO	M	M	M	M
ifInBroadcastPkts	RO	M	M	M	M
ifOutMulticastPkts	RO	M	M	M	M
ifOutBroadcastPkts	RO	M	M	M	M
IfHCInOctets	RO	O	O	O	O
ifHCInUcastPkts	RO	O	O	O	O
ifHCInMulticastPkts	RO	O	O	O	O
ifHCInBroadcastPkts	RO	O	O	O	O
ifHCOutOctets	RO	O	O	O	O
ifHCOutUcastPkts	RO	O	O	O	O
ifHCOutMulticastPkts	RO	O	O	O	O
ifHCOutBroadcastPkts	RO	O	O	O	O

In Table A-7, the packet and octet counters are implemented based on the requirements in Section 7 of this specification. In this table, the value NA means that the particular counter is not applicable to this interface. Objects labeled as NA or O in Table A-7 can be optionally implemented and if implemented, the object will return 0 when read.

**Table A-7 - [RFC 2863] ifTable/ifXTable Counter32 and Counter64 MIB-Object Details for MAC and RF Interfaces<sup>140</sup>**

MIB Counter Objects	Access	CMTS-MAC	CMTS-Down-stream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Down-stream	CM-Upstream
<b>ifTable</b>								
ifInOctets For RF Upstream/Downstream (where not zero); This includes MAC packets as well as data packets, and includes the length of the MAC header, this does not include any PHY overhead. For MAC; The total number of data octets (data in transit, data targeted to the managed device) received on this interface from the RF interface and before application of protocol filters.	RO	M	NA	M	M	M	M	NA

<sup>140</sup> Table revised per OSSIV3.0-N-08.0644-1 on 5/1/08 by KN.

MIB Counter Objects	Access	CMTS-MAC	CMTS-Down-stream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Down-stream	CM-Upstream
ifInUcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; the total number of Unicast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	M	NA	O	O	M	O	NA
ifInDiscards	RO	M	NA	O	O	M	O	NA
ifInErrors	RO	M	NA	O	O	M	O	NA
ifInUnknownProtos	RO	M	NA	O	O	M	O	NA
ifOutOctets For RF Upstream/ Downstream (where not zero); This includes MAC packets as well as data packets, and includes the length of the MAC header, this does not include any PHY overhead. For MAC; The total number of data octets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	M	M	NA	NA	M	NA	M
ifOutUcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Unicast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	M	O	NA	NA	M	NA	O
ifOutDiscards	RO	M	O	NA	NA	M	NA	O
ifOutErrors	RO	M	O	NA	NA	M	NA	O
<b>ifXTable</b>								
ifInMulticastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; the total number of Multicast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	M	NA	O	O	M	O	NA
ifInBroadcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Broadcast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	M	NA	O	O	M	O	NA
ifOutMulticastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Multicast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	M	O	NA	NA	M	NA	O

MIB Counter Objects	Access	CMTS-MAC	CMTS-Down-stream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Down-stream	CM-Upstream
ifOutBroadcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Broadcast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	M	O	NA	NA	M	NA	O
IfHCInOctets For RF Upstream/Downstream (where not zero); This includes MAC packets as well as data packets, and includes the length of the MAC header, this does not include any PHY overhead. For MAC; The total number of data octets (data in transit, data targeted to the managed device) received on this interface from the RF interface and before application of protocol filters.	RO	M	NA	M	M	M	M	NA
ifHCInUcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; the total number of Unicast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	O	NA	O	O	O	O	NA
ifHCInMulticastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; the total number of Multicast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	O	NA	O	O	O	O	NA
ifHCInBroadcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Broadcast data packets (data in transit, data targeted to the managed device) received on this interface from the RF interface before application of protocol filters.	RO	O	NA	O	O	O	O	NA
ifHCOOutOctets For RF Upstream/Downstream (where not zero); This includes MAC packets as well as data packets, and includes the length of the MAC header, this does not include any PHY overhead. For MAC; The total number of data octets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	M	M	NA	NA	M	NA	M
ifHCOOutUcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Unicast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	O	O	NA	NA	O	NA	O

MIB Counter Objects	Access	CMTS-MAC	CMTS-Down-stream	CMTS-Upstream Physical Interface	CMTS-Upstream Logical Channel	CM-MAC	CM-Down-stream	CM-Upstream
ifHCOutMulticastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Multicast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RO	O	O	NA	NA	O	NA	O
ifHCOutBroadcastPkts For RF Upstream/Downstream; Reports zero if implemented. For MAC; The total number of Broadcast data packets (data in transit, data generated by the managed device) transmitted on this interface to the RF interface after application of protocol filters.	RW	O	O	NA	NA	O	NA	O

## Annex B IPDR for DOCSIS Cable Data Systems Subscriber Usage Billing Records (Normative)

### B.1 Service Definition

Cable Data Systems consist of Cable Modem Termination Systems (CMTSs), located at a Multiple Service Operator's (MSO's) head-end office, that provide broadband Internet access to subscribers connected via Cable Modems (CMs), through the Hybrid Fiber/Coax (HFC) cable plant. These Cable Data Systems comply with the Data-Over-Cable Service Interface Specifications (DOCSIS) sponsored by Cable Television Laboratories, Inc. The IPDR format for Cable Data Systems Subscriber Usage Billing Records specified herein, support the DOCSIS 1.1, 2.0 and 3.0 Operations Support System Interface Specification (OSSI). The DOCSIS 1.1, 2.0 and 3.0 OSSI specifications require the CMTS to provide usage-billing records for all bandwidth consumed by the subscribers connected to it by their Cable Modems, when polled by the MSO's billing or mediation system.

#### B.1.1 DOCSIS Service Requirements

1. Cable Data Service is "always on". Thus, from the CMTS perspective, there are no subscriber log-on events to track, but rather, in a manner similar to electric power utilities, there are only data traffic flows to meter and police.
2. Cable Data Subscribers are uniquely identified by their Cable Modem MAC addresses (i.e., Ethernet addresses). Note that a CM is usually assigned a dynamic IP address via DHCP, so the IP address of a subscriber may change over time. Since the CM MAC address is constant, it is used to identify the subscriber's usage billing records. All Internet traffic generated by the subscriber's CPE is bridged by the CM to and from the CMTS. The subscriber's packet and byte (octet) traffic counts are recorded by the CMTS in Service Flow counters associated with the CM MAC address. A CM may have two or more Service Flows active during a collection interval. Note that the current IP addresses of the CM and all the CPE in use during the collection interval are recorded for auditing purposes.
3. Cable Data Service is metered and enforced against a Service Level Agreement (SLA) that specifies the Quality of Service (QoS) that an MSO provides to a subscriber. An MSO typically has several Service Packages to offer to their subscribers, such as "Gold", "Silver", or "Bronze". Each of the Service Packages implements a specific SLA and is available for a specific price. A Service Package is implemented by a set of Service Flows that are known to the billing system by their Service Flow IDs (SFIDs) and Service Class Names (SCNs). Service Flows are the unit of billing data collection for a Cable Data Subscriber. In addition, since a subscriber may change their Service Package over time, it is very likely that a given subscriber will have several IPDRs, one for each Service Flow they have used during the collection interval. Basic Service Packages can be offered for legacy DOCSIS 1.0 networks or CMs being provisioned with DOCSIS 1.0 Class of Services.
4. Bandwidth in a Cable Data System is measured separately in both the downstream and upstream directions (relative to the CMTS). Each Service Flow is unidirectional and may be associated with packet traffic of a specific type (e.g., TCP or UDP). Since most SLAs provide for asymmetric bandwidth guarantees, it is necessary to separate the downstream and upstream traffic flows in the billing usage records. Bandwidth used is measured in both packets and octets. If the CM is registered in DOCSIS 1.0 mode, statistics associated to the CM SID are collected for upstream and downstream data flows.
5. The bandwidth guarantee component of the SLA is enforced and metered by the CMTS with the assistance of the CM. However, the CM is not considered a trusted device because of its location on the Customer's Premises, so the CMTS is expected to provide all of the usage billing information for each subscriber connected to it. SLA metrics are not measured for DOCSIS 1.0 Class of Service type of usage billing records.
6. Since an SLA may require the CMTS to enforce bandwidth limits by dropping or delaying packets that exceed the maximum throughput bandwidth for a Service Flow, the SLA dropped packets counters and delayed packets counters are also included in the usage records for each Service Flow. These counters are not intended to compute billable subscriber usage but rather are available to the billing and customer care systems to enable "up-selling" to subscribers who consistently exceed their subscribed service level. Thus, subscribers whose usage patterns indicate a large number of dropped octets are probably candidates for an upgrade to a higher SLA that supports their true application bandwidth demands which, in turn, generates more revenue for the MSO.

7. The packet and octet values in the usage billing records are based on absolute 64-bit counters maintained in the CMTS. These counters may be reset when the CMTS system resets, therefore the CMTS system up time (see CmtsSysUpTime in Annex C) is included in the IPDRDoc so that the billing or mediation system can correlate counters that appear to regress.
8. Group Service Flows are Service Flows received by one or more Cable Modems. A single record is created for a Group Service flow.<sup>141</sup>

### B.1.2 SAMIS Usage Attribute List

A DOCSIS SAMIS IPDR record is constructed from a number of attributes that describe the IPDR itself, the CMTS that is serving the subscriber, the subscriber's CM, and the QoS attributes and counters.

#### B.1.2.1 CMTS Information

A DOCSIS SAMIS IPDR record contains attributes that identify the CMTS that is serving the subscriber. The CMTS attributes are defined in the CMTS Information section of Annex C. Note that the CMTS information attributes defined in Annex C can be streamed independently (i.e., in other IPDR record types) from the SAMIS IPDR and then correlated at the Collector using the CmtsHostName attribute.

DOCSIS SAMIS Type 1 IPDR records contain the following CMTS attributes:

- CmtsHostName
- CmtsSysUpTime
- CmtsIpv4Addr
- CmtsIpv6Addr
- CmtsMdIfName
- CmtsMdIfIndex

DOCSIS SAMIS Type 2 IPDR records contain the following CMTS attributes:

- CmtsHostName
- CmtsSysUpTime
- CmtsMdIfName
- CmtsMdIfIndex

#### B.1.2.2 CM Information<sup>142</sup>

A DOCSIS SAMIS IPDR record contains attributes that uniquely identify the CM or Group Service Flow. Each SAMIS IPDR for a given CM or Group Service Flow within the IPDRDoc will contain identical values for these attributes. The CM attributes are defined in the CM or Group Service Flow Information section of Annex C. Note that the CM information attributes defined in Annex C can be streamed independently (i.e., in other IPDR record types) from the SAMIS IPDR and then correlated at the Collector.

DOCSIS SAMIS Type 1 IPDR records contain the following CM attributes:

- CmMacAddr
- CmIpv4Addr
- CmIpv6Addr
- CmIpv6LinkLocalAddr
- CmQosVersion

<sup>141</sup> Revised per OSSIV3.0-N-10.0971-2 on 4/26/11 by JB.

<sup>142</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN. Revised per OSSIV3.0-N-10.0971-2 on 4/26/11 by JB.

- CmRegStatusValue
- CmLastRegTime

DOCSIS SAMIS Type 2 IPDR records contain the following CM attributes:

- CmMacAddr

#### **B.1.2.3 Record Information**

A DOCSIS SAMIS IPDR record contains attributes that identify the type of record and creation time. The Record attributes are defined in the Record Information section of Annex C.

DOCSIS SAMIS Type 1 and Type 2 IPDR records contain the following CM attributes:

- RecType
- RecCreationTime

#### **B.1.2.4 QoS Information<sup>143</sup>**

A DOCSIS SAMIS IPDR record contains the following attributes that identify the service flow and contain the counters maintained by the CMTS for that service flow (i.e., QoS attributes). The QoS attributes are defined in the QoS Information section of Annex C.

DOCSIS SAMIS Type 1 and Type 2 IPDR records contain the following CM attributes:

- ServiceFlowChSet
- ServiceAppId
- ServiceDsMulticast
- ServiceIdentifier
- ServiceGateId
- ServiceClassName
- ServiceDirection
- ServiceOctetsPassed
- ServicePktsPassed
- ServiceSlaDropPkts
- ServiceSlaDelayPkts
- ServiceTimeCreated
- ServiceTimeActive

## **B.2 IPDR Service Definition Schemas**

The section defines the IPDR Service Definition schemas for the SAMIS feature. Refer to Annex C for the global element definitions referenced in the Service Definition schema files.

### **B.2.1 DOCSIS-SAMIS-TYPE-1\_3.5.1-A.1.xsd<sup>144</sup>**

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
```

<sup>143</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN. Revised per OSSIV3.0-N-10.0971-2 on 4/26/11 by JB.

<sup>144</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 by KN, per OSSIV3.0-N-07.0478-2 by ab on 7/12/07, and per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```
targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-
TYPE-1"
    xmlns:DOCSIS-SAMIS-TYPE-
1="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-1"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
            xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
                xmlns:DOCSIS-
QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
                    xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                            version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
QOS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
QOS/DOCSIS-QOS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
            for global element references.</documentation>
        </annotation>
    </include>
    <annotation>
        <documentation>DOCSIS-SAMIS-TYPE-1 is an IPDR Service Definition
        schema defining the Subscriber Account Management (SAMIS)
        Type 1 IPDR data record which references the imported global elements.
        SAMIS-TYPE-1 is based on the inclusive streaming model where all
        fields are included in each streamed record.</documentation>
        <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I01-061207, Annex B.
            </ipdr:reference>
        </documentation>
    </annotation>
<complexType name="SAMIS-TYPE-1">
    <complexContent>
        <extension base="ipdr:IPDRTyp
<sequence>
    <element ref="DOCSIS-CMTS:CmtsHostName" />
    <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
    <element ref="DOCSIS-CMTS:CmtsIpv4Addr" />
    <element ref="DOCSIS-CMTS:CmtsIpv6Addr" />
    <element ref="DOCSIS-CMTS:CmtsMdIfName" />
    <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
    <element ref="DOCSIS-CM:CmMacAddr" />
    <element ref="DOCSIS-CM:CmIpv4Addr" />
    <element ref="DOCSIS-CM:CmIpv6Addr" />
    <element ref="DOCSIS-CM:CmIpv6LinkLocalAddr" />
```

```

<element ref="DOCSIS-CM:CmQosVersion"/>
<element ref="DOCSIS-CM:CmRegStatusValue"/>
<element ref="DOCSIS-CM:CmLastRegTime"/>
<element ref="DOCSIS-REC:RecType"/>
<element ref="DOCSIS-REC:RecCreationTime"/>
<element ref="DOCSIS-QOS:ServiceFlowChSet"/>
<element ref="DOCSIS-QOS:ServiceAppId"/>
<element ref="DOCSIS-QOS:ServiceDsMulticast"/>
<element ref="DOCSIS-QOS:ServiceIdentifier"/>
<element ref="DOCSIS-QOS:ServiceGateId"/>
<element ref="DOCSIS-QOS:ServiceClassName"/>
<element ref="DOCSIS-QOS:ServiceDirection"/>
<element ref="DOCSIS-QOS:ServiceOctetsPassed"/>
<element ref="DOCSIS-QOS:ServicePktsPassed"/>
<element ref="DOCSIS-QOS:ServiceSlaDropPkts"/>
<element ref="DOCSIS-QOS:ServiceSlaDelayPkts"/>
<element ref="DOCSIS-QOS:ServiceTimeCreated"/>
<element ref="DOCSIS-QOS:ServiceTimeActive"/>
</sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

## B.2.2 DOCSIS-SAMIS-TYPE-2\_3.5.1-A.1.xsd<sup>145</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-
TYPE-2"
    xmlns:DOCSIS-SAMIS-TYPE-
2="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-2"
    xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-
QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
    xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
QOS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
QOS/DOCSIS-QOS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>

```

<sup>145</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```
<documentation>Import auxiliary schemas  
for global element references.</documentation>  
</annotation>  
</include>  
<annotation>  
    <documentation>DOCSIS-SAMIS-TYPE-2 is an IPDR Service Definition  
    schema defining the Subscriber Account Management (SAMIS)  
    Type 2 IPDR data record which references the imported global elements.  
    SAMIS-TYPE-2 is based on the optimized streaming model where only  
    updated fields are included in each streamed record.</documentation>  
    <documentation>  
        <ipdr:reference>  
            DOCSIS 3.0 Operations Support System Interface Specification  
            CM-SP-OSSIv3.0-I01-061207, Annex B.  
        </ipdr:reference>  
    </documentation>  
</annotation>  
<complexType name="SAMIS-TYPE-2">  
    <complexContent>  
        <extension base="ipdr:IPDRTypE">  
            <sequence>  
                <element ref="DOCSIS-CMTS:CmtsHostName" />  
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />  
                <element ref="DOCSIS-CMTS:CmtsMdIfName" />  
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />  
                <element ref="DOCSIS-CM:CmMacAddr" />  
                <element ref="DOCSIS-REC:RecType" />  
                <element ref="DOCSIS-REC:RecCreationTime" />  
                <element ref="DOCSIS-QOS:ServiceFlowChSet" />  
                <element ref="DOCSIS-QOS:ServiceAppId" />  
                <element ref="DOCSIS-QOS:ServiceDsMulticast" />  
                <element ref="DOCSIS-QOS:ServiceIdentifier" />  
                <element ref="DOCSIS-QOS:ServiceGateId" />  
                <element ref="DOCSIS-QOS:ServiceClassName" />  
                <element ref="DOCSIS-QOS:ServiceDirection" />  
                <element ref="DOCSIS-QOS:ServiceOctetsPassed" />  
                <element ref="DOCSIS-QOS:ServicePktsPassed" />  
                <element ref="DOCSIS-QOS:ServiceSlaDropPkts" />  
                <element ref="DOCSIS-QOS:ServiceSlaDelayPkts" />  
                <element ref="DOCSIS-QOS:ServiceTimeCreated" />  
                <element ref="DOCSIS-QOS:ServiceTimeActive" />  
            </sequence>  
        </extension>  
    </complexContent>  
</complexType>  
</schema>
```

## Annex C Auxiliary Schemas for DOCSIS IPDR Service Definitions (Normative)

### C.1 Overview

This annex defines a set of auxiliary schema files for the DOCSIS IPDR Service Definitions defined in Annex R. In some cases, the auxiliary schema element definitions are derived from attributes defined in object models from other annexes within this specification. Otherwise the attributes are defined within this annex before the inclusion of the auxiliary schema file.

An auxiliary schema file defines global elements that are referenced in various DOCSIS IPDR Service Definition schemas. The purpose for defining auxiliary schemas is to allow defining global elements that can be externally referenced in multiple DOCSIS IPDR Service Definition schemas. This allows for modularization of schema documents and easier extensibility.

### C.2 XML Semantics

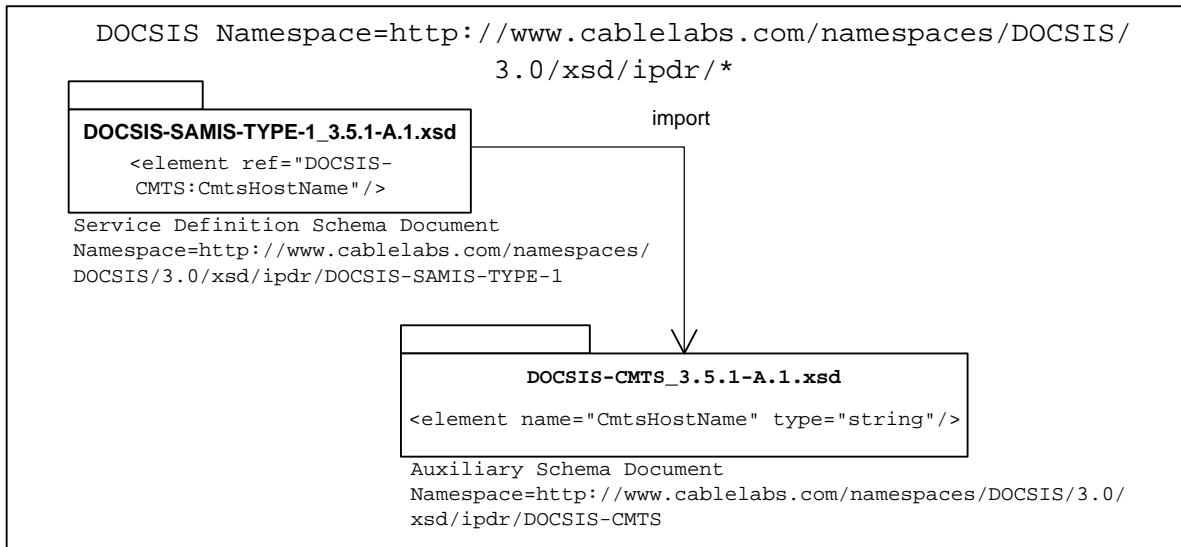
#### C.2.1 Import Element

DOCSIS IPDR Service Definition schemas are often composed from multiple schema documents (called auxiliary schemas). This is accomplished through the import mechanism since the Service Definition schema and auxiliary schemas have different namespaces.

Auxiliary schemas are imported in any one of the DOCSIS IPDR Service Definition schemas using the import element as follows:

```
<import namespace="<Auxiliary Schema Namespace>" schemaLocation="<Auxiliary Schema Location>" />
```

The import element appears at the top level of the Service Definition schema document. Figure C-1 shows an example of the import mechanism.



**Figure C-1 - Auxiliary Schema Import**

#### C.2.2 Element References

In many instances, an object model defines a group of objects where each object defines a set of attributes. Attributes are then realized in XML schemas as element definitions (not XML attribute definitions). Therefore the terms 'attribute' and 'element' are often interchangeable). It should be clarified that object model attributes (as

defined in this specification) are not the same as XML attributes (as often used in XML Schemas). IPDR schemas do not define XML attributes.

DOCSIS IPDR Service Definition schema documents reference global element declarations from auxiliary schemas using a ref attribute. For example, a Service Definition schema references the CmtsHostName global element using the ref attribute as follows:

```
<element ref="DOCSIS-CMTS:CmtsHostName" />
```

Figure C-1 shows the CmtsHostName global element declaration in the auxiliary schema DOCSIS-CMTS\_3.5.1-A.1.xsd and the element reference in the Service Definition schema DOCSIS-SAMIS-TYPE-1\_3.5.1-A.1.xsd.

### C.3 CMTS Information

The DOCSIS CMTS Information auxiliary schema contains the following attributes that identify a CMTS.

**Table C-1 - CMTS Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
Who	CmtsHostName	String	Required	FQDN
When	CmtsSysUpTime	unsignedInt	Required	nnnnnnnnnn
Who	Cmtslpv4Addr	ipV4Addr	Required	nnn.nnn.nnn.nnn
Who	Cmtslpv6Addr	ipV6Addr	Required	xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx
What	CmtsMdifName	String	Required	SIZE (0..50)
What	CmtsMdifIndex	unsignedInt	Required	nnnnnnnnnn

#### C.3.1 CmtsHostName

CmtsHostName is the fully qualified domain name (FQDN) of the CMTS. This attribute will contain an empty string only if the CMTS does not have a domain name. A null FQDN will be represented as <CmtsHostName></CmtsHostName> or <CmtsHostName/>. An example FQDN is "cmts01.mso.com".

References: [RFC 2821].

#### C.3.2 CmtsSysUpTime

CmtsSysUpTime is the sysUpTime value taken from the CMTS at the time the IPDR record is created, formatted in decimal notation and represented in XDR compact representation as a 32-bit integer. This is the number of 100ths of a second since initialization of the CMTS system or CMTS interface module, whichever is most appropriate for a given CMTS architecture. For any given Service Flow or DOCSIS 1.0 SID reported in an IPDRDoc, it is required that the value be monotonically increased to minimize SFIDs and SIDs reusage within a two reporting intervals, unless the system or interface represented by the sysUpTime value has been reinitialized. If the value has decreased, this can be used by the Collector as a hint that the service flow counters are likely to have regressed. It is specifically not required that the value of CmtsSysUpTime be the same for all records in an IPDRDoc.

References: [RFC 3418].

#### C.3.3 Cmtslpv4Addr

Cmtslpv4Addr is the IPv4 address for the CMTS. This element is formatted in standard decimal dotted notation such as 10.10.100.1. The XDR compact representation of this element is a 32-bit integer.

#### C.3.4 Cmtslpv6Addr

Cmtslpv6Addr is the IPv6 address for the CMTS. This element is formatted in colon separated 2-byte block hexadecimal notation such as FEDC:AB19:12FE:0234:98EF:1178:8891:CAFF. The XDR compact representation of this element is a 32-bit integer.

### C.3.5 CmtsMdIfName

CmtsMdIfName contains the first 50 characters of the ifName from the Interfaces Group MIB for the row entry corresponding to the CMTS MAC Domain interface (ifType = 127) for this CM. The ifName is defined as: "The textual name of the interface. The value of this object should be the name of the interface as assigned by the local device and should be suitable for use in commands entered at the device's 'console'. This might be a text name, such as 'le0' or a simple port number, such as '1', depending on the interface naming syntax of the device. If several entries in the ifTable together represent a single interface as named by the device, then each will have the same value of ifName. Note that for an agent which responds to SNMP queries concerning an interface on some other (proxied) device, then the value of ifName for such an interface is the proxied device's local name for it. If there is no local name, or this attribute is otherwise not applicable, then this attribute contains a zero-length string."

References: [RFC 2863].

### C.3.6 CmtsMdIfIndex

CmtsMdIfIndex is the ifIndex from the Interfaces Group MIB for the CMTS MAC Domain interface (described in CmtsMdIfName). This value makes the ServiceIdentifier unique.

References: [RFC 2863].

### C.3.7 DOCSIS-CMTS\_3.5.1-A.1.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
        version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-CMTS_3.5.1-A.1 is an auxiliary schema
which defines information specific to a CMTS.</documentation>
        <documentation>
            <ipdr:reference>DOCSIS 3.0 Operations Support System Interface
Specification CM-SP-OSSIv3.0-I01-061207, Annex C.
            </ipdr:reference>
        </documentation>
    </annotation>
    <element name="CmtsHostName" type="string">
        <annotation>
            <documentation>Contains the Fully Qualified Domain Name (FQDN) of the
CMTS.
                If the CMTS does not have a domain name, it contains an empty string.
            </documentation>
        </annotation>
    </element>
    <element name="CmtsSysUpTime" type="unsignedInt">
        <annotation>
            <documentation>Contains a 32-bit count of hundredths of a second
since system initialization, in decimal notation.</documentation>
        </annotation>
    </element>
    <element name="CmtsIpv4Addr" type="ipdr:ipV4Addr">
        <annotation>
            <documentation>Contains the IPv4 address of the CMTS.
                If the CMTS IPv4 address is unassigned or unknown, it
contains an empty string.</documentation>
        </annotation>
    </element>

```

```

</element>
<element name="CmtsIpv6Addr" type="ipdr:ipV6Addr">
    <annotation>
        <documentation>Contains the IPv6 address of the CMTS.
        If the CMTS IPv6 address is unassigned or unknown, it
        contains an empty string.</documentation>
    </annotation>
</element>
<element name="CmtsMdIfName">
    <annotation>
        <documentation>Contains the first 50 characters of the
        ifName from the Interfaces Group MIB for the row entry corresponding
        to the CMTS Mac Domain interface (ifType = 127).</documentation>
    </annotation>
    <simpleType>
        <restriction base="string">
            <maxLength value="50"/>
            <minLength value="0"/>
        </restriction>
    </simpleType>
</element>
<element name="CmtsMdIfIndex" type="unsignedInt">
    <annotation>
        <documentation>Contains the ifIndex for the CMTS MAC domain
        interface (described in CmtsMdIfName).</documentation>
    </annotation>
</element>
</schema>

```

## C.4 CM Information

Refer to the CmtsCmRegStatus object of Annex N for the definition of the CM attributes.

### C.4.1 DOCSIS-CM\_3.5.1-A.3.xsd<sup>146</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="3.5.1-A.3">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-CM_3.5.1-A.3 is an auxiliary schema
        which defines CM information.</documentation>
        <documentation>
            Revision History:
            3.5.1-A.1 Initial version.
            3.5.1-A.2 Revised version includes ECN OSSIV3.0-N-12.1073-3
            and published as I20.
            3.5.1-A.3 Revised version includes ECN OSSIV3.0-N-12.1083
            and published as I21.
            <ipdr:reference>DOCSIS 3.0 Operations Support System Interface
            Specification CM-SP-OSSIv3.0-I21-130404, Annex C.</ipdr:reference>
        </documentation>
    </annotation>

```

<sup>146</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN. Revised per OSSIV3.0-N-10.0971-2 on 4/26/11, per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB, and OSSIV3.0-N-12.1073-3 on 11-2-12 by PO, title changed, xsd modified per OSSIV3.0-N-12.1083-5 on 3/20/13 by PO.

```

<element name="CmMacAddr" type="ipdr:macAddress">
    <annotation>
        <documentation>Contains the MAC Address of the CM.  

        If the CM has multiple MAC Addresses, it contains the  

        MAC address associated with the Cable (i.e., RF MAC) interface.  

        When the record is a Group Service Flow, the MAC address should  

        contain a multicast address compliant with either [RFC 2464] or  

        [RFC 1112] as applicable</documentation>
    </annotation>
</element>
<element name="CmRegStatusId" type="unsignedInt">
    <annotation>
        <documentation>  

            Contains the id value to uniquely identify a CM.
        </documentation>
    </annotation>
</element>
<element name="CmIpv4Addr" type="ipdr:ipV4Addr">
    <annotation>
        <documentation>Contains the IPv4 address of the CM.  

        If the CM IPv4 address is unassigned or unknown, it  

        contains an empty string. If the CM has multiple IPv4 addresses,  

        it contains the IPv4 address associated with the  

        Cable (i.e., RF MAC) interface.
    </documentation>
    </annotation>
</element>
<element name="CmIpv6Addr" type="ipdr:ipV6Addr">
    <annotation>
        <documentation>Contains the IPv6 address of the CM.  

        If the CM IPv6 address is unassigned or unknown, it  

        contains an empty string.</documentation>
    </annotation>
</element>
<element name="CmIpv6LinkLocalAddr" type="ipdr:ipV6Addr">
    <annotation>
        <documentation>Contains the IPv6 Link Local address of  

        the CM. If the CM IPv6 Link Local address is unassigned or unknown,  

        it contains an empty string.</documentation>
    </annotation>
</element>
<element name="CmQosVersion">
    <annotation>
        <documentation> This attribute denotes the queuing services the CM  

        registered, either DOCSIS 1.1 QoS or DOCSIS 1.0 CoS mode.</documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="1">
                <annotation>
                    <documentation>  

                        <ipdr:enumMeaning>DOCSIS 1.0 CoS  

                    mode</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="2">
                <annotation>
                    <documentation>  

                        <ipdr:enumMeaning>DOCSIS 1.1 QoS  

                    mode</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>

```

```
        </enumeration>
    </restriction>
</simpleType>
</element>
<element name="CmRegStatusValue">
    <annotation>
        <documentation>Contains the current Cable Modem connectivity
state,
as specified in the OSSI Specification.
Returned status information is the CM status as assumed by the
CMTS.</documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="1">
                <annotation>
                    <documentation>
```

<ipdr:enumMeaning>other</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="2">
 <annotation>
 <documentation>

<ipdr:enumMeaning>initialRanging</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="4">
 <annotation>
 <documentation>

<ipdr:enumMeaning>rangingAutoAdjComplete</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="10">
 <annotation>
 <documentation>

<ipdr:enumMeaning>startEae</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="11">
 <annotation>
 <documentation>

<ipdr:enumMeaning>startDhcpv4</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="12">
 <annotation>
 <documentation>

<ipdr:enumMeaning>startDhcpv6</ipdr:enumMeaning>
 </documentation>
 </annotation>
 </enumeration>
 <enumeration value="5">

```
<annotation>
    <documentation>

<ipdr:enumMeaning>dhcpv4Complete</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="13">
    <annotation>
        <documentation>

<ipdr:enumMeaning>dhcpv6Complete</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="14">
    <annotation>
        <documentation>

<ipdr:enumMeaning>startConfigFileDownload</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="15">
    <annotation>
        <documentation>

<ipdr:enumMeaning>configFileDialogComplete</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="16">
    <annotation>
        <documentation>

<ipdr:enumMeaning>startRegistration</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="6">
    <annotation>
        <documentation>

<ipdr:enumMeaning>registrationComplete</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="8">
    <annotation>
        <documentation>

<ipdr:enumMeaning>operational</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="9">
    <annotation>
        <documentation>

<ipdr:enumMeaning>bpiInit</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
```

```
<enumeration value="17">
    <annotation>
        <documentation>

<ipdr:enumMeaning>forwardingDisabled</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
<enumeration value="18">
    <annotation>
        <documentation>

<ipdr:enumMeaning>rfMuteAll</ipdr:enumMeaning>
    </documentation>
    </annotation>
</enumeration>
</restriction>
</simpleType>
</element>
<element name="CmLastRegTime" type="dateTime">
    <annotation>
        <documentation>Contains the date and time value when
the CM was last registered.</documentation>
    </annotation>
</element>
<element name="CmEnergyMgtEnabled" type="hexBinary">
    <annotation>
        <documentation>This attribute indicates which, if any, of the
Energy Management Features are enabled for this CM. If this
attribute returns em1x1Mode(0) bit set, the CM is configured
with the Energy Management 1x1 Feature enabled. If this
attribute returns all bits cleared, the CM will not request
to operate in any Energy Management mode of operation. Note:
This attribute only indicates if an Energy Management Feature
is enabled/disabled via the CM config file and registration
request/response exchange and does not indicate whether the
CM is actively operating in an Energy Management
Mode.</documentation>
    </annotation>
</element>
<element name="CmEnergyMgtOperStatus" type="hexBinary">
    <annotation>
        <documentation>This attribute indicates whether the CM is
currently operating in an Energy Management Mode. If this
attribute returns em1x1Mode(0) bit set, the CM is operating
in Energy Management 1x1 Mode. If this attribute returns
all bits cleared, the CM is not operating in any Energy
Management Mode. This attribute always returns 0x00 (no
bits set) in the case when EnergyMgtEnabled is set to
0x00 (no Energy Management Features enabled).</documentation>
    </annotation>
</element>
<element name="CmEnergyMgt1x1ModeTotalDuration" type="unsignedInt">
    <annotation>
        <documentation>This attribute indicates the total time
duration, in seconds since registration, the CM identified
by Id has been in Energy Management 1x1 mode, as controlled
by the DBC-REQ Energy Management 1x1 Mode Indicator TLV.
    </documentation>
    </annotation>
</element>
</schema>
```

## C.5 Record Information

The DOCSIS Record Information auxiliary schema contains the following attributes which define information about an IPDR record.

**Table C-2 - Record Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
What	RecType	Integer	Required	Interim(1) Stop(2) Start(3) Event(4)
When	RecCreationTime	dateTimeMsec	Required	yyyy-mm-ddThh:mm:ss.mmmZ

### C.5.1 Rectype

The service flow type may be either Interim or Stop. An Interim type indicates a running service flow. A Stop type indicates a terminated service flow. A terminated service flow is only reported once in the IPDRDoc that is created on the cycle after the service flow is deleted. An Interim service flow is reported in each IPDRDoc that is created while it is running.

The CMTS MUST include in the IPDR record the current sample of the active counters for a running service flow or DOCSIS 1.0 SID.

The CMTS MUST include in the IPDR record the final, logged counter values for a terminated service flow.

### C.5.2 RecCreationTime<sup>147</sup>

The RecCreationTime = "yyyy-mm-ddThh:mm:ssZ" UTC time stamp at the time the data for the record was acquired based on CMTSSysUpTime (see CMTS Information section) value. The compact representation of this attribute is the 64-bit Long value since Epoch Time.

The CMTS MUST NOT delete the internal logged SF counters until after the terminated service flow has been recorded into an IPDR record that has been transmitted to a collector and acknowledged or stored in non-volatile memory, regardless of any other capability to manage them via SNMP through the DOCS-QOS3-MIB. DOCSIS 1.0 CoS related counters are maintained in a similar way, after SID termination, the CMTS MUST keep those values (regardless of SID reallocation for other CM or services) and export them in a 'Stop' record during the next IPDR collection interval.

The time zone is always GMT for DOCSIS IPDRs.

References: Annex O.

### C.5.3 DOCSIS-REC\_3.5.1-A.1.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
      xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
      xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
  <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
  <annotation>
    <documentation>DOCSIS-REC_3.5.1-A.1 is an auxiliary schema
    which defines IPDR Record information.</documentation>
    <documentation>
      <ipdr:reference>DOCSIS 3.0 Operations Support System Interface
```

<sup>147</sup> revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

```

        Specification CM-SP-OSSIv3.0-I01-061207, Annex C.</ipdr:reference>
    </documentation>
</annotation>
<element name="RecType">
    <annotation>
        <documentation>Contains the IPDR record type.
        'Interim' identifies a running record.
        'Stop' identifies the end of a record.
        'Start' identifies the start of a record.
        'Event' identifies a single message record containing all information.
        </documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="1">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>Interim</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="2">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>Stop</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="3">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>Start</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="4">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>Event</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
</element>
<element name="RecCreationTime" type="ipdr:dateTimeMsec">
    <annotation>
        <documentation>Contains a 64-bit count of milliseconds UTC time stamp
        at the time the data for the record was acquired.</documentation>
    </annotation>
</element>
</schema>

```

## C.6 QoS Information<sup>148</sup>

The DOCSIS QoS Information auxiliary schema contains the following attributes which define QoS information such as service flow information and counters.

---

<sup>148</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

**Table C-3 - QoS Information Attributes**

<b>Category</b>	<b>Attribute Name</b>	<b>Type</b>	<b>Presence</b>	<b>Permitted Values</b>
Where	ServiceFlowChSet	hexBinary	Required	SIZE (1..255)
What	ServiceAppId	unsignedInt	Required	32-bit integer
What	ServiceDsMulticast	boolean	Required	true, false
What	ServiceIdentifier	unsignedInt	Required	32-bit integer
What	ServiceGateId	unsignedInt	Required	32-bit integer
What	ServiceClassName	String	Required	ASCII string identifier
What	ServiceDirection	Integer	Required	Downstream(1) Upstream(2)
What	ServiceOctetsPassed	unsignedLong	Required	64-bit counter, in decimal notation
What	ServicePktsPassed	unsignedLong	Required	64-bit counter, in decimal notation
What	ServiceSlaDropPkts	unsignedInt	Required	32-bit counter, in decimal notation
What	ServiceSlaDelayPkts	unsignedInt	Required	32-bit integer, in decimal notation
When	ServiceTimeCreated	unsignedInt	Required	32-bit integer
When	ServiceTimeActive	unsignedInt	Required	32-bit integer

### C.6.1 ServiceFlowChSet

The ServiceFlowChSet attribute contains the set of channels configured for the service flow. Each octet represents the channel id of a channel.

### C.6.2 ServiceAppId<sup>149</sup>

The ServiceAppId attribute contains the application identifier associated with the service flow.

### C.6.3 ServiceDsMulticast<sup>150</sup>

The ServiceDsMulticast attribute indicates whether the service flow is multicast or unicast. A value of 'true' indicates a multicast service flow. A value of 'false' indicates a unicast service flow. If the ServiceDsMulticast attribute indicates a multicast service flow with a value of 'true', the CMTS MUST generate one or more corresponding IP-MULTICAST-STATS-TYPE records containing the IP multicast session statistics as defined in Annex R.

### C.6.4 ServiceIdentifier

The ServiceIdentifier attribute contains the internal service flow identifier (SFID) for DOCSIS 1.1 QoS provisioned CMs, or the service ID SID for CMs provisioned in DOCSIS 1.0 mode known to the CMTS. This attribute is needed to correlate the IPDRs for an individual service flows or DOCSIS 1.0 SIDs between adjacent IPDR records when computing delta counters. To avoid potential confusion in the billing system, it is desirable that the CMTS not reuse the ServiceIdentifier component for a minimum of two collection cycles. Depending of the collection interval and services dynamics, this goal may not be practical. As an intermediate solution a CMTS MAY assign ServiceIdentifier (SFIDs/SIDs) values with a monotonically increasing pattern.

### C.6.5 ServiceGateId<sup>151</sup>

The "GateID" associated with the service flow (SFID). For DOCSIS 1.0 service ID (SID) and non-Dynamic service flows, a zero value is reported.

References: [PKT-DQOS]; [PKT-PCMM]; [MULPI].

<sup>149</sup> Section revised per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

<sup>150</sup> Revised per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

<sup>151</sup> Section added per OSSIV3.0-N-07.0478-2 by ab on 7/12/07.

### C.6.6 ServiceClassName

The ServiceClassName attribute contains the name associated with the QoS parameter set for this service flow in the CMTS. The SCN is an ASCII string identifier, such as "GoldUp" or "SilverDn", which can be used by external operations systems to assign, monitor, and bill for different levels of bandwidth service without having to interpret the details of the QoS parameter set itself. A service flow is associated with an SCN whenever a cable modem configuration file uses the SCN to define an active service flow. A dynamic service flow application such as PacketCable may also assign an SCN to a service flow as a parameter during the dynamic creation of the service flow. Note that the use of SCNs is optional within the context of the DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification, however, for operational purposes, especially when billing for tiered data services per this specification, their use often becomes mandatory. Since this policy is within the control of the operator, the use of SCNs is not mandatory in this specification, but rather highly recommended.

The CMTS MUST include the ServiceClassName attribute in the IPDR record. The CMTS MUST encode this attribute as a zero length string if no SCN is used to identify the service flow.

References: [PKT-DQOS]; [MULPI].

### C.6.7 ServiceDirection

The CMTS MUST include the ServiceDirection attribute, which identifies the service flow direction relative to the CMTS RFI interface, as follows:

- Identifies DOCSIS 1.1 downstream service flows passing packets from the CMTS to the CM or DOCSIS 1.0 downstream traffic records.
- Identifies upstream DOCSIS 1.1 service flows passing packets from the cable modem to the CMTS or DOCSIS 1.0 CM upstream SIDs.

### C.6.8 ServiceOctetsPassed

The CMTS MUST include the ServiceOctetsPassed attribute as follows:

- For DOCSIS QoS service flows, ServiceOctetsPassed contains the current (or final) 64-bit count of the number of octets passed, formatted in decimal notation.
- For DOCSIS CoS CM provisioning, ServiceOctetsPassed contains the current (or final) count of octets passed by this SID or CM Downstream packets, depending on ServiceDirection.

If the RecType is Interim, then this is the current value of the running counter. If the RecType is Stop, then this is the final value of the terminated counter. The 64-bit counter value will not wrap around within the service lifetime of the CMTS.

### C.6.9 ServicePktsPassed

The CMTS MUST include the ServicePktsPassed attribute as follows:

- For DOCSIS QoS service flows, ServicePktsPassed contains the current (or final) 64-bit count of the number of packets passed, formatted in decimal notation.
- For DOCSIS CoS CM provisioning, ServicePktsPassed contains the current (or final) count of packets passed by this SID or CM Downstream packets, depending on ServiceDirection.

If the RecType is Interim, then this is the current value of the running counter. If the RecType is Stop, then this is the final value of the terminated counter. The 64-bit counter value will not wrap around within the service lifetime of the CMTS.

### C.6.10 ServiceSlaDropPkts

The CMTS MUST include the ServiceSlaDropPkts attribute as follows:

- For DOCSIS QoS service flows, ServiceSlaDropPkts contains the current (or final) count of packets dropped by this service flow.
- For DOCSIS CoS CM provisioning, ServiceSlaDropPkts is optional; if not supported, a zero value is reported.

This is based on a 32-bit counter value maintained in the CMTS where it is unlikely to overflow within the service lifetime of the DOCSIS Qos or CoS service. Note that this value is the count of packets dropped by the CMTS for upstream service flows. Upstream packets dropped by the CM are not counted here.

### C.6.11 ServiceSlaDelayPkts

The CMTS MUST include the ServiceSlaDelayPkts attribute as follows:

- For DOCSIS QoS service flows, ServiceSlaDelayPkts contains the current (or final) count of packets delayed by this service flow.
- For DOCSIS CoS CM provisioning, ServiceSlaDelayPkts is optional; if not supported, a zero value is reported.

This is based on a 32-bit counter value maintained in the CMTS where it is unlikely to overflow within the service lifetime of the DOCSIS Qos or CoS service. This counter value will not overflow within the service lifetime of the CMTS. Note that this value is the count of packets delayed by the CMTS for upstream service flows. Upstream packets delayed by the CM are not counted here.

### C.6.12 ServiceTimeCreated

The CMTS MUST include the ServiceTimeCreated attribute which contains the value of CMTSsysUpTime or CMTS interface module, whichever is most appropriate for a given CMTS architecture when service flow was created. For a given service flow instance, this value is required to be the same in every IPDRDoc file until the service flow is deleted and no longer being reported. If the value is not consistent between IPDRDoc files, this must be interpreted by the Collector as a completely new service flow instance.

### C.6.13 ServiceTimeActive

The CMTS MUST include the ServiceTimeActive attribute as follows:

- For DOCSIS QoS service flows, ServiceTimeActive contains the total time that the service flow is active in seconds.

For DOCSIS CoS CM provisioning, ServiceTimeActive contains the total time the non-temporary SID is active. If RecType is 'Stop(2)', the CMTS MUST report the total number of active seconds when the service flow was deleted or the total number of seconds until the DOCSIS CoS provisioned CM de-registers.

### C.6.14 DOCSIS-QOS\_3.5.1-A.1.xsd<sup>152</sup>

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
    xmlns:DOCSIS=
QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-QOS_3.5.1-A.1 is an auxiliary schema
which defines Quality of Service (QOS) information.</documentation>
        <documentation>
            <ipdr:reference>DOCSIS 3.0 Operations Support System Interface Specification
CM-SP-OSSIv3.0-I12-100611, Annex C.
            </ipdr:reference>
        </documentation>
    </annotation>
    <element name="ServiceFlowChSet">
        <annotation>
            <documentation>Contains the set of channels

```

<sup>152</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07, per OSSIV3.0-N-07.0506-3 by ab on 10/11/07, and per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```
configured for the service flow. Each octet represents the
channel id of a channel.</documentation>
</annotation>
<simpleType>
    <restriction base="hexBinary">
        <maxLength value="255"/>
        <minLength value="1"/>
    </restriction>
</simpleType>
</element>
<element name="ServiceAppId" type="unsignedInt">
    <annotation>
        <documentation>Contains the application identifier associated
with the service flow.</documentation>
    </annotation>
</element>
<element name="ServiceDsMulticast" type="boolean">
    <annotation>
        <documentation>Indicates whether the service flow
is multicast or unicast. A value of 'true' indicates a multicast
service flow. A value of 'false' indicates a unicast service
flow</documentation>
    </annotation>
</element>
<element name="ServiceIdentifier" type="unsignedInt">
    <annotation>
        <documentation>Contains a 32-bit Service Flow ID of the SF, in decimal
notation.</documentation>
    </annotation>
</element>
<element name="ServiceGateId" type="unsignedInt">
    <annotation>
        <documentation> 32-bit GateID of the SF, or zero if not applicable, in
decimal notation.</documentation>
    </annotation>
</element>
<element name="ServiceClassName" type="string">
    <annotation>
        <documentation>Contains the Service Class Name (SCN) of the Service
Flow.</documentation>
    </annotation>
</element>
<element name="ServiceDirection">
    <annotation>
        <documentation>Contains the direction of the SF from the CMTS cable
interface.</documentation>
    </annotation>
<simpleType>
    <restriction base="integer">
        <enumeration value="1">
            <annotation>
                <documentation>
                    <ipdr:enumMeaning>Downstream</ipdr:enumMeaning>
                </documentation>
            </annotation>
        </enumeration>
        <enumeration value="2">
            <annotation>
                <documentation>
                    <ipdr:enumMeaning>Upstream</ipdr:enumMeaning>
                </documentation>
            </annotation>
        </enumeration>
    </restriction>
</simpleType>
```

```

        </restriction>
    </simpleType>
</element>
<element name="ServiceOctetsPassed" type="unsignedLong">
    <annotation>
        <documentation>Contains a 64-bit absolute counter value of octets passed
by this SF.</documentation>
    </annotation>
</element>
<element name="ServicePktsPassed" type="unsignedLong">
    <annotation>
        <documentation>Contains a 64-bit absolute counter value of octets passed
by this SF.</documentation>
    </annotation>
</element>
<element name="ServiceSlaDropPkts" type="unsignedInt">
    <annotation>
        <documentation>Contains a 32-bit absolute counter value of packets dropped
exceeding SLA by this SF (Downstream only).</documentation>
    </annotation>
</element>
<element name="ServiceSlaDelayPkts" type="unsignedInt">
    <annotation>
        <documentation>Contains a 32-bit absolute counter value of packets delayed
exceeding SLA by this SF (Downstream only).</documentation>
    </annotation>
</element>
<element name="ServiceTimeCreated" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of CmtsSysUpTime when the Service
Flow was created for DOCSIS QOS CM provisioning. For DOCSIS
COS CM provisioning, it is the time the non-temporary SID is created.
For downstream CM traffic it indicates the time the CM registers.
        </documentation>
    </annotation>
</element>
<element name="ServiceTimeActive" type="unsignedInt">
    <annotation>
        <documentation>Contains the total time that the Service Flow
was active, specified in seconds.</documentation>
    </annotation>
</element>
</schema>

```

## C.7 CPE Information<sup>153</sup>

The DOCSIS CPE Information auxiliary schema contains the following attributes that uniquely identify a CPE.

**Table C-4 - CPE Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
Who	CpeMacAddr	macAddress	Required	nn:nn:nn:nn:nn:nn
Who	Cpelpv4AddrList	hexBinary	Required	nnn.nnn.nnn.fff nnn.nnn.nnn.yyy
Who	Cpelpv6AddrList	hexBinary	Required	xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:yyyy xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:zzzz
Who	CpeFqdn	String	Required	FQDN

<sup>153</sup> Revised per OSSlv3.0-N-10.0914-3 on 5/20/10 by JB.

### C.7.1 CpeMacAddr<sup>154</sup>

The Ethernet MAC address of each CPE using this CM during the reporting interval. The CMTS normally tracks CPE MAC addresses per CM, but there may be cases where they are not reported in this element, in which case the value of this element is encoded as macAddress type with value of all zeros.

### C.7.2 CpeIpv4AddrList<sup>155</sup>

List of IPv4 address assigned to each CPE using this CM during the reporting interval. If the CMTS is not tracking CPE IP addresses, then the value of this element is encoded as zero length list. This element may be non-null only for the default upstream SID/service flow for a CM, and gives the current known CPE IP addresses on the CM's Ethernet interface regardless of the SID/SF from which the CPE IP address was learned. All CPE IP addresses maintained in an ARP table for a cable MAC interface must be reported in this field of at least one IPDR record. It is not expected that CpeIpv4AddrList values reported are unique to a single CM, since the CMTS may implement multiple overlapping private IP address spaces.

The XDR encoding type is hexBinary consisting of consecutive 32-bit unsigned integers each one being an ipV4Addr data type. Thus, the encoding of multiple CPE IP Addresses in the CpeIpv4AddrList corresponds to a multiple of 4-octet string.

**NOTE:** The configuration state of the DOCS-SUBMGT3-MIB influences whether CPE IP addresses are being tracked by the CMTS and are thus being reported in the IPDRs (the DOCS-SUBMGT3-MIB controls the CM and CPE filters on the CMTS). Other mechanisms such as the ARP table may also be used in this case.

### C.7.3 CpeIpv6AddrList<sup>156</sup>

List of IPv6 address assigned to each CPE using this CM during the reporting interval. If the CMTS is not tracking CPE IP addresses, then the value of this element is encoded as zero length list. This element may be non-null only for the default upstream SID/service flow for a CM, and gives the current known CPE IP addresses on the CM's Ethernet interface regardless of the SID/SF from which the CPE IP address was learned. All CPE IP addresses maintained in an ARP table for a cable MAC interface must be reported in this field of at least one IPDR record. It is not expected that CpeIpv6AddrList values reported are unique to a single CM, since the CMTS may implement multiple overlapping private IP address spaces.

The XDR encoding type is hexBinary consisting of consecutive ipV6Addr data types (4 byte length + 16 byte address encoding). Thus, the encoding of multiple CPE IP Addresses in the CpeIpv6AddrList corresponds to a multiple of 20-octet string.

### C.7.4 CpeFqdn<sup>157</sup>

The Fully Qualified Domain Name (FQDN) assigned to each CPE using this CM during the reporting interval. If the CMTS is not tracking CPE FQDNs, then this element will be the zero-length string. This element includes only CPE FQDNs gleaned by the CMTS, such as from DHCP relay, and otherwise stored in the CMTS for reporting or other purposes. It is not required for the CMTS to query perform reverse DNS query to obtain the FQDN of a CPE IP address otherwise reported in the CpeIpv4AddrList or CpeIpv6AddrList field. An example FQDN is "Cpe1@cm1.cmts2.com".

References: [RFC 2821].

### C.7.5 DOCSIS-CPE\_3.5.1-A.2.xsd<sup>158</sup>

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE"
      xmlns:DOCSIS-
CPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE"
```

<sup>154</sup> Revised per OSSIV3.0-N-07.0506-3 by ab on 10/11/07.

<sup>155</sup> Revised per OSSIV3.0-N-07.0506-3 by ab on 10/11/07 and per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB.

<sup>156</sup> Revised per OSSIV3.0-N-07.0506-3 by ab on 10/11/07 and per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB.

<sup>157</sup> Revised per OSSIV3.0-N-07.0506-3 by ab on 10/11/07 and per OSSIV3.0-N-10.0937-4 on 9/24/10 by JB.

<sup>158</sup> Revised per OSSIV3.0-N-10.0914-3 on 5/20/10 and per OSSIV3.0-N-10.0937-4 on 9/24/10 by JB.

```

    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.2"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
  <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
  <annotation>
    <documentation>DOCSIS-CPE_3.5.1-A.2 is an auxiliary schema
      which defines CPE information. </documentation>
    Revision History:
      3.5.1-A.1 Initial version.
      3.5.1-A.2 Revised version includes ECN
      OSSIV3.0-N-10.0914-3 and OSSIV3.0-N-10.0928-1 and published as I12.
    <documentation>
      <ipdr:reference>Data-Over-Cable Service Interface Specifications: Operations
        Support System Interface Specification CM-SP-OSSIV3.0-I12-100611, Annex C.
      </ipdr:reference>
    </documentation>
  </annotation>
  <element name="CpeMacAddr" type="ipdr:macAddress">
    <annotation>
      <documentation>Contains the MAC address of the CPE.</documentation>
    </annotation>
  </element>
  <element name="CpeIpv4AddrList" type="hexBinary">
    <annotation>
      <documentation>Contains IPv4 addresses of the CPE. Each IP Address is
        encoded as ipdr:ipv4Addr. If the CPE IPv4 address
          is unassigned or unknown, it contains zero length
        hexBinary.</documentation>
    </annotation>
  </element>
  <element name="CpeIpv6AddrList" type="hexBinary">
    <annotation>
      <documentation>Contains IPv6 addresses of the CPE. Each IP Address is
        encoded as ipdr:ipv6Addr. If the CPE IPv6 address
          is unassigned or unknown, it contains zero length
        hexBinary.</documentation>
    </annotation>
  </element>
  <element name="CpeFqdn" type="string">
    <annotation>
      <documentation>Contains the Fully Qualified Domain Name (FQDN) of the CPE.
        If the CPE FQDN is unassigned or unknown, it contains an empty
        string.</documentation>
    </annotation>
  </element>
</schema>

```

## C.8 Spectrum Measurement Information

Refer to the CmtsSpectrumAnalysisMeas object of Annex J for the definition of the Spectrum Measurement attributes.

### C.8.1 DOCSIS-SPECTRUM\_3.5.1-A.2.xsd<sup>159</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
  SPECTRUM"

```

<sup>159</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

```
    xmlns:DOCSIS-
SPECTRUM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-SPECTRUM_3.5.1-A.2 is an auxiliary schema
which defines Spectrum Analysis and Measurement information.
3.5.1-A.1 Initial version.
3.5.1-A.2 Revised version includes ECN
OSSIv3.0-N-10.0968-2 and published as I14.
</documentation>
        <documentation>
            <ipdr:reference>Data-Over-Cable Service Interface Specifications: Operations
Support System Interface Specification CM-SP-OSSIv3.0-I01-061207, Annex J.
</ipdr:reference>
        </documentation>
    </annotation>
<element name="SpectrumAnalysisMeasIfIndex" type="unsignedInt">
    <annotation>
        <documentation>Contains the ifIndex of the CMTS logical upstream
channel.</documentation>
    </annotation>
</element>
<element name="ChId" type="unsignedByte">
    <annotation>
        <documentation>The US/DS channel id as defined in
docsIf3MdChCfgChId.</documentation>
    </annotation>
</element>
<element name="SpectrumAnalysisMeasChCenterFreq" type="integer">
    <annotation>
        <documentation>Contains the center of the frequency band associated with the
CMTS physical upstream interface. It contains zero if the frequency
is undefined or unknown.</documentation>
        <documentation>
            <ipdr:units>hertz</ipdr:units>
        </documentation>
    </annotation>
</element>
<element name="SpectrumAnalysisMeasFreqSpan" type="unsignedInt">
    <annotation>
        <documentation>Contains the width of the band across which the spectral
amplitudes characterizing the channel are measured.</documentation>
        <documentation>
            <ipdr:units>hertz</ipdr:units>
        </documentation>
    </annotation>
</element>
<element name="SpectrumAnalysisMeasNumOfBins" type="unsignedInt">
    <annotation>
        <documentation>The number of data points or bins that compose the
spectral data. The leftmost bin corresponds to the lower band
edge, the rightmost bin corresponds to the upper band edge,
and the middle bin center is aligned with the center frequency
of the analysis span.</documentation>
        <documentation>
            <ipdr:units>bins</ipdr:units>
        </documentation>
    </annotation>
</element>
```

```

<element name="SpectrumAnalysisMeasResolutionBW" type="unsignedInt">
    <annotation>
        <documentation>Contains the resolution bandwidth
        (defined as the equivalent noise bandwidth) of each bin.</documentation>
        <documentation>
            <ipdr:units>hertz</ipdr:units>
        </documentation>
    </annotation>
</element>
<element name="SpectrumAnalysisMeasBinSpacing" type="unsignedInt">
    <annotation>
        <documentation>Contains the frequency separation between adjacent bins,
        not to exceed 25 kHz for channel widths less than or equal 6.4
        MHz.</documentation>
        <documentation>
            <ipdr:units>hertz</ipdr:units>
        </documentation>
    </annotation>
</element>
<element name="SpectrumAnalysisMeasAmplitude" type="hexBinary">
    <annotation>
        <documentation>A sequence of two byte elements. Each element
        represents the spectral amplitudes in relation to the expected
        received signal power of a bin, in units of 0.01dB. That is, a
        test CMTS input signal with square-root raised-cosine spectrum,
        bandwidth equal to the expected received signal bandwidth, and
        power equal to the expected received signal power, which is
        present for the entire spectrum sampling period, will exhibit a
        spectrum measurement of 0 dB average power in each bin of the
        signal passband.
        Each bin element amplitude value format is 2's complement which
        provides a range of -327.68 dB to 327.67 dB amplitude value
        for the bin measurement.
        </documentation>
    </annotation>
</element>
</schema>

```

## C.9 Diagnostic Log Information

Refer to the DiagLog and DiagLogDetail objects of Annex G for the definition of the Diagnostic Log attributes.

### C.9.1 DOCSIS-DIAG-LOG\_3.5.1-A.1.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG"
    xmlns:DOCSIS-DIAG-
LOG="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-DIAG-LOG_3.5.1-A.1 is an auxiliary schema
        which defines Diagnostic Log (DiagLog) information.</documentation>
        <documentation>
```

```
<ipdr:reference>Data-Over-Cable Service Interface Specifications: Operations
Support System Interface Specification CM-SP-OSSIv3.0-I01-061207, Annex G.
</ipdr:reference>
</documentation>
</annotation>
<element name="LastUpdateTime" type="dateTime">
    <annotation>
        <documentation>Contains the last time-of-day when a cable modem triggered
one or more of its detectors.</documentation>
    </annotation>
</element>
<element name="CreateTime" type="dateTime">
    <annotation>
        <documentation>Contains the time-of-day when a cable modem was initially
added to the diagnostic log.</documentation>
    </annotation>
</element>
<element name="LastRegTime" type="dateTime">
    <annotation>
        <documentation>Contains the time-of-day when a cable modem last
registered.</documentation>
    </annotation>
</element>
<element name="RegCount" type="unsignedInt">
    <annotation>
        <documentation>Contains the number of times the Registration diagnostic
detector has been triggered for a cable modem.</documentation>
    </annotation>
</element>
<element name="RangingRetryCount" type="unsignedInt">
    <annotation>
        <documentation>Contains the number of times the Ranging Retry diagnostic
detector has been triggered for a cable modem.</documentation>
    </annotation>
</element>
<element name="TriggerFlagValue">
    <annotation>
        <documentation>Contains the diagnostic log trigger type
value.</documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="1">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>Registration</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="2">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>RangingRetry</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
</element>
</schema>
```

### C.9.2 DOCSIS-DIAG-LOG-DETAIL\_3.5.1-A.1.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSI
S-DIAG-LOG-DETAIL"
    xmlns:DOCSIS-DIAG-LOG-
DETAIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
DETAIL"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-DIAG-LOG-DETAIL_3.5.1-A.1 is an auxiliary schema
which defines Diagnostic Log Detail (DiagLogDetail)
information.</documentation>
        <documentation>
            <ipdr:reference>Data-Over-Cable Service Interface Specifications: Operations
Support System Interface Specification CM-SP-OSSIV3.0-I01-061207, Annex G.
            </ipdr:reference>
        </documentation>
    </annotation>
    <element name="TypeValue">
        <annotation>
            <documentation>Contains detailed log types which include all possible
values for all triggers that need detailed counter information.</documentation>
        </annotation>
        <simpleType>
            <restriction base="integer">
                <enumeration value="1">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>other</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="2">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>initialRanging</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="3">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>rangingAutoAdjComplete</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="4">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>startEae</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="5">

```

```
<annotation>
    <documentation>
        <ipdr:enumMeaning>startDhcpv4</ipdr:enumMeaning>
    </documentation>
</annotation>
</enumeration>
<enumeration value="6">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>startDhcpv6</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="7">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>dhcpv4Complete</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="8">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>dhcpv6Complete</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="9">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>startConfigFileDownload</ipdr:enumMeanin
g>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="10">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>configFileDownloadComplete</ipdr:enumMea
ning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="11">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>startRegistration</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="12">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>registrationComplete</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
<enumeration value="13">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>bpiInit</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
```

```

        </enumeration>
        <enumeration value="14">
            <annotation>
                <documentation>
                    <ipdr:enumMeaning>operational</ipdr:enumMeaning>
                </documentation>
            </annotation>
        </enumeration>
    </restriction>
</simpleType>
</element>
<element name="Count" type="unsignedInt">
    <annotation>
        <documentation>Contains a count of values specified by TypeValue.</documentation>
    </annotation>
</element>
<element name="LastUpdate" type="dateTime">
    <annotation>
        <documentation>Contains the time-of-day when this DiagLogDetail object instance was last updated.</documentation>
    </annotation>
</element>
<element name="LastErrorText" type="string">
    <annotation>
        <documentation> Contains the Event ID and Event Text (as defined in Annex D or vendor specific)
            of the event condition that triggers the update of the DiagLogDetail object for the TypeValue this instance represents.
            The format is:
            &lt;Event ID&gt; Event Text</documentation>
    </annotation>
</element>
</schema>

```

## C.10 CMTS CM Upstream Status Information

Refer to the CmtsCmUsStatus object of Annex N for the definition of the CMTS CM Upstream Status attributes.

### C.10.1 DOCSIS-CMTS-CM-US\_3.5.1-A.3.xsd<sup>160</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
    CMTS-CM-US"
    xmlns:DOCSIS-CMTS-CM-
    US="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.3"
    elementFormDefault="qualified" attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
    schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-CMTS-CM-US is an auxiliary schema that defines
            the CM's upstream channel status information.
        </documentation>
        <documentation>

```

<sup>160</sup> Section revised per OSSIV3.0-N-07.0410-4, #11 on 5/8/07 by KN and per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB. Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB, OSSIV3.0-N-10.0968-21/21/11 by JB, replaced by OSSIV3.0-13.1096-1 on 3/21/13 by PO.

Revision History:

3.5.1-A.1 Initial version.

3.5.1-A.2 Revised version includes ECN  
OSSIv3.0-N-10.0914-3 and OSSIv3.0-N-10-0928-1 and published as I12.

3.5.1-A.3 Revised version includes ECN  
OSSIv3.0-N-10.0968-2 and published as I14.

```
<ipdr:reference>
    DOCSIS 3.0 Operations Support System Interface Specification
    CM-SP-OSSIv3.0-I14-110210, Annex N.
</ipdr:reference>
</documentation>
</annotation>
<element name="CmtsCmUsChIfName">
    <annotation>
        <documentation>
            Contains the first 50 characters of the
            ifName from the Interfaces Group MIB for the row entry corresponding
            to the CMTS upstream interface (ifType = 129).
        </documentation>
    </annotation>
    <simpleType>
        <restriction base="string">
            <maxLength value="50"/>
            <minLength value="0"/>
        </restriction>
    </simpleType>
</element>
<element name="CmtsCmUsChIfIndex" type="unsignedInt">
    <annotation>
        <documentation>
            Contains the ifIndex for the upstream interface (described in
CmtsCmUsChIfName).
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsChId" type="unsignedByte">
    <annotation>
        <documentation>
            Contains the US channel id as defined in docsIf3MdChCfgChId.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsModulationType">
    <annotation>
        <documentation>
            Contains the modulation type currently used by this
            upstream channel.
        </documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="0">
                <annotation>
                    <ipdr:enumMeaning>unknown</ipdr:enumMeaning>
                </annotation>
            </enumeration>
            <enumeration value="1">
                <annotation>
                    <ipdr:enumMeaning>tdma</ipdr:enumMeaning>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
</element>
```

```

        </annotation>
    </enumeration>
    <enumeration value="2">
        <annotation>
            <documentation>
                <ipdr:enumMeaning>atdma</ipdr:enumMeaning>
            </documentation>
        </annotation>
    </enumeration>
    <enumeration value="3">
        <annotation>
            <documentation>
                <ipdr:enumMeaning>scdma</ipdr:enumMeaning>
            </documentation>
        </annotation>
    </enumeration>
    <enumeration value="4">
        <annotation>
            <documentation>
                <ipdr:enumMeaning>tdmaAndAtdma</ipdr:enumMeaning>
            </documentation>
        </annotation>
    </enumeration>
</restriction>
</simpleType>
</element>
<element name="CmtsCmUsRxPower" type="integer">
    <annotation>
        <documentation>
            Contains the receive power as perceived for the upstream channel.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsSignalNoise" type="integer">
    <annotation>
        <documentation>
            Contains Signal/Noise ratio as perceived for upstream data from the CM.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsMicroreflections" type="unsignedByte">
    <annotation>
        <documentation>
            Contains the microreflections received on this interface.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsEqData" type="hexBinary">
    <annotation>
        <documentation>
            Contains the equalization data for the CM.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsUnerroreds" type="unsignedInt">
    <annotation>
        <documentation>
            Contains the codewords received without error from the CM.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsCorrecteds" type="unsignedInt">
    <annotation>

```

```
<documentation>
    Contains codewords received with correctable errors from the CM.
</documentation>
</annotation>
</element>
<element name="CmtsCmUsUncorrectables" type="unsignedInt">
    <annotation>
        <documentation>
            Contains codewords received with uncorrectable errors from the CM.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsHighResolutionTimingOffset" type="integer">
    <annotation>
        <documentation>
            Contains the higher resolution timing offset to provide a
            finer granularity timing offset.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsIsMuted" type="boolean">
    <annotation>
        <documentation>
            Denotes if the CM upstream channel has been muted
            via CM-CTRL-REQ or CM-CTRL-RSP message exchange.
        </documentation>
    </annotation>
</element>
<element name="CmtsCmUsRangingStatus">
    <annotation>
        <documentation>Contains the ranging status
            of the CM</documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="1">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>other</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="2">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>aborted</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="3">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>retriesExceeded</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="4">
                <annotation>
                    <documentation>
                        <ipdr:enumMeaning>success</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
</element>
```

```

<enumeration value="5">
    <annotation>
        <documentation>
            <ipdr:enumMeaning>continue</ipdr:enumMeaning>
        </documentation>
    </annotation>
</enumeration>
</restriction>
</simpleType>
</element>
</schema>

```

## C.11 CMTS CM Node Channel Information

Refer to the CmtsCmRegStatus object of Annex N for the definition of the CMTS CM Node Channel attributes.

### C.11.1 DOCSIS-CMTS-CM-NODE-CH\_3.5.1-A.2.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
    CMTS-CM-NODE-CH"
    xmlns:DOCSIS-CMTS-CM-NODE-
    CH="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.2" elementFormDefault="qualified"
    attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
    schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-CMTS-CM-NODE-CH is an auxiliary schema that
            defines the CM's MAC Domain registration status from the
            CMTS perspective.
            Revision History:
            3.5.1-A.1 Initial version.
            3.5.1-A.2 Revised version includes ECN
            OSSIV3.0-N-10.0914-3 and published as I12.
        </documentation>      <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I 12-100611, Annex N.
            </ipdr:reference>
        </documentation>
    </annotation>
    <element name="CmtsMdCmSgId" type="unsignedInt">
        <annotation>
            <documentation>
                Contains the ID of the MAC Domain Cable Modem Service
                Group Id (MD-CM-SG-ID) in which the cable modem is registered.
                If the ID is unknown, the CMTS reports a value of zero.
            </documentation>
        </annotation>
    </element>
    <element name="CmtsRcpId">
        <annotation>
            <documentation>
                Contains the RCP-ID associated with the CM.
                If unknown, the CMTS returns a zero length hexBinary.
            </documentation>
        </annotation>
    </element>

```

```

<simpleType>
    <restriction base="hexBinary">
        <length fixed="true" value="5" />
    </restriction>
</simpleType>
</element>
<element name="CmtsRccStatusId" type="unsignedInt">
    <annotation>
        <documentation>
            Contains the RCC id the CMTS used to configure the CM
            receive channel set during registration.
            If unknown, the CMTS returns 0.
        </documentation>
    </annotation>
</element>
<element name="CmtsRcsId" type="unsignedInt">
    <annotation>
        <documentation>
            Contains the Receive Channel Set (RCS) that the CM is currently
using.
            If unknown, the CMTS returns the value zero.
        </documentation>
    </annotation>
</element>
<element name="CmtsTcsId" type="unsignedInt">
    <annotation>
        <documentation>
            Contains the Transmit Channel Set (TCS) that the CM is currently
using.
            If unknown, the CMTS returns the value zero.
        </documentation>
    </annotation>
</element>
</schema>

```

## C.12 CMTS MAC Domain Node Information <sup>161</sup>

Refer to the MdNodeStatus, MdDsSgStatus and MdUsSgStatus objects of Annex O for the definition of the MAC Domain (MD) Node attributes.

### C.12.1 DOCSIS-MD-NODE\_3.5.1-A.2.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
    MD-NODE"
    xmlns:DOCSIS-MD-
    NODE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.2" elementFormDefault="qualified"
    attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
    schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-MD-NODE is an auxiliary schema that defines the
            association of upstream and downstream channel within
            a particular MAC Domain that is connected to one or more
            fiber nodes.
        </documentation>
    </annotation>

```

<sup>161</sup> Revised per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB.

```

Revision History:
 3.5.1-A.1 Initial version.
 3.5.1-A.2 Revised version includes ECN
 OSSIV3.0-N-10.0914-3 OSSIV3.0-N-10.0928-1 and published as I12.
 </documentation>           <documentation>           <ipdr:reference>
                         DOCSIS 3.0 Operations Support System Interface Specification
                         CM-SP-OSSIv3.0-I12-100611, Annex O.
                       </ipdr:reference>
                     </documentation>
                   </annotation>
<element name="CmtsNodeName" type="string">
  <annotation>
    <documentation>
      Contains the textual display name for a fiber node.
    </documentation>
  </annotation>
</element>
<element name="CmtsMdCmSgId" type="unsignedInt">
  <annotation>
    <documentation>
      Contains the MD-CM-SG-ID.
    </documentation>
  </annotation>
</element>
<element name="CmtsMdDsSgId" type="unsignedByte">
  <annotation>
    <documentation>
      Contains the corresponding MD-DS-SG-ID of the
      MD-CM-SG-ID.
    </documentation>
  </annotation>
</element>
<element name="CmtsMdUsSgId" type="unsignedByte">
  <annotation>
    <documentation>
      Contains the corresponding MD-US-SG-ID of the
      MD-CM-SG-ID.
    </documentation>
  </annotation>
</element>
<element name="CmtsMdDsSgChList">
  <annotation>
    <documentation>
      Contains the ordered list of downstream channels of the
      MD-DS-SG-ID. Each octet represents a 8-bit DCID of a channel
      represented in hexadecimal format.
    </documentation>
  </annotation>
    <simpleType>
      <restriction base="hexBinary">
        <maxLength value="255"/>
        <minLength value="1"/>
      </restriction>
    </simpleType>
  </element>
<element name="CmtsMdUsSgChList">
  <annotation>
    <documentation>
      Contains the ordered list of upstream channels of the
      MD-US-SG-ID. Each octet represents a 8-bit UCID of a channel.
    </documentation>
  </annotation>
    <simpleType>

```

```

<restriction base="hexBinary">
    <maxLength value="255"/>
    <minLength value="1"/>
</restriction>
</simpleType>
</element>
</schema>

```

## C.13 CMTS Upstream Utilization Information<sup>162</sup>

The DOCSIS CMTS Upstream Utilization Information auxiliary schema contains the following attributes which define upstream logical channel utilization counters.

**Table C-5 - CMTS Upstream Utilization Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
Which	IfIndex	unsignedInt	Required	nnnnnnnnn
What	IfName	String	Required	SIZE(0..50)
What	UsChId	unsignedByte	Required	1..255
What	Interval	unsignedInt	Required	0..86400
What	IndexPercentage	unsignedByte	Required	0..100
What	TotalMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	UcastGrantedMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	TotalCtnMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	UsedCtnMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	CollCtnMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	TotalCtnReqMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	UsedCtnReqMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	CollCtnReqMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	TotalCtnReqDataMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	UsedCtnReqDataMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	CollCtnReqDataMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	TotalCtnInitMaintMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	UsedCtnInitMaintMslots	unsignedLong	Required	64-bit counter, in decimal notation
What	CollCtnInitMaintMslots	unsignedLong	Required	64-bit counter, in decimal notation

### C.13.1 IfIndex

The ifIndex from the Interfaces Group MIB for the CMTS upstream logical channel interface.

### C.13.2 fName

The ifName from the Interfaces Group MIB for the CMTS upstream interface.

### C.13.3 UsChId

This attribute represents the upstream channel id.

### C.13.4 Interval

This attribute represents the time interval, in seconds, over which the channel utilization index is calculated.

References: [RFC 4546] docsIfCmtsChannelUtilizationInterval.

<sup>162</sup> Section added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN and revised per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB. Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

### **C.13.5 IndexPercentage**

This attribute represents the calculated and truncated utilization index percentage for the upstream logical channel interface.

References: [RFC 4546] docsIfCmtsChannelUtUtilization.

### **C.13.6 TotalMslots**

This attribute represents the current count, from CMTS initialization, of all mini-slots defined for this upstream logical channel interface. This count includes all IUCs and SIDs, even those allocated to the NULL SID for a logical channel that is inactive.

Reference: [RFC 4546] docsIfCmtsUpChnlCtrExtTotalMslots.

### **C.13.7 UcastGrantedMslots**

This attribute represents the current count, from CMTS initialization, of unicast granted mini-slots on the upstream logical channel regardless of burst type. Unicast granted mini-slots are those in which the CMTS assigned bandwidth to any unicast SID on the logical channel. However, this object does not include mini-slots for reserved IUCs, or grants to SIDs designated as meaning 'no CM'.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtUcastGrantedMslots.

### **C.13.8 TotalCtnMslots**

This attribute represents the current count, from CMTS initialization, of contention mini-slots defined for this upstream logical channel. This count includes all mini-slots assigned to a broadcast or multicast SID on the logical channel.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtTotalCtnMslots.

### **C.13.9 UsedCtnMslots**

This attribute represents the current count, from CMTS initialization, of contention mini-slots utilized on the upstream logical channel. For contention regions, utilized mini-slots are those in which the CMTS correctly received an upstream burst from any CM on the upstream logical channel.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtUsedCtnMslots.

### **C.13.10 CollCtnMslots**

This attribute represents the current count, from CMTS initialization, of collision contention mini-slots on the upstream logical channel. For contention regions, these are the mini-slots applicable to burst that the CMTS detected but could not correctly receive.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtCollCtnMslots.

### **C.13.11 TotalCtnReqMslots**

This attribute represents the current count, from CMTS initialization, of contention request mini-slots defined for this upstream logical channel. This count includes all mini-slots for IUC1 assigned to a broadcast or multicast SID on the logical channel.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtTotalCtnReqMslots.

### **C.13.12 UsedCtnReqMslots**

This attribute represents the current count, from CMTS initialization, of contention request mini-slots utilized on this upstream logical channel. This count includes all contention mini-slots for UIC1 applicable to bursts that the CMTS correctly received.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtUsedCtnReqMslots.

### **C.13.13 CollCtnReqMslots**

This attribute represents the current count, from CMTS initialization, of contention request mini-slots subjected to collisions on this upstream logical channel. This includes all contention mini-slots for IUC1 applicable to bursts that the CMTS detected but could not correctly receive.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtCollCtnReqMslots.

### **C.13.14 TotalCtnReqDataMslots**

This attribute represents the current count, from CMTS initialization, of contention request data mini-slots defined for this upstream logical channel. This count includes all mini-slots for IUC2 assigned to a broadcast or multicast SID on the logical channel.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtTotalCtnReqMslots.

### **C.13.15 UsedCtnReqDataMslots**

This attribute represents the current count, from CMTS initialization, of contention request data mini-slots utilized on this upstream logical channel. This includes all contention mini-slots for IUC2 applicable to bursts that the CMTS correctly received.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtUsedCtnReqMslots.

### **C.13.16 CollCtnReqDataMslots**

This attribute represents the current count, from CMTS initialization, of contention request data mini-slots subjected to collisions on this upstream logical channel. This includes all contention mini-slots for IUC2 applicable bursts that the CMTS detected but could not correctly receive.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtCollCtnReqMslots.

### **C.13.17 TotalCtnInitMaintMslots**

This attribute represents the current count, from CMTS initialization, of initial maintenance mini-slots defined for this upstream logical channel. This count includes all mini-slots for IUC3 assigned to a broadcast or multicast SID on the logical channel.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtTotalCtnInitMaintMslots.

### **C.13.18 UsedCtnInitMaintMslots**

This attribute represents the current count, from CMTS initialization, of initial maintenance mini-slots utilized on this upstream logical channel. This includes all contention mini-slots for IUC3 applicable to bursts that the CMTS correctly received.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtUsedCtnInitMaintMslots.

### **C.13.19 CollCtnInitMaintMslots**

This attribute represents the current count, from CMTS initialization, of contention initial maintenance mini-slots subjected to collisions on this upstream logical channel. This includes all contention mini-slots for IUC3 applicable to bursts that the CMTS detected but could not correctly receive.

References: [RFC 4546] docsIfCmtsUpChnlCtrExtCollCtnInitMaintMslots.

### **C.13.20 DOCSIS-CMTS-US-UTIL\_3.5.1-A.3.xsd**

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-US-UTIL"
  xmlns:DOCSIS-CMTS-US-
  UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL"
  xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
  version="3.5.1-A.2" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <import namespace="http://www.ipdr.org/namespaces/ipdr"
```

```

schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd" />
<include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd" />
<annotation>
    <documentation>
        DOCSIS-CMTS-US-UTIL is an auxiliary schema that defines
        CMTS upstream logical channel interface utilization
        statistics.
        Revision History:
        3.5.1-A.1 Initial version.
        3.5.1-A.2 Revised version includes ECN
        OSSIV3.0-N-10.0914-3 and OSSIV3.0-N-10.0928-1 and published as I12.
        3.5.1-A.3 Revised version includes ECN
        OSSIV3.0-N-10.0968-2 and published as I14.
    </documentation>      <documentation>
        <ipdr:reference>
            DOCSIS 3.0 Operations Support System Interface
            Specification CM-SP-OSSIv3.0-I14-110210, Annex O.
        </ipdr:reference>
    </documentation>
</annotation>
<element name="UsIfIndex" type="unsignedInt">
    <annotation>
        <documentation>
            The ifIndex from the Interfaces Group MIB for the CMTS
            upstream logical channel interface.
        </documentation>
    </annotation>
</element>
<element name="UsIfName">
    <annotation>
        <documentation>
            Contains the first 50 characters of the
            ifName from the Interfaces Group MIB for the row entry corresponding
            to the CMTS upstream interface.
        </documentation>
    </annotation>
<simpleType>
<restriction base="string">
<maxLength value="50" />
<minLength value="0" />
</restriction>
</simpleType>
</element>
<element name="UsChId" type="unsignedByte">
    <annotation>
        <documentation>
            The US channel id as defined in docsIf3MdChCfgChId.
        </documentation>
    </annotation>
</element>
<element name="UsUtilInterval" type="unsignedInt">
    <annotation>
        <documentation>
            The time interval, in seconds, over which the channel
            utilization index is calculated.
        </documentation>
    </annotation>
</element>
<element name="UsUtilIndexPercentage" type="unsignedByte">
    <annotation>
        <documentation>
            The calculated and truncated utilization index
            percentage for the downstream interface.
        </documentation>
    </annotation>
</element>

```

```
</documentation>
</annotation>
</element>
<element name="UsUtilTotalMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of all
            mini-slots defined for this upstream logical channel
            interface. This count includes all IUCs and SIDs,
            even those allocated to the NULL SID for a logical
            channel that is inactive.
        </documentation>
    </annotation>
</element>
<element name="UsUtilUcastGrantedMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of unicast
            granted mini-slots on the upstream logical channel
            regardless of burst type. Unicast granted mini-slots
            are those in which the CMTS assigned bandwidth to any
            unicast SID on the logical channel. However, this
            object does not include mini-slots for reserved IUCs,
            or grants to SIDs designated as meaning 'no CM'.
        </documentation>
    </annotation>
</element>
<element name="UsUtilTotalCtnMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention mini-slots defined for this upstream logical
            channel. This count includes all mini-slots assigned
            to a broadcast or multicast SID on the logical channel.
        </documentation>
    </annotation>
</element>
<element name="UsUtilUsedCtnMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention mini-slots utilized on the upstream logical
            channel. For contention regions, utilized mini-slots
            are those in which the CMTS correctly received an
            upstream burst from any CM on the upstream logical channel.
        </documentation>
    </annotation>
</element>
<element name="UsUtilCollCtnMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            collision contention mini-slots on the upstream
            logical channel. For contention regions, these
            are the mini-slots applicable to burst that the
            CMTS detected but could not correctly receive.
        </documentation>
    </annotation>
</element>
<element name="UsUtilTotalCtnReqMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
```

```

contention request mini-slots defined for this upstream
logical channel. This count includes all mini-slots
for IUC1 assigned to a broadcast or multicast SID on
the logical channel.
    </documentation>
</annotation>
</element>
<element name="UsUtilUsedCntnReqMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention request mini-slots utilized on this upstream
            logical channel. This count includes all contention
            mini-slots for IUC1 applicable to bursts that the CMTS
            correctly received.
        </documentation>
    </annotation>
</element>
<element name="UsUtilCollCntnReqMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention request mini-slots subjected to collisions
            on this upstream logical channel. This includes all
            contention mini-slots for IUC1 applicable to bursts
            that the CMTS detected but could not correctly receive.
        </documentation>
    </annotation>
</element>
<element name="UsUtilTotalCntnReqDataMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention request data mini-slots defined for this
            upstream logical channel. This count includes all
            mini-slots for IUC2 assigned to a broadcast or
            multicast SID on the logical channel.
        </documentation>
    </annotation>
</element>
<element name="UsUtilUsedCntnReqDataMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention request data mini-slots utilized on this
            upstream logical channel. This includes all contention
            mini-slots for IUC2 applicable to bursts that the CMTS
            correctly received.
        </documentation>
    </annotation>
</element>
<element name="UsUtilCollCntnReqDataMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention request data mini-slots subjected to
            collisions on this upstream logical channel. This
            includes all contention mini-slots for IUC2 applicable
            bursts that the CMTS detected but could not correctly
            receive.
        </documentation>
    </annotation>
</element>

```

```

<element name="UsUtilTotalCntnInitMaintMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            initial maintenance mini-slots defined for this
            upstream logical channel. This count includes all
            mini-slots for IUC3 assigned to a broadcast or
            multicast SID on the logical channel.
        </documentation>
    </annotation>
</element>
<element name="UsUtilUsedCntnInitMaintMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            initial maintenance mini-slots utilized on this
            upstream logical channel. This includes all
            contention mini-slots for IUC3 applicable to bursts
            that the CMTS correctly received.
        </documentation>
    </annotation>
</element>
<element name="UsUtilCollCntnInitMaintMslots" type="unsignedLong">
    <annotation>
        <documentation>
            The current count, from CMTS initialization, of
            contention initial maintenance mini-slots subjected
            to collisions on this upstream logical channel. This
            includes all contention mini-slots for IUC3 applicable
            to bursts that the CMTS detected but could not
            correctly receive.
        </documentation>
    </annotation>
</element>
</schema>

```

## C.14 CMTS Downstream Utilization Information<sup>163</sup>

The DOCSIS CMTS Downstream Utilization Information auxiliary schema contains the following attributes which define downstream utilization counters.

**Table C-6 - CMTS Downstream Utilization Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
Which	IfIndex	unsignedInt	Required	nnnnnnnn
What	DsChild	unsignedByte	Required	1..255
What	IfName	String	Required	SIZE(0..50)
What	Interval	unsignedInt	Required	0..86400
What	IndexPercentage	unsignedByte	Required	0..100
What	TotalBytes	unsignedLong	Required	64-bit counter, in decimal notation
What	UsedBytes	unsignedLong	Required	64-bit counter, in decimal notation

### C.14.1 IfIndex

The ifIndex from the Interfaces Group MIB for the CMTS downstream interface.

---

<sup>163</sup> Section added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN and revised per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB.  
Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

### C.14.2 IfName

The ifName from the Interfaces Group MIB for the CMTS downstream interface.

### C.14.3 DsChId

This attribute represents the downstream channel id.

### C.14.4 Interval

This attribute represents the time interval, in seconds, over which the channel utilization index is calculated.

References: [RFC 4546] docsIfCmtsChannelUtilizationInterval.

### C.14.5 IndexPercentage

This attribute represents the calculated and truncated utilization index percentage for the downstream interface.

References: [RFC 4546] docsIfCmtsChannelUtUtilization.

### C.14.6 TotalBytes

This attribute represents the total number of bytes in the payload portion of MPEG Packets, not including MPEG header or pointer\_field, transported by the downstream interface.

Reference: [RFC 4546] docsIfCmtsDownChnlCtrExtTotalBytes.

### C.14.7 UsedBytes

This attribute represents the total number of DOCSIS data bytes transported by the downstream interface. The number of data bytes is defined as the total number of bytes transported in DOCSIS payloads minus the number of stuff bytes transported in DOCSIS payloads.

References: [RFC 4546] docsIfCmtsDownChnlCtrExtUsedBytes.

### C.14.8 DOCSIS-CMTS-DS-UTIL\_3.5.1-A.3.xsd<sup>164</sup>

```
<
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
  CMTS-DS-UTIL"
  xmlns:DOCSIS-CMTS-DS-
  UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL"
  xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
  version="3.5.1-A.2" elementFormDefault="qualified"
  attributeFormDefault="unqualified">
  <import namespace="http://www.ipdr.org/namespaces/ipdr"
  schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
  <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
  <annotation>
    <documentation>
      DOCSIS-CMTS-DS-UTIL is an auxiliary schema that defines
      CMTS downstream interface utilization statistics.
      Revision History:
      3.5.1-A.1 Initial version.
      3.5.1-A.2 Revised version includes ECN
      OSSIV3.0-N-10.0914-3 and OSSIV3.0-N-10.0928-1 and published as I12.
      3.5.1-A.3 Revised version includes ECN
      OSSIV3.0-N-10.0968-2 and published as I14.
    </documentation>
    <documentation>
      <ipdr:reference>
        DOCSIS 3.0 Operations Support System Interface
    </ipdr:reference>
  </annotation>
</schema>
```

<sup>164</sup> Revised per OSSIV3.0-N-10.0914-3 on 5/20/10, per OSSIV3.0-N-10.0928-1 on 6/3/10 and per OSSIV3.0-N-10.0937-4 on 9/25/10 by JB.

```
Specification CM-SP-OSSIv3.0-I14-110210, Annex O.

</ipdr:reference>
</documentation>
</annotation>
<element name="DsIfIndex" type="unsignedInt">
    <annotation>
        <documentation>
            The ifIndex from the Interfaces Group MIB for the CMTS
            downstream interface.
        </documentation>
    </annotation>
</element>
<element name="DsIfName">
    <annotation>
        <documentation>
            Contains the first 50 characters of the ifName from the Interfaces
            Group MIB for the row entry corresponding to the CMTS downstream
            interface.
        </documentation>
    </annotation>
    <simpleType>
        <restriction base="string">
            <maxLength value="50"/>
            <minLength value="0"/>
        </restriction>
    </simpleType>
</element>
<element name="DsChId" type="unsignedByte">
    <annotation>
        <documentation>
            The DS channel id as defined in docsIf3MdChCfgChId.
        </documentation>
    </annotation>
</element>
<element name="DsUtilInterval" type="unsignedInt">
    <annotation>
        <documentation>
            The time interval, in seconds, over which the channel
            utilization index is calculated.
        </documentation>
    </annotation>
</element>
<element name="DsUtilIndexPercentage" type="unsignedByte">
    <annotation>
        <documentation>
            The calculated and truncated utilization index
            percentage for the downstream interface.
        </documentation>
    </annotation>
</element>
<element name="DsUtilTotalBytes" type="unsignedLong">
    <annotation>
        <documentation>
            The total number of bytes in the payload portion of
            MPEG Packets, not including MPEG header or
            pointer_field, transported by the downstream
            interface.
        </documentation>
    </annotation>
</element>
<element name="DsUtilUsedBytes" type="unsignedLong">
    <annotation>
        <documentation>
```

The total number of DOCSIS data bytes transported by the downstream interface. The number of data bytes is defined as the total number of bytes transported in DOCSIS payloads minus the number of stuff bytes transported in DOCSIS payloads.

```

</documentation>
</annotation>
</element>
</schema>
```

## C.15 Service Flow Information <sup>165</sup>

The DOCSIS Service Flow Information auxiliary schema contain the following attributes that describe the configured QoS parameters.

**Table C-7 - Service Flow Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
What	ServiceTrafficPriority	unsignedInt	Required	
What	ServiceMaxSustained	unsignedInt	Required	
What	ServiceMaxBurst	unsignedInt	Required	
What	ServiceMinReservedRate	unsignedInt	Required	
What	ServiceMinReservedPktSize	unsignedInt	Required	
What	ServiceTpTos	hexBinary	Required	
What	ServicePeakRate	unsignedInt	Required	
What	ServiceSchedule	Integer	Required	0 Reserved 1 for Undefined (CMTS implementation-dependent) 2 for Best Effort 3 for Non-Real-Time Polling Service 4 for Real-Time Polling Service 5 for Unsolicited Grant Service with Activity Detection 6 for Unsolicited Grant Service
What	ServiceNomPollInterval	unsignedInt	Required	
What	ServiceTolPolJitter	unsignedInt	Required	
What	ServiceUGSize	unsignedInt	Required	
What	ServiceNomGrantInterval	unsignedInt	Required	
What	ServiceTollGrantJitter	unsignedInt	Required	
What	ServiceGrantsPerInterval	unsignedInt	Required	
What	ServicePacketClassifiers	hexBinary	Required	

### C.15.1 ServiceTrafficPriority

The value of the relative priority assigned to this service flow.

### C.15.2 ServiceMaxSustained

The value of the maximum rate in bits/second assigned to this service flow.

### C.15.3 ServiceMaxBurst

The value of the maximum rate in bits/second assigned to this service flow.

<sup>165</sup> Revised per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB.

**C.15.4 ServiceMinReservedRate**

The minimum reserved rate in bits/second assigned to this service flow.

References: Annex O, MinReservedRate attribute of ParamSet object.

**C.15.5 ServiceMinReservedPktSize**

The value of the assumed minimum packet size in bytes for which the ServiceMinReservedRate will be provided.

References: Annex O, MinReservedPkt attribute of ParamSet object.

**C.15.6 ServiceIpTos**

The value of the IP Type of Service (DSCP) Overwrite assigned to this service flow. This is encoded as hexBinary in 2 bytes. The first byte is encoding the tos-and-mask, the second byte is encoding the tos-or-mask.

References: Annex O, TosAndMask and TosOrMask attributes of ParamSet object.

**C.15.7 ServicePeakRate**

The value of the Peak Traffic Rate in bit/second assigned to this service flow.

**C.15.8 ServiceSchedule**

The value for the scheduling type assigned to this service flow.

**C.15.9 ServiceNomPollInterval**

The value of the Nominal Polling Interval in microseconds assigned to this service flow.

**C.15.10 ServiceTolPollJitter**

The value of Tolerated Poll Jitter in microseconds assigned to this service flow.

**C.15.11 ServiceUGSize**

The value of the Unsolicited Grant Size in bytes assigned to this service flow.

**C.15.12 ServiceNomGrantInterval**

The value of the Nominal Grant Interval in microseconds assigned to this service flow.

**C.15.13 ServiceTolGrantJitter**

The value of the Tolerated Grant Jitter in microseconds assigned to this service flow.

**C.15.14 ServiceGrantsPerInterval**

The value of the Grants Per Interval as integer (0-127) assigned to this service flow.

**C.15.15 ServicePacketClassifiers**

Packet classifiers assigned to this service flow. Each classifier is encoded in hexBinary according to the TLV encoding. When multiple classifiers exist for the same service flow then they are encoded as the concatenated sequence of encodings of each classifier.

References: [MULPI] Section C.2 – Quality-of-Service-Related Encodings

**C.15.16 DOCSIS-SERVICE-FLOW\_3.5.1-A.1.xsd<sup>166</sup>**

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SERVICE-FLOW" xmlns:DOCSIS-SERVICE-
FLOW="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SERVICE-FLOW"
xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
```

<sup>166</sup> Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

```

<import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
<include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd" />
<annotation>
    <documentation>DOCSIS-SERVICE-FLOW is an auxiliary schema which defines
Service Flow information.
    Revision History:
3.5.1-A.1 Initial version.</documentation>
    <documentation>
        <ipdr:reference>DOCSIS 3.0 Operations Support System Interface
Specification CM-SP-OSSIv3.0-I13-101008, Annex C.</ipdr:reference>
    </documentation>
</annotation>
<element name="ServiceTrafficPriority" type="unsignedInt">
    <annotation>
        <documentation>Contains the relative priority assigned to this
service flow.</documentation>
    </annotation>
</element>
<element name="ServiceMaxSustained" type="unsignedInt">
    <annotation>
        <documentation>Contains the maximum rate int bits/sec assigned to
this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceMaxBurst" type="unsignedInt">
    <annotation>
        <documentation>Contains the maximum burst in bytes assigned to
this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceMinReservedRate" type="unsignedInt">
    <annotation>
        <documentation>Contains the minimum reserved rate in bits/second
assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceMinReservedPktSize" type="unsignedInt">
    <annotation>
        <documentation>The value of the assumed minimum packet size in
bytes for which the ServiceMinReservedRate will be provided.
.</documentation>
    </annotation>
</element>
<element name="ServiceIpTos" type="hexBinary">
    <annotation>
        <documentation>The value of the IP Type of Service (DSCP)
Overwrite assigned to this service flow. This is encoded as hexBinary in 2 bytes. The
first byte is encoding the tos-and-mask, the second byte is encoding the tos-or-
mask.</documentation>
    </annotation>
</element>
<element name="ServicePeakRate" type="unsignedInt">
    <annotation>
        <documentation>Contains value of the Peak Traffic Rate in bits/sec
assigned to this Service Flow.</documentation>
    </annotation>
</element>
<element name="ServiceSchedule">
    <annotation>
        <documentation>Contains value of the Type of Service assigned to
this Service Flow.</documentation>
    </annotation>

```

```
<simpleType>
    <restriction base="integer">
        <enumeration value="0">
            <annotation>
                <documentation>
                    <ipdr:enumMeaning>Reserved</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="1">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Best Effort</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="2">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Non-Real-Time Polling Service</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="3">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Real-Time Polling Service</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="4">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Unsolicited Grant Service with Activity Detection</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="5">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Unsolicited Grant Service</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
                <enumeration value="6">
                    <annotation>
                        <documentation>
                            <ipdr:enumMeaning>Unsolicited Grant Service</ipdr:enumMeaning>
                        </documentation>
                    </annotation>
                </enumeration>
            </restriction>
        </simpleType>
    </element>
    <element name="ServiceNomPollInterval" type="unsignedInt">
        <annotation>
```

```

<documentation>Contains the value of the Nominal Polling Interval
in microseconds assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceTolPollJitter" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of the Tolerated Polling
Interval in microseconds assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceUGSize" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of the Unsolicited Grant Size in
bytes assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceNomGrantInterval" type="unsignedInt">
    <annotation>
        <documentation>Contains the Nominal Grant Interval in microseconds
assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceTolGrantJitter" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of the Tolerated Grant Jitter in
microseconds assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServiceGrantsPerInterval" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of Grants Per Interval as
integer (0-127) assigned to this service flow.</documentation>
    </annotation>
</element>
<element name="ServicePacketClassifiers" type="hexBinary">
    <annotation>
        <documentation>Contains classifiers assigned to this service flow.
Each classifier is encoded in hexBinary according to the TLV encoding. When multiple
classifiers exist for the same service flow then they are encoded as the concatenated
sequence of encodings of each classifier.</documentation>
    </annotation>
</element>
</schema>

```

## C.16 IP Multicast Information

The DOCSIS IP Multicast Information auxiliary schema contains the following attributes that describe the joined (S,G) IP multicast session parameters.

**Table C-8 - IP Multicast Information Attributes**

Category	Attribute Name	Type	Presence	Permitted Values
What	IpMcastSrcIpv4Addr	InetAddressIPv4	Required	
What	IpMcastSrcIpv6Addr	InetAddressIPv6	Required	
What	IpMcastGrpIpv4Addr	InetAddressIPv4	Required	
What	IpMcastGrpIpv6Addr	InetAddressIPv6	Required	
What	IpMcastGsfd	unsignedInt	Required	
What	IpMcastDsid	unsignedInt	Required	

Category	Attribute Name	Type	Presence	Permitted Values
What	IpMcastSessionProtocolType	Integer	Required	0 Reserved 1 for IGMP 2 for MLD
What	IpMcastCpeMacAddrList	hexBinary	Required	
When	IpMcastJoinTime	dateTimeMsec	Required	yyyy-mm-ddThh:mm:ss:mmmZ
When	IpMcastLeaveTime	dateTimeMsec	Required	yyyy-mm-ddThh:mm:ss:mmmZ

### C.16.1 IpMcastSrclpv4Addr

The value of the IPv4 address of 'S' as the source address for a particular (S,G) IP multicast session. For the case of Any Source Multicast (ASM), this attribute reports a value of 0.0.0.0.

### C.16.2 IpMcastSrclpv6Addr

The value of the IPv6 address of 'S' as the source address for a particular (S,G) IP multicast session. For the case of Any Source Multicast (ASM), this attribute reports a value of 0::/0.

### C.16.3 IpMcastGrplpv4Addr

The value of the IPv4 address of 'G' as the group address for a particular (S,G) IP multicast session.

### C.16.4 IpMcastGrplpv6Addr

The value of the IPv6 address of 'G' as the group address for a particular (S,G) IP multicast session.

### C.16.5 IpMcastGsId

The value of the Group Service Flow Id. This element is associated with the ServiceIdentifier element from the SAMIS-TYPE-1 and SAMIS-TYPE-2 Service Definition Schemas.

### C.16.6 IpMcastDsid

The value of the Downstream Service ID (DSID) label with which the CMTS labels all packets of a particular (S,G) IP multicast session.

### C.16.7 IpMcastSessionProtocolType

The value of the type of IP multicast session (Reserved, IGMP or MLD).

### C.16.8 IpMcastCpeMacAddrList

The value of the list of CPE MAC addresses joining the (S,G) IP multicast session. The associated CPE IPv4 and IPv6 address information can be obtained with the CPE-TYPE Service Definition Schema.

### C.16.9 IpMcastJoinTime

The value of the UTC time stamp "yyyy-mm-ddThh:mm:ssZ" at the time the IP multicast JOIN request from this CPE for this multicast session was processed by the CMTS. The compact representation of this attribute is the 64-bit Long value of milliseconds since Epoch Time.

### C.16.10 IpMcastLeaveTime

The value of the UTC time stamp "yyyy-mm-ddThh:mm:ssZ" at the time the "LeaveMulticastSession" request from this CPE for this multicast session was processed by the CMTS or the CMTS determines that this CPE has left the IP multicast session. The compact representation of this attribute is the 64-bit Long value of milliseconds since Epoch Time.

If the multicast session is active (i.e. the CMTS has yet to determine that the CPE has left the IP multicast session) when this record is generated, the compact representation of the IpMcastLeaveTime value MUST be set to 0.

Reference: [MULPIv3.0] Downstream Multicast Forwarding section.

**C.16.11 DOCSIS-IP-MULTICAST\_3.5.1-A.1.xsd<sup>167</sup>**

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-
MULTICAST-STATS-TYPE"
    xmlns:DOCSIS-IP-MULTICAST-STATS-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST-
STATS-TYPE"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
            xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
                xmlns:DOCSIS-IP-
MULTICAST="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-
MULTICAST"
                    xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                            version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.3.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
IP-MULTICAST"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-
MULTICAST/DOCSIS-IP-MULTICAST_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
for global element references.</documentation>
            <documentation>
Revision History:
3.5.1-A.1 Initial version.
            </documentation>
        </annotation>
    </include>
<annotation>
    <documentation>DOCSIS-IP-MULTICAST-STATS-TYPE is an IPDR Service
Definition schema defining a particular (S,G) IP multicast
session statistics IPDR data record which references the
imported global elements.
    </documentation>
    <documentation>
        <ipdr:reference>
            DOCSIS 3.0 Operations Support System Interface Specification
            CM-SP-OSSIv3.0-I24-140729, Annex C.
        </ipdr:reference>
    </documentation>
</annotation>
<complexType name="IP-MULTICAST-STATS-TYPE">

```

<sup>167</sup> Schema added per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

```
<complexContent>
  <extension base="ipdr:IPDRTypE">
    <sequence>
      <element ref="DOCSIS-CMTS:CmtsHostName" />
      <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
      <element ref="DOCSIS-CM:CmMacAddr" />
      <element ref="DOCSIS-REC:RecType" />
      <element ref="DOCSIS-REC:RecCreationTime" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastSrcIpv4Addr" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastSrcIpv6Addr" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastGrpIpv4Addr" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastGrpIpv6Addr" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastGsfId" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastDsid" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastSessionProtocolType" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastCpeMacAddrList" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastJoinTime" />
      <element ref="DOCSIS-IP-MULTICAST:IpMcastLeaveTime" />
    </sequence>
  </extension>
</complexContent>
</complexType>
</schema>
```

## Annex D Format and Content for Event, SYSLOG, and SNMP Notification (Normative)<sup>168</sup>

Table D-1 in this annex summarizes the format and content for event, syslog, and SNMP notifications required for DOCSIS 3.0-compliant CMTS and CM.

Each row specifies a possible event that may appear in the CM or CMTS. These events are to be reported by a cable device through local event logging, and may be accompanied by syslog or SNMP notification.

The "Process" and "Sub-Process" columns indicate in which stage the event happens. The "CM Priority" and "CMTS Priority" columns indicate the priority the event is assigned in the CM or CMTS. These priorities are the same as is reported in the docsDevEvLevel object in the cable device MIB [RFC 4639] and in the LEVEL field of the syslog.

The "Event Message" column specifies the event text, which is reported in the docsDevEvText object of the cable device MIB and the text field of the syslog. The "Message Notes And Details" column provides additional information about the event text in the "Event Message" column. Some of the text fields include variable information. The variables are explained in the "Message Notes And Details" column. For some events the "Message Notes And Details" column may include the keyword <Deprecated> to indicate this event is being deprecated and its implementation is optional. For events where the "Event Message" or "Message Notes and Details" column includes either <P1> or <P2>, there is a single space between the value as defined by the <P1> or <P2> and the preceding text.

Example SNMP Notification and Syslog message "Event Message" text string for Event ID 69020900:

SNMP CVC Validation Failure SNMP Manager: 10.50.1.11;CM-MAC=00:22:ce:03:f4:da;CMTS-MAC=00:15:20:00:25:ab;CM-QOS=1.1;CM-VER=3.0;

This specification defines the following keywords as part of the "Event Message" column:

"<TAGS>" (without the quotes) corresponds to:

For the CM (without the quotes) : " ;<CM-MAC> ;<CMTS-MAC> ;<CM-QOS> ;<CM-VER> ; "

For the CMTS (without the quotes) : " ;<CM-MAC> ;<CM-QOS> ;<CM-VER> ;<CMTS-VER> ; "

Where :

<CM-MAC> : CM MAC Address;

Format\*: "CM-MAC=xx:xx:xx:xx:xx:xx"

<CMTS-MAC> : CMTS MAC Address;

Format\*: "CMTS-MAC=xx:xx:xx:xx:xx:xx"

<CM-QOS> : CM DOCSIS QoS Version;

Format\*: "CM-QOS=1.0" or "CM-QOS=1.1"

<CM-VER> : CM DOCSIS Version;

Format\*: "CM-VER=1.0" or | "CM-VER=1.1" or "CM-VER=2.0" or "CM-VER=3.0"

<CMTS-VER> : CMTS DOCSIS Version;

Format\*: "CMTS-VER=1.0" or "CMTS-VER=1.1" or "CMTS-VER=2.0" or "CMTS-VER=3.0"

(\*) without the quotes

<sup>168</sup> Section modified per OSSIV3.0-N-07.0532-4, OSSIV3.0-N-07.0548-3 on 1/29/08, OSSIV3.0-N-08.0614-1 on 1/30/08, OSSIV3.0-N-07.0602-1, OSSIV3.0-N-07.0603-2 on 1/31/08, and OSSIV3.0-N-08.0640-4 on 4/24/08 by KN. Revised per OSSIV3.0-N-09.0871-4 and OSSIV3.0-N-09.0879-2 on 1/5/10 by JB, revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09..

The CM MUST format the CM MAC Address field <CM-MAC> of the Event Message text, including such instances of docsDevEvText, using lowercase letters.

The CMTS MUST format the CMTS MAC Address field <CMTS-MAC> of the Event Message text, including such instances of docsDevEvText, using lower case letters.

Example SNMP Notification and Syslog message "Event Message" text string for Event ID 69010100:

```
SW Download INIT - Via NMS SW file: junk.bin - SW server: 10.50.1.11;CM-  
MAC=00:22:ce:03:f4:da;CMTS-MAC=00:15:20:00:25:ab;CM-QOS=1.1;CM-VER=3.0;
```

The CM MAY append additional vendor-specific text to the end of the event text reported in the docsDevEvText object and the syslog text field.

The CMTS MAY append additional vendor-specific text to the end of the event text reported in the docsDevEvText object and the syslog text field.

The "Error Code Set" column specifies the error code. The "Event ID" column indicates a unique identification number for the event, which is assigned to the docsDevEvId object in the cable device MIB and the <eventId> field of the syslog. The "Notification Name" column specifies the SNMP notification, which notifies this event to an SNMP notification receiver.

The syslog format, as well as the rules to uniquely generate an event ID from the error code, are described in Section 8.1.2.1.3 of this specification.

**Table D-1 - Event Format and Content<sup>169</sup>**

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
<b>Authentication and Encryption</b>								
				<Reserved>			0	
BPKM	AUTH-FSM	Warning	Error	Auth Reject – No Information<TAGS>		B301.2	66030102	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Reject – Unauthorized CM<TAGS>		B301.3	66030103	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Reject – Unauthorized SAID<TAGS>		B301.4	66030104	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Error	Error	Auth Reject – Permanent Authorization Failure<TAGS>		B301.8	66030108	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Reject – Time of Day not acquired<TAGS>		B301.9	66030109	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Informational	Informational	Auth Reject – EAE disabled<TAGS>		B301.10	66030110	CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Alert	Error	CM Certificate Error<TAGS>		B301.11	66030111	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Invalid – No Information<TAGS>		B302.2	66030202	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

<sup>169</sup> Table replaced per OSSIV3.0-N-0500-4 by ab on 7/19/07 and updated per OSSIV3.0-N-07.0551-4 by ab on 11/12/07. Updated per OSSIV3.0-N-07.0532-4 and OSSIV3.0-N-07.0548-3 on 1/29/08, OSSIV3.0-N-07.0532-4, and OSSIV3.0-N-07.0603-2 on 1/30/08 by KN. Table replaced per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN. Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09; per OSSIV3.0-N-0773-1 on 5/8/09, per OSSIV3.0-N-09.0865-2 on 11/17/09, per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB, per OSSIV3.0-12.1073-3 on 10/29/12 by PO, per OSSIV3.0-N-132-1083-5 on 3/19/13 by PO; per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
BPKM	AUTH-FSM	Warning	Error	Auth Invalid – Unauthorized CM<TAGS>		B302.3	66030203	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Invalid – Unsolicited<TAGS>		B302.5	66030205	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Invalid – Invalid Key Sequence Number<TAGS>		B302.6	66030206	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Auth Invalid – Message (Key Request) Authentication Failure<TAGS>		B302.7	66030207	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Warning	Error	Unsupported Crypto Suite<TAGS>		B303.0	66030300	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	AUTH-FSM	Informational		Authorized<TAGS>		B401.0	66040100	CM: docslf3CmEventNotif
BPKM	AUTH-FSM	Informational		Auth Pend<TAGS>		B402.0	66040200	CM: docslf3CmEventNotif
BPKM	AUTH-FSM	Informational		Auth Comp<TAGS>		B403.0	66040300	CM: docslf3CmEventNotif
BPKM	AUTH-FSM	Informational		Stop<TAGS>		B404.0	66040400	CM: docslf3CmEventNotif
BPKM	CERTIFICATE REVOCATION		Warning	Failed to retrieve CRL from <P1>	P1 = CRL Server IP	B304.0	66030400	CMTS: docslf3CmtsEventNotif
BPKM	CERTIFICATE REVOCATION		Warning	Failed to retrieve OCSP status		B304.1	66030401	CMTS: docslf3CmtsEventNotif
BPKM	CERTIFICATE REVOCATION		Warning	CRL data not available when validating CM certificate chain<TAGS>		B304.2	66030402	CMTS: docslf3CmtsEventNotif
BPKM	TEK-FSM	Warning	Error	Key Reject – No Information<TAGS>		B501.2	66050102	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
BPKM	TEK-FSM	Warning	Error	Key Reject – Unauthorized SAID<TAGS>		B501.3	66050103	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	TEK-FSM	Warning	Error	TEK Invalid – No Information<TAGS>		B502.3	66050203	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
BPKM	TEK-FSM	Warning	Error	TEK Invalid – Invalid Key Sequence Number<TAGS>		B502.6	66050206	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Dynamic SA	SA MAP-FSM	Informational		SA Map State Machine Started<TAGS>		B601.0	66060100	CM: docslf3CmEventNotif
Dynamic SA	SA MAP-FSM	Warning	Error	Unsupported Crypto Suite<TAGS>		B602.0	66060200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Dynamic SA	SA MAP-FSM	Error		Map Request Retry Timeout<TAGS>		B603.0	66060300	CM: docslf3CmEventNotif
Dynamic SA	SA MAP-FSM	Informational		Unmap<TAGS>		B604.0	66060400	CM: docslf3CmEventNotif
Dynamic SA	SA MAP-FSM	Informational	Informational	Map Reject – Downstream Traffic Flow Not Mapped to BPI+ SAID (EC=8)<TAGS>		B605.10	66060510	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Dynamic SA	SA MAP-FSM	Warning	Error	Map Reject – Not Authorized for Requested Downstream Traffic Flow (EC=7)<TAGS>		B605.9	66060509	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Dynamic SA	SA MAP-FSM	Warning	Error	Mapped to Existing SAID<TAGS>		B606.0	66060600	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Dynamic SA	SA MAP-FSM	Warning	Error	Mapped to New SAID<TAGS>		B607.0	66060700	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init (BPI+)	DOCSIS 1.0 CONFIG FILE	Error	Notice	Missing BP Configuration Setting TLV Type: <P1><TAGS>	P1 = missing required TLV Type	B101.0	66010100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
Init (BPI+)	DOCSIS 1.0 CONFIG FILE	Alert	Notice	Invalid BP Configuration Setting Value: <P1> for Type: <P2><TAGS>	P1=The TLV Value for P2. P2 = The first Configuration TLV Type that contain invalid value.	B102.0	66010200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
<b>DBC, DCC and UCC</b>								
DBC	DBC Request	Warning		CMTS Bad DBC – confirmation code <P1>: <P2><TAGS>	P1=<Confirmation Code> P2=<Confirmation> See [MULPI] Annex C.4 Confirmation Code	C501.0	67050100	
DBC	DBC Request	Warning		DBC-REQ denied – confirmation code <P1>: <P2><TAGS>	P1=<Confirmation Code> P2=<Confirmation> See [MULPI] Annex C.4 Confirmation Code	C502.0	67050200	
DBC	DBC Response		Notice	Unknown DBC transaction<TAGS>		C601.0	67060100	
DBC	DBC Response		Warning	DBC-REQ rejected – confirmation code <P1>: <P2><TAGS>	P1=<Confirmation Code> P2=<Confirmation> See [MULPI] Annex C.4 Confirmation Code	C602.0	67060200	
DBC	DBC Response		Warning	DBC-RSP not received<TAGS>		C603.0	67060300	
DBC	DBC Response		Warning	Bad CM DBC-RSP: <P1><TAGS>	P1="unspecified reason"   "authentication failure"   "msg syntax error"	C604.0	67060400	
DBC	DBC Response		Warning	DBC-RSP Partial Service <P1><TAGS>	P1=<reason>	C605.0	67060500	
DBC	DBC Acknowledgement	Error		DBC-ACK not received<TAGS>		C701.0	67070100	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DBC	DBC Acknowledgement	Notice		Bad CMTS DBC-ACK: <P1><TAGS>	P1="unspecified reason"   "unknown transaction ID"   "authentication failure"   "msg syntax error"	C702.0	67070200	
DCC	DCC Request	Error	Warning	DCC rejected already there<TAGS>		C201.0	67020100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Informational	Notice	DCC depart old<TAGS>		C202.0	67020200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Informational	Notice	DCC arrive new<TAGS>		C203.0	67020300	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Critical	Warning	DCC aborted unable to acquire new downstream channel<TAGS>		C204.0	67020400	
DCC	DCC Request	Critical	Warning	DCC aborted no UCD for new upstream channel<TAGS>		C205.0	67020500	
DCC	DCC Request	Critical	Warning	DCC aborted unable to communicate on new upstream channel<TAGS>		C206.0	67020600	
DCC	DCC Request	Error	Warning	DCC rejected unspecified reason<TAGS>		C207.0	67020700	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected permanent – DCC not supported<TAGS>		C208.0	67020800	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected service flow not found<TAGS>		C209.0	67020900	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected required parameter not present<TAGS>		C210.0	67021000	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DCC	DCC Request	Error	Warning	DCC rejected authentication failure<TAGS>		C211.0	67021100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected multiple errors<TAGS>		C212.0	67021200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected, duplicate SF reference-ID or index in message<TAGS>		C215.0	67021500	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected parameter invalid for context<TAGS>		C216.0	67021600	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected message syntax error<TAGS>		C217.0	67021700	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected message too big<TAGS>		C218.0	67021800	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Request	Error	Warning	DCC rejected 2.0 mode disabled<TAGS>		C219.0	67021900	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP not received on old channel<TAGS>		C301.0	67030100	CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP not received on new channel<TAGS>		C302.0	67030200	CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP rejected unspecified reason<TAGS>		C303.0	67030300	CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP rejected unknown transaction ID<TAGS>		C304.0	67030400	CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP rejected authentication failure<TAGS>		C305.0	67030500	CMTS: docslf3CmtsEventNotif
DCC	DCC Response		Warning	DCC-RSP rejected message syntax error<TAGS>		C306.0	67030600	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DCC	DCC Acknowledgement	Error	Warning	DCC-ACK not received<TAGS>		C401.0	67040100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Acknowledgement	Error	Warning	DCC-ACK rejected unspecified reason<TAGS>		C402.0	67040200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Acknowledgement	Error	Warning	DCC-ACK rejected unknown transaction ID<TAGS>		C403.0	67040300	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Acknowledgement	Error	Warning	DCC-ACK rejected authentication failure<TAGS>		C404.0	67040400	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DCC	DCC Acknowledgement	Error	Warning	DCC-ACK rejected message syntax error<TAGS>		C405.0	67040500	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
UCC	UCC Request	Error		UCC-REQ received with invalid or out of range US channel ID<TAGS>		C01.0	67000100	
UCC	UCC Request	Error		UCC-REQ received unable to send UCC-RSP<TAGS>		C02.0	67000200	
UCC	UCC Response		Warning	UCC-RSP not received on previous channel ID<TAGS>		C101.0	67010100	
UCC	UCC Response		Warning	UCC-RSP received with invalid channel ID<TAGS>		C102.0	67010200	
UCC	UCC Response		Warning	UCC-RSP received with invalid channel ID on new channel<TAGS>		C103.0	67010300	
<b>DHCP, TOD and TFTP</b>								
DHCP		Error		DHCP RENEW sent – No response for <P1><TAGS>	P1=IPv4 or IPv6	D101.0	68010100	
DHCP		Error		DHCP REBIND sent – No response for <P1><TAGS>	P1=IPv4 or IPv6	D102.0	68010200	
DHCP		Error		DHCP RENEW WARNING – Field invalid in response <P1> option<TAGS>	P1=v4	D103.0	68010300	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DHCP		Critical		DHCP RENEW FAILED - Critical field invalid in response		D103.1	68010301	
DHCP		Error		DHCP REBIND WARNING – Field invalid in response <TAGS>		D104.0	68010400	
DHCP		Critical		DHCP REBIND FAILED - Critical field invalid in response		D104.1	68010401	
DHCP		Notice		DHCP Reconfigure received<TAGS>		D105.0	68010500	
DHCP		Notice		DHCP Renew - lease parameters <P1> modified<TAGS>	P1 = list of params that changed at renew	D106.0	68010600	
DHCP		Error		Primary lease failed, IPv4 fallback initiated<TAGS>		D107.0	68010700	
Init	DHCP	Critical		DHCP FAILED – Discover sent, no offer received<TAGS>		D01.0	68000100	
Init	DHCP	Critical		DHCP FAILED – Request sent, No response<TAGS>		D02.0	68000200	
Init	DHCP	Warning		DHCP WARNING - Non-critical field invalid in response <TAGS>		D03.0	68000300	
Init	DHCP	Critical		DHCP FAILED – Critical field invalid in response <TAGS>		D03.1	68000301	
Init	DHCP	Critical		DHCP failed – RS sent, no RA received<TAGS>		D12.0	68001200	
Init	DHCP	Critical		DHCP Failed – Invalid RA<TAGS>		D12.1	68001201	
Init	DHCP	Critical		DHCP failed – DHCP Solicit sent, No DHCP Advertise received<TAGS>		D12.2	68001202	
Init	DHCP	Critical		DHCP failed – DHCP Request sent, No DHCP REPLY received<TAGS>		D12.3	68001203	
Init	DHCP	Error		Primary address acquired, secondary failed<TAGS>		D12.4	68001204	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	DHCP	Error		Primary address failed, secondary active<TAGS>		D12.5	68001205	
Init	IPv6 Address Acquisition	Critical		Link-Local address failed DAD<TAGS>		D13.1	68001301	
Init	IPv6 Address Acquisition	Critical		DHCP lease address failed DAD<TAGS>		D13.2	68001302	
Init	TOD	Warning		ToD request sent – No Response received<TAGS>		D04.1	68000401	
Init	TOD	Warning		ToD Response received – Invalid data format<TAGS>		D04.2	68000402	
Init	TFTP	Critical		TFTP failed – Request sent – No Response<TAGS>		D05.0	68000500	
Init	TFTP	Critical		TFTP failed – configuration file NOT FOUND<TAGS>	For SYSLOG only: append: File name = <P1> P1 = requested file name	D06.0	68000600	
Init	TFTP	Critical		TFTP Failed – OUT OF ORDER packets<TAGS>		D07.0	68000700	
Init	TFTP	Critical		TFTP file complete – but failed Message Integrity check MIC<TAGS>	For SYSLOG only: append: File name = <P1> P1 = file name of TFTP file	D08.0	68000800	
Init	TFTP	Critical		TFTP file complete – but missing mandatory TLV<TAGS>		D09.0	68000900	
Init	TFTP	Critical		TFTP Failed – file too big<TAGS>		D10.0	68001000	
Init	TFTP	Critical		TFTP file complete- but doesn't enable 2.0 Mode – conflicts with current US channel type<TAGS>	For SYSLOG only: append: File name = <P1> P1 = file name of TFTP file	D11.0	68001100	
Init	TFTP	Critical		TFTP Request Retries exceeded, CM unable to register	For SYSLOG only: append: File name = <P1> P1 = file name of TFTP file	D11.1	68001101	
TOD		Error		ToD request sent- No Response received<TAGS>		D04.3	68000403	CM: docslf3CmEventNotif
TOD		Error		ToD Response received – Invalid data format<TAGS>		D04.4	68000404	CM: docslf3CmEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
<b>Secure Software Download</b>								
SW Upgrade	SW UPGRADE INIT	Notice		SW Download INIT – Via NMS	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E101.0	69010100	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE INIT	Notice		SW Download INIT – Via Config file <P1>	Other than Local Log, append: SW file: <P2> - SW server: < P3><TAGS>  P1 = CM config file name P2 = SW file name P3 = SW Download server IP address	E102.0	69010200	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW Upgrade Failed during download – Max retry exceed (3)	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E103.0	69010300	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW Upgrade Failed Before Download – Server not Present	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E104.0	69010400	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW upgrade Failed before download – File not Present	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E105.0	69010500	CM: docslf3CmEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW upgrade Failed before download –TFTP Max Retry Exceeded	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E106.0	69010600	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW upgrade Failed after download –Incompatible SW file	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E107.0	69010700	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		SW upgrade Failed after download – SW File corruption	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E108.0	69010800	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Disruption during SW download – Power Failure	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E109.0	69010900	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Disruption during SW download – RF removed	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E110.0	69011000	CM: docslf3CmEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
SW Upgrade	SW UPGRADE SUCCESS	Notice		SW download Successful – Via NMS	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E111.0	69011100	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE SUCCESS	Notice		SW download Successful – Via Config file	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E112.0	69011200	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Improper Code File Controls	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E201.0	69020100	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Code File Manufacturer CVC Validation Failure	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E202.0	69020200	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Code File Manufacturer CVS Validation Failure	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E203.0	69020300	CM: docslf3CmEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Code File Co-Signer CVC Validation Failure	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E204.0	69020400	CM: docslf3CmEventNotif
SW Upgrade	SW UPGRADE GENERAL FAILURE	Error		Code File Co-Signer CVS Validation Failure	Other than Local Log, append: SW file: <P1> - SW server: < P2><TAGS>  P1 = SW file name P2 = SW Download server IP address	E205.0	69020500	CM: docslf3CmEventNotif
SW Upgrade	VERIFICATION OF CVC	Error		Improper Configuration File CVC Format	Other than Local Log, append: Config file: <P1> - Config file server: < P2><TAGS>  P1 = Config file name P2 = Config file server IP address	E206.0	69020600	CM: docslf3CmEventNotif
SW Upgrade	VERIFICATION OF CVC	Error		Configuration File CVC Validation Failure	Other than Local Log, append: Config file: <P1> - Config file server: < P2><TAGS>  P1 = Config file name P2 = Config file server IP address	E207.0	69020700	CM: docslf3CmEventNotif
SW Upgrade	VERIFICATION OF CVC	Error		Improper SNMP CVC Format	Other than local Log, append: SNMP Manager: <P1><TAGS>  P1= IP Address of SNMP Manager	E208.0	69020800	CM: docslf3CmEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
SW Upgrade	VERIFICATION OF CVC	Error		SNMP CVC Validation Failure	Other than local Log, append: SNMP Manager: <P1><TAGS> P1= IP Address of SNMP Manager	E209.0	69020900	CM: docslf3CmEventNotif
<b>Registration and TLV-11</b>								
Init	REGISTRATION RESPONSE	Critical		REG-RSP – invalid format or not recognized;<TAGS>		I01.0	73000100	
Init	REGISTRATION RESPONSE	Critical		REG RSP not received<TAGS>		I02.0	73000200	
Init	REGISTRATION RESPONSE	Critical		REG RSP bad SID <P1><TAGS>		I03.0	73000300	
Init	REGISTRATION REQUEST		Warning	Service unavailable – Other<TAGS>		I04.0	73000400	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Service unavailable – Unrecognized configuration setting<TAGS>		I04.1	73000401	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Service unavailable – Temporarily unavailable<TAGS>		I04.2	73000402	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Service unavailable – Permanent<TAGS>		I04.3	73000403	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Registration rejected authentication failure: CMTS MIC invalid<TAGS>		I05.0	73000500	CMTS: docslf3CmtsEventNotif
Init	3.0 SPECIFIC REGISTRATION REQUEST		Warning	Registration authentication failure: REG REQ rejected – TLV parameters do not match learned config file TLV parameters<TAGS>		I05.1	73000501	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	REG REQ has Invalid MAC header<TAGS>		I101.0	73010100	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	REG REQ has Invalid SID or not in use<TAGS>		I102.0	73010200	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	REG REQ missed Required TLVs<TAGS>		I104.0	73010400	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad DS FREQ – Format Invalid<TAGS>		I105.0	73010500	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	REGISTRATION REQUEST		Warning	Bad DS FREQ – Not in use<TAGS>		I105.1	73010501	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad DS FREQ – Not Multiple of 62500 Hz<TAGS>		I105.2	73010502	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad US CH – Invalid or Unassigned<TAGS>		I106.0	73010600	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad US CH – Change followed with (RE-) Registration REQ<TAGS>		I106.1	73010601	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad US CH – Overload<TAGS>		I107.0	73010700	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Network Access has Invalid Parameter<TAGS>		I108.0	73010800	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Class of Service – Invalid Configuration<TAGS>		I109.0	73010900	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Class of Service – Unsupported class<TAGS>		I110.0	73011000	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Class of Service – Invalid class ID or out of range<TAGS>		I111.0	73011100	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max DS Bit Rate – Invalid Format<TAGS>		I112.0	73011200	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max DS Bit Rate Unsupported Setting<TAGS>		I112.1	73011201	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max US Bit – Invalid Format<TAGS>		I113.0	73011300	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max US Bit Rate – Unsupported Setting<TAGS>		I113.1	73011301	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad US Priority Configuration – Invalid Format<TAGS>		I114.0	73011400	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad US Priority Configuration – Setting out of Range<TAGS>		I114.1	73011401	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Guaranteed Min US CH Bit rate Configuration setting – Invalid Format<TAGS>		I115.0	73011500	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	REGISTRATION REQUEST		Warning	Bad Guaranteed Min US CH Bit rate Configuration setting – Exceed Max US Bit Rate<TAGS>		I115.1	73011501	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Guaranteed Min US CH Bit rate Configuration setting – Out of Range<TAGS>		I115.2	73011502	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max US CH Transmit Burst configuration setting – Invalid Format<TAGS>		I116.0	73011600	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Bad Max US CH Transmit Burst configuration setting – Out of Range<TAGS>		I116.1	73011601	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Invalid Modem Capabilities configuration setting<TAGS>		I117.0	73011700	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION REQUEST		Warning	Configuration file contains parameter with the value outside of the range<TAGS>		I118.0	73011800	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Unspecified reason<TAGS>		I201.0	73020100	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Unrecognized configuration setting<TAGS>		I201.1	73020101	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Major service flow error<TAGS>		I201.10	73020110	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Major classifier error<TAGS>		I201.11	73020111	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Major PHS rule error<TAGS>		I201.12	73020112	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Multiple major errors<TAGS>		I201.13	73020113	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Message syntax error <P1><TAGS>		I201.14	73020114	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Primary service flow error <P1><TAGS>		I201.15	73020115	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – temporary no resource<TAGS>		I201.2	73020102	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Permanent administrative<TAGS>		I201.3	73020103	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Required parameter not present <P1><TAGS>		I201.4	73020104	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Header suppression setting not supported<TAGS>		I201.5	73020105	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Multiple errors<TAGS>		I201.6	73020106	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – duplicate reference-ID or index in message<TAGS>		I201.7	73020107	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – parameter invalid for context <P1><TAGS>		I201.8	73020108	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Authorization failure<TAGS>		I201.9	73020109	CMTS: docslf3CmtsEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		REG RSP contains service flow parameters that CM cannot support <P1><TAGS>	P1 = Service Flow ID	I251.0	73025100	
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		REG RSP contains classifier parameters that CM cannot support <P1><TAGS>	P1 = Service Flow ID	I251.1	73025101	
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		REG RSP contains PHS parameters that CM cannot support <P1><TAGS>	P1 = Service Flow ID	I251.2	73025102	
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		Registration RSP rejected unspecified reason<TAGS>		I251.3	73025103	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		Registration RSP rejected message syntax error <P1><TAGS>	P1 = message	I251.4	73025104	
Init	1.1 and 2.0 SPECIFIC REGISTRATION RESPONSE	Critical		Registration RSP rejected message too big <P1><TAGS>	P1 = # of characters	I251.5	73025105	
Init	2.0 SPECIFIC REGISTRATION RESPONSE	Warning		REG-RSP received after REG-ACK. Returning to 1.x transmit mode<TAGS>		I261.0	73026100	
Init	REGISTRATION ACKNOWLEDGEMENT		Warning	REG aborted no REG-ACK<TAGS>		I301.0	73030100	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION Acknowledgement		Warning	REG ACK rejected unspecified reason<TAGS>		I302.0	73030200	CMTS: docslf3CmtsEventNotif
Init	REGISTRATION ACKNOWLEDGEMENT		Warning	REG ACK rejected message syntax error<TAGS>		I303.0	73030300	CMTS: docslf3CmtsEventNotif
Init	TLV-11 PARSING	Notice		TLV-11 – unrecognized OID<TAGS>		I401.0	73040100	CM: docslf3CmEventNotif
Init	TLV-11 PARSING	Critical		TLV-11 – Illegal Set operation failed<TAGS>		I402.0	73040200	CM: docslf3CmEventNotif
Init	TLV-11 PARSING	Critical		TLV-11 – Failed to set duplicate elements<TAGS>		I403.0	73040300	CM: docslf3CmEventNotif
Init	1.1 and 2.0 SPECIFIC REGISTRATION REQUEST		Warning	REG REQ rejected – Message too big <P1><TAGS>		I201.16	73020116	CMTS: docslf3CmEventNotif
Init	Waiting for REG-RSP or REG-RSP-MP	Error		T6 Timeout and retries exceeded<TAGS>		I271.0	73027100	
Init	CM Complete Registration	Error		Can not create US Primary Service Flow<TAGS>		I501.0	73050100	
Init	CM Complete Registration	Notice		Received REG-RSP while in REG-HOLD1 state<TAGS>		I502.0	73050200	
Init	CM Complete Registration	Notice		Received REG-RSP while in REG-HOLD2 state<TAGS>		I503.0	73050300	
Init	Waiting for REG-REQ or REG-REQ-MP		Warning	T9 Timeout – Never received REG-REQ or all REG-REQ-MP fragments<TAGS>		I211.0	73021100	
Init	CMTS Registration		Error	Missing RCP in REG-REQ or REG-REQ-MP<TAGS>		I551.0	73055100	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	CMTS Registration		Notice	Received Non-Queue-Depth Based Bandwidth Request and Multiple Transmit Channel mode is enabled<TAGS>		I552.0	73055200	
Init	CMTS Registration		Notice	Received Queue-Depth Based Bandwidth Request when Multiple Transmit Channel mode is not enabled<TAGS>		I553.0	73055300	
Init	CMTS Registration		Notice	Received REG-ACK with TCS - Partial Service<TAGS>		I554.0	73055400	
Init	CMTS Registration		Notice	Received REG-ACK with RCS - Partial Service<TAGS>		I555.0	73055500	
Init	CMTS Registration		Warning	T6 Timer expires and Retries Exceeded<TAGS>		I556.0	73055600	
Init	CMTS Registration		Warning	Initializing Channel Timeout<TAGS>		I557.0	73055700	
Init	CMTS Registration		Warning	REG-REQ-MP received when no MDD present<TAGS>		I558.0	73055800	
Init	CMTS Registration		Warning	REG-REQ rejected invalid Energy Management parameters<TAGS>		I559.0	73055900	
<b>QoS</b>								
Service Flow	Service Flow Assignment		Notice	Attribute Masks for SF (SFID <P1>) do not satisfy those in the SCN <P2>	P1 = SFID P2 = SCN	K101.0	75010100	
<b>General</b>								
		Informational		A transmit opportunity was missed because the MAP arrived too late.		N01.0	78000100	
<b>Ranging</b>								
Init	RANGING	Critical		No Maintenance Broadcasts for Ranging opportunities received – T2 time-out<TAGS>		R01.0	82000100	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	RANGING	Critical		No Ranging Response received – T3 time-out<TAGS>		R02.0	82000200	
Init	RANGING	Critical		Ranging Request Retries exhausted<TAGS>		R03.0	82000300	
Init	RANGING	Critical		Received Response to Broadcast Maintenance Request, But no Unicast Maintenance opportunities received – T4 time out<TAGS>		R04.0	82000400	
Init	RANGING	Critical		Started Unicast Maintenance Ranging – No Response received – T3 time-out<TAGS>		R05.0	82000500	
Init	RANGING	Critical		Unicast Maintenance Ranging attempted – No response – Retries exhausted<TAGS>		R06.0	82000600	
Init	RANGING	Critical		Unicast Ranging Received Abort Response – Re-initializing MAC<TAGS>		R07.0	82000700	
Init	RANGING	Critical		16 consecutive T3 timeouts while trying to range on upstream channel <P1><TAGS>	P1 = Upstream Channel ID	R08.0	82000800	
Init	RANGING	Warning		B-INIT-RNG Failure – Retries exceeded<TAGS>		R09.0	82000900	
Init	RANGING		Warning	No Ranging Requests received from POLLED CM (CMTS generated polls);<CM-MAC>;		R101.0	82010100	
Init	RANGING		Warning	Retries exhausted for polled CM (report MAC address). After 16 R101.0 errors<CM-MAC>;		R102.0	82010200	
Init	RANGING		Warning	Unable to Successfully Range CM (report MAC address) Retries Exhausted;<CM-MAC>;	NOTE: this is different from R102.0 in that it was able to try, i.e., got REQs but failed to Range properly.	R103.0	82010300	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	RANGING		Warning	Failed to receive Periodic RNG-REQ from modem (SID X), timing-out SID;<CM-MAC>		R104.0	82010400	
Init	RANGING		Informational	CM transmitted B-INIT-RNG-REQ with MD-DS-SG ID of zero;<CM-MAC>	For CMTS SYSLOG only, append: MAC addr: <P1> P1 = Mac Addr of CM	R105.0	82010500	
<b>Dynamic Services</b>								
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Unspecified reason<TAGS>		S01.0	83000100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Unrecognized configuration setting<TAGS>		S01.1	83000101	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Classifier not found<TAGS>		S01.10	83000110	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Classifier exists<TAGS>		S01.11	83000111	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – PHS rule exists<TAGS>		S01.13	83000113	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Duplicated reference-ID or index in message<TAGS>		S01.14	83000114	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Multiple upstream flows<TAGS>		S01.15	83000115	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Multiple downstream flows<TAGS>		S01.16	83000116	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Classifier for another flow<TAGS>		S01.17	83000117	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – PHS rule for another flow<TAGS>		S01.18	83000118	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Parameter invalid for context<TAGS>		S01.19	83000119	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Temporary no resource<TAGS>		S01.2	83000102	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Authorization failure<TAGS>		S01.20	83000120	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Major service flow error<TAGS>		S01.21	83000121	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Major classifier error<TAGS>		S01.22	83000122	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Major PHS rule error<TAGS>		S01.23	83000123	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Multiple major errors<TAGS>		S01.24	83000124	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Message syntax error<TAGS>		S01.25	83000125	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Message too big<TAGS>		S01.26	83000126	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Temporary DCC<TAGS>		S01.27	83000127	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Permanent administrative<TAGS>		S01.3	83000103	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Required parameter not present<TAGS>		S01.4	83000104	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Header suppression setting not supported<TAGS>		S01.5	83000105	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Service flow exists<TAGS>		S01.6	83000106	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – HMAC Auth failure<TAGS>		S01.7	83000107	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Add aborted<TAGS>		S01.8	83000108	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Add rejected – Multiple errors<TAGS>		S01.9	83000109	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Unspecified reason<TAGS>		S02.0	83000200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Unrecognized configuration setting<TAGS>		S02.1	83000201	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Classifier not found<TAGS>		S02.10	83000210	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Classifier exists<TAGS>		S02.11	83000211	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – PHS rule not found<TAGS>		S02.12	83000212	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – PHS rule exists<TAGS>		S02.13	83000213	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Duplicated reference-ID or index in message<TAGS>		S02.14	83000214	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Multiple upstream flows<TAGS>		S02.15	83000215	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Multiple downstream flows<TAGS>		S02.16	83000216	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Classifier for another flow<TAGS>		S02.17	83000217	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – PHS rule for another flow<TAGS>		S02.18	83000218	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Invalid parameter for context<TAGS>		S02.19	83000219	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Temporary no resource<TAGS>		S02.2	83000202	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Authorization failure<TAGS>		S02.20	83000220	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Major service flow error<TAGS>		S02.21	83000221	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Major classifier error<TAGS>		S02.22	83000222	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Major PHS error<TAGS>		S02.23	83000223	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Multiple major errors<TAGS>		S02.24	83000224	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Message syntax error<TAGS>		S02.25	83000225	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Message too big<TAGS>		S02.26	83000226	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Temporary DCC<TAGS>		S02.27	83000227	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Permanent administrative<TAGS>		S02.3	83000203	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Requester not owner of service flow<TAGS>		S02.4	83000204	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Service flow not found<TAGS>		S02.5	83000205	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Required parameter not present<TAGS>		S02.6	83000206	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Header suppression setting not supported<TAGS>		S02.7	83000207	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – HMAC Auth failure<TAGS>		S02.8	83000208	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Change rejected – Multiple errors<TAGS>		S02.9	83000209	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Delete rejected – Unspecified reason<TAGS>		S03.0	83000300	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Delete rejected – Requester not owner of service flow<TAGS>		S03.1	83000301	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Delete rejected – Service flow not found<TAGS>		S03.2	83000302	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Delete rejected – HMAC Auth failure<TAGS>		S03.3	83000303	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE REQUEST	Error	Warning	Service Delete rejected – Message syntax error<TAGS>		S03.4	83000304	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Invalid transaction ID<TAGS>		S101.0	83010100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add aborted – No RSP<TAGS>		S101.1	83010101	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – PHS rule exists<TAGS>		S101.10	83010110	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Duplicate reference_ID or index in message<TAGS>		S101.11	83010111	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Classifier for another flow<TAGS>		S101.12	83010112	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Parameter invalid for context<TAGS>		S101.13	83010113	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Major service flow error<TAGS>		S101.14	83010114	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Major classifier error<TAGS>		S101.15	83010115	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Major PHS Rule error<TAGS>		S101.16	83010116	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Multiple major errors<TAGS>		S101.17	83010117	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Message too big<TAGS>		S101.18	83010118	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – HMAC Auth failure<TAGS>		S101.2	83010102	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – Message syntax error<TAGS>		S101.3	83010103	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Unspecified reason<TAGS>		S101.4	83010104	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Unrecognized configuration setting<TAGS>		S101.5	83010105	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected –Required parameter not present<TAGS>		S101.6	83010106	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – Service Flow exists<TAGS>		S101.7	83010107	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – Multiple errors<TAGS>		S101.8	83010108	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Add Response rejected – Classifier exists<TAGS>		S101.9	83010109	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Invalid transaction ID<TAGS>		S102.0	83010200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change aborted- No RSP<TAGS>		S102.1	83010201	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Duplicated reference-ID or index in<TAGS>		S102.10	83010210	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Invalid parameter for context<TAGS>		S102.11	83010211	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Major classifier error<TAGS>		S102.12	83010212	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Major PHS rule error<TAGS>		S102.13	83010213	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Multiple Major errors<TAGS>		S102.14	83010214	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Message too big<TAGS>		S102.15	83010215	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICE S	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – HMAC Auth failure<TAGS>		S102.2	83010202	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Message syntax error<TAGS>		S102.3	83010203	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Unspecified reason<TAGS>		S102.4	83010204	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Unrecognized configuration setting<TAGS>		S102.5	83010205	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Required parameter not present<TAGS>		S102.6	83010206	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Multiple errors<TAGS>		S102.7	83010207	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – Classifier exists<TAGS>		S102.8	83010208	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Change Response rejected – PHS rule exists<TAGS>		S102.9	83010209	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE RESPONSE	Error	Warning	Service Delete Response rejected – Invalid transaction ID<TAGS>		S103.0	83010300	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Add Response rejected – Invalid Transaction ID<TAGS>		S201.0	83020100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Add Aborted – No ACK<TAGS>		S201.1	83020101	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Add ACK rejected – HMAC auth failure<TAGS>		S201.2	83020102	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Add ACK rejected- Message syntax error<TAGS>		S201.3	83020103	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Change ACK rejected – Invalid transaction ID<TAGS>		S202.0	83020200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Change Aborted – No ACK<TAGS>		S202.1	83020201	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Change ACK rejected – HMAC Auth failure<TAGS>		S202.2	83020202	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
DYNAMIC SERVICES	DYNAMIC SERVICE ACKNOWLEDGEMENT	Error	Warning	Service Change ACK rejected – Message syntax error<TAGS>		S202.3	83020203	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
<b>Downstream Acquisition</b>								
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure – Failed to acquire QAM/QPSK symbol timing;<TAGS>		T01.0	84000100	
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure – Failed to acquire FEC framing<TAGS>		T02.0	84000200	
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure, Acquired FEC framing – Failed to acquire MPEG2 Sync<TAGS>		T02.1	84000201	
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure – Failed to acquire MAC framing<TAGS>		T03.0	84000300	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure – Failed to receive MAC SYNC frame within time-out period<TAGS>		T04.0	84000400	
Init	DOWNSTREAM ACQUISITION	Critical		SYNC Timing Synchronization failure – Loss of Sync<TAGS>		T05.0	84000500	
Init	DOWNSTREAM ACQUISITION	Error		RCS Primary DS Failure<TAGS>		T06.0	84000600	
Init	DOWNSTREAM ACQUISITION	Warning		RCS Partial Service<TAGS>		T07.0	84000700	
Init	RCP and RCC	Error		RCP-ID in RCC not supported<TAGS>		T101.0	84010100	
Init	RCP and RCC	Error		More than one RCP-ID included in RCC<TAGS>		T102.0	84010200	
Init	RCP and RCC	Error		Receive Module Index missing in RCC<TAGS>		T103.0	84010300	
Init	RCP and RCC	Error		RCC contains a Receive Module Index which is not supported<TAGS>		T104.0	84010400	
Init	RCP and RCC	Error		Receive channel center frequency not within allowed range of center frequencies for Receive Module<TAGS>		T105.0	84010500	
Init	RCP and RCC	Error		Receive Module first channel center frequency not within allowed range of center frequencies<TAGS>		T106.0	84010600	
Init	RCP and RCC	Error		Receive Module first channel center frequency not present in RCC<TAGS>		T107.0	84010700	
Init	RCP and RCC	Error		No primary downstream channel assignment in RCC<TAGS>		T108.0	84010800	
Init	RCP and RCC	Error		More than one primary downstream channel assignment present in RCC<TAGS>		T109.0	84010900	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Init	RCP and RCC	Error		Receive Module connectivity encoding in RCC Requires configuration not supported<TAGS>		T110.0	84011000	
Init	RCP and RCC	Error		Receive channel index in RCC not supported by CM<TAGS>		T111.0	84011100	
Init	RCP and RCC	Error		Center frequency in RCC not a multiple of 62500 Hz<TAGS>		T112.0	84011200	
Init	MDD	Error		Missing Mandatory MDD TLV on primary DS Channel<TAGS>		T201.0	84020100	
Init	MDD	Warning		Lost MDD Timeout<TAGS>		T202.0	84020200	
Init	MDD	Warning		MDD message timeout<TAGS>		T203.0	84020300	
Init	OBTAİN UPSTREAM PARAMETERS	Critical		No UCDs Received – Timeout;<TAGS>		U01.0	85000100	
Init	OBTAİN UPSTREAM PARAMETERS	Critical		UCD invalid or channel unusable<TAGS>		U02.0	85000200	
Init	OBTAİN UPSTREAM PARAMETERS	Critical		UCD & SYNC valid – NO MAPS for this channel<TAGS>		U04.0	85000400	
Init	OBTAİN UPSTREAM PARAMETERS	Critical		US channel wide parameters not set before Burst Descriptors<TAGS>		U06.0	85000600	
Init	Acquire CM Transmit Channels	Error		TCS Fail on all Upstream Channels<TAGS>		U101.0	85010100	
Init	Acquire CM Transmit Channels	Warning		TCS Partial Service<TAGS>		U102.0	85010200	
Init	Acquire CM Transmit Channels	Warning		Initializing Channel Timeout Expires – Time the CM can perform initial ranging on all upstream channels in the TCS has expired<TAGS>		U103.0	85010300	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
<b>Diagnostic Log</b>								
Diag	LogSize		Warning	Diagnostic log size reached high threshold. Enabled detectors: <P1>;Log maximum size: <P2>	P1 = (ASCII hex representation of enabled diagnostic log detectors bit mask) P2 = maximum size of the diagnostic log	V001.0	86000100	docsDiagLogSizeHighThrshld Reached
Diag	LogSize		Notice	Diagnostic log size dropped to low threshold. Enabled detectors: <P1>;Log maximum size: <P2>	P1 = (ASCII hex representation of enabled diagnostic log detectors bit mask) P2 = maximum size of the diagnostic log	V002.0	86000200	docsDiagLogSizeLowThrshld Reached
Diag	LogSize		Warning	Diagnostic log size reached full threshold. Enabled detectors: <P1>;Log maximum size: <P2>	P1 = (ASCII hex representation of enabled diagnostic log detectors bit mask) P2 = maximum size of the diagnostic log	V003.0	86000300	docsDiagLogSizeFull
<b>IPDR</b>								
IPDR	IPDR/SP Protocol		Notice	IPDR Connection Terminated. Collector IP:<P1>;Session ID: <P2>;Error Code: <P3>; Error Description: <P4>	P1 = Collector Host Name P2 = Session ID P3 = Error Code P4 = Error Description	W001.0	87000100	
IPDR	IPDR/SP Redundancy		Warning	IPDR Collector Failover Error: Backup Collector IP: <P1>;	P1 = Backup Collector IP	W002.0	87000200	
<b>Multicast</b>								
Multicast	QoS		Warning	Aggregate Session Limit defined by GC,GQC entry (<P1>) exceeded by join for (<P2>)<TAGS>	P1 = GC ID,GQC ID P2 = S,G of the join  Note: The event only records the CM MAC Addr though the Join could be from a CM or a CPE behind it.	Y101.0	89010100	CMTS: docsIf3CmtsEventNotif
Multicast	QoS		Warning	Admitted Multicast Aggregate Bandwidth Increased Above Low Water Mark <P1> on Interface <P2>:<P3><TAGS>	P1 = Low Water Mark Threshold P2 = ifName.ifIndex P3 = ifIndex	Y101.1	89010101	CMTS: docsIf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Multicast	QoS		Notice	Admitted Multicast Aggregate Bandwidth Dropped Below Low Water Mark <P1> on Interface <P2>:<P3><TAGS>	P1 = Low Water Mark Threshold P2 = ifName.ifIndex P3 = ifIndex	Y101.2	89010102	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Error	Admitted Multicast Aggregate Bandwidth Increased to High Water Mark <P1> on Interface <P2>:<P3><TAGS>	P1 = High Water Mark Threshold P2 = ifName.ifIndex P3 = ifIndex	Y101.3	89010103	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Warning	Multicast Group Service Flow <P1> on Interface <P2>:<P3> Dropping Packets;<P4>:<P5>:<P6><TAGS>	P1 = Service Flow ID associated with GSF P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex P4 = Service Class Name P5 = Max Traffic Rate D.1 P6 = GC ID, GQC ID	Y101.4	89010104	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Notice	Multicast Group Service Flow <P1> on Interface <P2>:<P3> No Longer Dropping Packets;<P4>:<P5>:<P6><TAGS>	P1 = Service Flow ID associated with GSF P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex P4 = Service Class Name P5 = Max Traffic Rate P6 = GC ID, GQC ID	Y101.5	89010105	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Warning	Ingress IGMP Protocol Messages Increased to Threshold <P1> on Interface <P2>:<P3><TAGS>	P1 = Threshold P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex	Y101.6	89010106	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Notice	Ingress IGMP Protocol Messages Dropped Below Threshold <P1> on Interface <P2>:<P3><TAGS>	P1 = Threshold P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex	Y101.7	89010107	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
Multicast	QoS		Warning	Ingress MLD Protocol Messages Increased to Threshold <P1> on Interface <P2>:<P3><TAGS>	P1 = Threshold P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex	Y101.8	89010108	CMTS: docslf3CmtsEventNotif
Multicast	QoS		Notice	Ingress MLD Protocol Messages Dropped Below Threshold <P1> on Interface <P2>:<P3><TAGS>	P1 = Threshold P2 = MAC Domain ifName.ifIndex P3 = MAC Domain ifIndex	Y101.9	89010109	CMTS: docslf3CmtsEventNotif
Multicast	Authorization		Notice	Multicast session <P1> not authorized for Client <P2> behind CM <P3><TAGS>	P1 = S,G of the join P2 = IPv4 or IPv6 Address of Client P3 = CM MAC Addr	Y102.0	89010200	CMTS: docslf3CmtsEventNotif
Multicast	Authorization		Warning	Maximum Multicast Session <P1> Threshold <P2> Reached for CM <P3><TAGS>	P1 = S,G of the join P2 = Multicast Session Limit P3 = CM MAC Addr	Y102.1	89010201	CMTS: docslf3CmtsEventNotif
Multicast	Authorization		Informational	Multicast Profile <P1> created for CM <P2> for CM <P3><TAGS>	P1 = Profile Name P2 = CM MAC Addr	Y103.0	89010300	CMTS: docslf3CmtsEventNotif
<b>CM-STATUS</b>								
CM-STATUS	CM-STATUS		Notice	CM-STATUS received prior to REG-ACK<TAGS>		J01.0	74000100	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received while enable bit cleared<TAGS>		J02.0	74000200	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – secondary channel MDD timeout<TAGS>		J03.0	74000300	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – QAM/FEC lock failure<TAGS>		J04.0	74000400	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – sequence out-of-range<TAGS>		J05.0	74000500	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – MDD recovery<TAGS>		J06.0	74000600	CMTS: docslf3CmtsEventNotif

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – QAM/FEC recovery<TAGS>		J07.0	74000700	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – T4 timeout<TAGS>		J08.0	74000800	CMTS: docslf3CmtsEventNotif
CM-STATUS	CM-STATUS		Notice	CM-STATUS received – T3 retries exceeded<TAGS>		J09.0	74000900	CMTS: docslf3CmtsEventNotif
<b>CM-CTRL</b>								
CM-CTRL	CM-CTRL	Debug	Debug	CM-CTRL – Command: <P1> (if P1= mute Add Interval: <P2> ChannelID: <P3>) (If P1 = forwarding Add Action: <P4>) <TAGS>	P1 = mute, or cmReinit, or forwarding  P2= mute interval, Value 0 indicate unmute operation  P3= Channel ID or 0 P4 = enable, or disable	L01.0	76000100	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
CM-CTRL	CM-CTRL	Debug	Debug	CM-CTRL- Invalid message format<TAGS>		L02.0	76000200	CM: docslf3CmEventNotif, CMTS: docslf3CmtsEventNotif
<b>Energy Management</b>								
EM	EM-REQ	Informational		EM-RSP not received<TAGS>		L101.0	76010100	
EM	EM-REQ	Warning		EM-REQ retries exhausted<TAGS>		L102.0	76010200	
EM	EM-REQ	Informational		EM-RSP received, Reject Temporary, deferring for <P1> seconds<TAGS>	<P1> = time to defer (seconds)	L103.0	76010300	
EM	EM-REQ	Warning		EM-RSP received, Reject Permanent<TAGS>		L104.0	76010400	
EM	EM-RSP		Warning	EM-RSP sent, Reject Temporary: Bonded Multicast Conflict<TAGS>		L105.0	76010500	
EM	EM-RSP		Warning	EM-RSP sent, Reject Temporary: UGS/RTPS Grant Conflict<TAGS>		L106.0	76010600	
EM	EM-RSP		Warning	EM-RSP sent, Reject Temporary: Attribute Mask Conflict<TAGS>		L107.0	76010700	

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
EM	EM-RSP		Warning	EM-RSP sent, Reject Temporary: Deferred<TAGS>		L108.0	76010800	
EM	EM-RSP		Warning	EM-RSP sent, Reject Permanent, Requested Low Power Mode(s) Not Supported<TAGS>		L109.0	76010900	
EM	EM-RSP		Warning	EM-RSP sent, Reject Permanent, Requested Low Power Mode(s) Disabled<TAGS>		L110.0	76011000	
EM	EM-RSP		Warning	EM-RSP sent, Reject Permanent, Other<TAGS>		L111.0	76011100	
EM	EM-RSP		Notice	CM allowed into 1x1 Mode while Attribute Masks not met<TAGS>		L112.0	76011200	
EM	DBC	Informational	Informational	CM entered EM 1x1 mode; Reason: <P1><TAGS>	P1=Unknown, Activity Detection, eSAFE, CMTS Initiated	L113.0	76011300	CM: docslf3CmEventNotif CMTS: docslf3CmtsEventNotif
EM	DBC	Informational	Informational	CM exited EM 1x1 mode<TAGS>		L114.0	76011400	CM: docslf3CmEventNotif CMTS: docslf3CmtsEventNotif
EM	Activity Detection	Informational		EM 1x1 Activity Detection Threshold crossed; Reason:<P1><TAGS>	P1=Upstream entry, Downstream entry, Upstream exit, Downstream exit	L115.0	76011500	CM: docslf3CmEventNotif
EM	EM-REQ	Informational		EM-REQ Sent<TAGS>		L116.0	76011600	
<b>DSG Reserved Events (See [DSG] for Event Definitions)</b>								
						Gxxxx.xx		
<b>eDOCSIS Reserved Events (See [eDOCSIS] for Event Definitions)</b>								
						Hxxxx.xx		
<b>M-CMTS Reserved Events (See [M-OSSI] for Event Definitions)</b>								
						Mxxxx.xx		
<b>DPoE Reserved Events (See [DPoE-MEFv1.0] for Event Definitions)</b>								
						Pxxxx.xx		

Process	Sub-Process	CM Priority	CMTS Priority	Event Message	Message Notes and Detail	Error Code Set	Event ID	Notification Name
<b>EQAM Reserved Events (See [EQAM-PMI] for Event Definitions)</b>								
						Qxxxx.xx		

## Annex E Application of MGMD-STD-MIB to DOCSIS 3.0 MGMD Devices (Normative)

### E.1 MGMD MIBs<sup>170</sup>

DOCSIS 3.0 defines three methods for forwarding multicast traffic [MULPI]. The first method is referred to as DSID based Multicast Forwarding. In this mode, the CMTS, not the CM, controls the forwarding of multicast traffic to CPE devices behind the CM. The second method is called GMAC Explicit Multicast Forwarding. In this mode, a DSID is used for filtering downstream packets and for some forwarding of multicast, but the CMTS also includes a GMAC address for the IP Multicast Group to allow the CM to utilize some hardware forwarding assistance. When the CM is operating in GMAC Explicit forwarding mode, the CM plays a completely passive role in the IGMP or MGMD framework and passes all membership traffic and related messages to the CMTS. The final forwarding mode is MDF Disabled. In this mode, the CM acts as it did in DOCSIS 2.0 and snoops the IGMP membership and related messages.

A CMTS that supports MGMD supports the MGMD-STD-MIB [RFC 5519]. As such, this section describes the application of the IETF [RFC 5519] to MGMD devices. The tables in the MGMD-STD- MIB [RFC 5519] have been condensed to two tables, with additional MIB objects added to match the IGMP-STD-MIB defined in [RFC 2933]. The MGMD MIB will also include information about MLD (Multicast Listener Discovery) from [RFC 3019] to support IPv6.

DOCSIS 3.0 CMs are required to support only the [RFC 2933] MIB objects. The reasoning for this is that a DOCSIS 3.0 CM registered with a DOCSIS 3.0 CMTS will not play an active role in managing the IGMP traffic for CPE devices behind it. When DOCSIS 3.0 CMs are registered with Multicast DSID Forwarding disabled or are registered with a Pre-3.0 DOCSIS CMTS, the CM will only forward IGMPv2 traffic; thus the requirement for these CMs is to support the objects defined in [RFC 2933].

The MGMD-STD-MIB [RFC 5519] is organized into two distinct tables; the interface and cache tables. The MGMD Interface Table contains entries for each interface that supports MGMD on a device. This includes the NSI and HFC interfaces for the CMTS. The MGMD Cache Table contains one row for each IP Multicast Group for which there are active members on a given interface. If the CMTS is implemented as a Multicast router, active multicast group membership MAY exist on both the NSI and HFC interfaces.

Support of the MGMD-STD-MIB [RFC 5519] is presented in terms of MGMD capabilities supported by the CMTS.

### E.2 CM Support of IGMP-STD-MIB [RFC 2933]

There are two types of interfaces applicable to IGMP on the DOCSIS 3.0 CM when it is registered with Multicast DSID Forwarding disabled or with a Pre-3.0 DOCSIS CMTS. These are the HFC-Side and CMCI-Side interfaces, respectively. Application of the IGMP-STD-MIB to DOCSIS 3.0 CMs is presented in terms of passive and active CM operation and these two interface types. The CM MUST implement the passive IGMP mode. Additionally, the CM MAY implement the active IGMP mode. If the CM implements the active IGMP mode, the CM MUST support a capability to switch between modes.

#### E.2.1 IGMP Interface Table Objects

The following table defines the objects that are expected to be supported in the CM when operating in Active or Passive Proxy modes. Any deviation or clarification of the expected values from [RFC 2933] is noted in the sections following the table. If the requirements for a given MIB object denote per [RFC 2933], the expected values for the objects do not deviate from the expectations defined in the RFC.

<sup>170</sup> Revised per OSSIV3.0-N-09.0835-2 on 9/15/09 by JB.

**Table E-1 - IGMP-STD-MIB igmpInterfaceTable Objects**

MIB OBJECT	CM PASSIVE		CM ACTIVE	
	HFC	CMCI	HFC	CMCI
igmplInterfaceIfIndex	"2"	"1"	"2"	"1"
igmplInterfaceQueryInterval	R/O Always "0"	Per [RFC 2933]	R/O Always "0"	Per [RFC 2933]
igmplInterfaceStatus	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceVersion	"2"	"2"	"2"	"2"
igmplInterfaceQuerier	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceQueryMaxResponseTime	R/O Always "0"	R/O	R/O Always "0"	Per [RFC 2933]
igmplInterfaceQuerierUpTime	Per [RFC 2933]	"0"	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceQuerierExpiryTime	"0"	"0"	"0"	"0"
igmplInterfaceVersion1QuerierTimer	"0"	"0"	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceWrongVersionQueries	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceJoins	"0"	Per [RFC 2933]	"0"	Per [RFC 2933]
igmplInterfaceProxyIfIndex	"0"	"2"	"0"	"2"
igmplInterfaceGroups	"0"	Per [RFC 2933]	"0"	Per [RFC 2933]
igmplInterfaceRobustness	"0"	"0"	Per [RFC 2933]	Per [RFC 2933]
igmplInterfaceLastMemberQueryIntvl	R/O Always "0"	R/O See details below	R/O Always "0"	0-255 ms, default 100 ms.

**E.2.1.1      *igmplInterfaceQueryInterval*****E.2.1.1.1    Passive Mode**

CMCI-side: The value of igmplInterfaceQueryInterval of a CM in Passive Mode is the interval between queries received from an upstream Querier.

**E.2.1.1.2    Active Mode**

CMCI-side: The Query Interval is the interval between General Queries sent by the CMCI Querier. Default: 125 seconds

**E.2.1.2      *igmplInterfaceQuerier*****E.2.1.2.1    Passive Mode**

HFC-side: The HFC side's igmplInterfaceQuerier of a CM in Passive Mode is the address of an upstream IGMP Querier device.

CMCI-side: The CMCI side's igmplInterfaceQuerier of a CM in Passive Mode is the address of an upstream IGMP Querier device.

**E.2.1.2.2    Active Mode**

HFC-side: The HFC side's igmplInterfaceQuerier of a CM in Active Mode is the address of an upstream IGMP Querier.

CMCI-side: Active CMs report the CMCI Interface. However, active CMs that participate in IGMP Querier negotiation on the CMCI may report a different CPE.

**E.2.1.3      *igmplInterfaceQueryMaxResponseTime*****E.2.1.3.1    Passive Mode**

CMCI-side: This value is derived from observation of maximum query response time advertised in IGMPv2 queries received from an upstream querier.

**E.2.1.3.2 Active Mode**

CMCI-side: The maximum query response time advertised in IGMPv2 queries on this interface.

**E.2.1.4 igmpInterfaceQuerierExpiryTime****E.2.1.4.1 Passive Mode**

CMCI-side: In Passive Proxy mode, the CM will return a 0 for this object.

**E.2.1.4.2 Active Mode**

CMCI-side: In Active mode, the CM is an active querier for the CMCI attached networks. As such, the value of this object is 0.

**E.2.1.5 igmpInterfaceJoins****E.2.1.5.1 All Modes**

CMCI-side: The CM counts all unsolicited membership reports for the CMCI interface only.

**E.2.1.6 igmpInterfaceGroups****E.2.1.6.1 All Modes**

CMCI-side: This counter contains the number of entries in the Cache table for this interface.

**E.2.1.7 igmpInterfaceLastMembQueryIntvl****E.2.1.7.1 Passive Mode**

CMCI-side: This read-only value is derived from Group-Specific Queries sent in response to Leave Group messages received from an upstream querier.

**E.2.1.7.2 Active Mode**

CMCI-side: The Last Member Query Interval is the Max Response Time inserted into Group-Specific Queries sent in response to Leave Group messages, and is also the amount of time between Group-Specific Query messages. This value may be tuned to modify the "leave latency" of the network. A reduced value results in reduced time to detect the loss of the last member of a group. Valid entries for this object range between 0 and 255 ms with a default value of 100.

**E.2.2 igmpCacheTable**

The following table defines the objects that are expected to be supported in the CM when operating in Active or Passive Proxy modes. Any deviation or clarification of the expected values from [RFC 2933] is noted in the sections following the table. If the requirements for a given MIB object denote Per [RFC 2933], the expected values for the objects do not deviate from the expectations defined in the RFC.

**Table E-2 - IGMP-STD-MIB igmpCacheTable Objects**

MIB OBJECT	CM PASSIVE		CM ACTIVE	
	HFC	CMCI	HFC	CMCI
igmpCacheAddress	N/A	Per [RFC 2933]	N/A	Per [RFC 2933]
igmpCacheIfIndex	N/A	"1"	N/A	"1"
igmpCacheSelf	N/A	R/O Always FALSE	N/A	See Below
igmpCacheLastReporter	N/A	Per [RFC 2933]	N/A	Per [RFC 2933]
igmpCacheUpTime	N/A	Per [RFC 2933]	N/A	Per [RFC 2933]
igmpCacheExpiryTime	N/A	Per [RFC 2933]	N/A	Per [RFC 2933]
igmpCacheStatus	N/A	Per [RFC 2933]	N/A	Per [RFC 2933]
igmpCacheVersion1HostTimer	N/A	"0"	N/A	Per [RFC 2933]

**E.2.2.1    *igmpCacheAddress*****E.2.2.1.1    All Modes**

CMCI-side: This object reflects the address of the active IP Multicast Group on the CMCI interface.

**E.2.2.2    *igmpCacheSelf*****E.2.2.2.1    Passive Mode**

CMCI-side: The CM's igmpCacheSelf is always set to false in passive mode.

**E.2.2.2.2    Active Mode**

CMCI-side: Implementation specific. If the CM is configured to be a member of the group, then membership reports are sent with the IP Address of the CM but only be sent in proxy for active sessions on the CMCI (e.g., the CM should not be a member of a multicast group that is not active on the CMCI). If the CM is not configured to be a member, then the source IP Address of membership reports should be set to the current value of the igmpCacheLastReporter address.

**E.3    CMTS Support of MGMD-STD-MIB [RFC 5519]<sup>171</sup>**

The CMTS MUST support the mgmdRouterInterfaceTable, mgmdRouterCacheTable, mgmdInverseRouterCacheTable and the mgmdRouterSrcListTable from the MGMD-STD-MIB [RFC 5519] within each MAC Domain where IP multicast is forwarded.

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<sup>171</sup> Revised per OSSIV3.0-N-07.0498-1 by ab on 7/17/07; per OSSIV3.0-N-09.0835-2 on 9/15/09 by JB; per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

## Annex F Protocol Filtering (Normative)

DOCSIS 3.0 supports two IP protocol filtering methods consisting of the legacy IP filtering mechanism specified in [RFC 4639] and Upstream Drop Classifiers (UDCs) which are an outgrowth of the QoS classification mechanism.<sup>172</sup> IP filtering continues to operate in DOCSIS 3.0 as it has in previous versions of the specification, though the minimum number of filtering rules has been increased from sixteen (16) to sixty-four (64). IP filters are limited to support of IPv4 protocols, while UDCs can be used for IPv4, IPv6, and LLC in a common framework with QoS classification. UDCs and IP filters are mutually exclusive modes and only one filtering method is permitted to operate at a time.

UDCs are modeled on the existing QoS Classifiers that were introduced in DOCSIS 1.1. UDCs apply only to the CM, the RF interface and only in the upstream direction of flow. The use of UDCs facilitates delegation of upstream protocol filtering at the CM through parameters in the configuration file that can be controlled by the CMTS. Any packet classified by the Upstream Drop Classifier rule is discarded, conceptually similarly to directing an IP route to "null 0" or output to /dev/null in a UNIX system.

As with IP filters, UDC rules may be configured through the CM configuration file statically, assigned dynamically from the CMTS through a Group ID reference in the CM configuration file, dynamically added, changed or deleted after registration through a DSC (Dynamic Service Change) MAC management message from the CMTS, or both the static and dynamic configuration methods may be used together. The CMTS alone provides the downstream protocol filtering and can further reinforce the upstream classification policy through Subscriber Management traffic filtering functionality.

Among the specific requirements for classification at the CM, the CM is required to perform protocol filtering from the host CPE(s) to the RF interface when UDCs are enabled, or protocol filtering from any interface to or from the RF interface when IP filtering is enabled. All ICMP (ICMPv4 and ICMPv6) and IP packets will be forwarded from the CMCI interface to the RFI upstream interface based on rules outlined in the Upstream Drop Classifiers section of [MULPI], unless they are specifically required to be discarded according to applied protocol filtering or classification rules.

It is recommended that to avoid unexpected behavior, consumption of excess local resources and oversized configuration files, the configuration of Upstream Drop Classifiers not be configured simultaneously with the legacy IP filters. It should also be noted that when a DOCSIS 3.0 CM registers with a DOCSIS 3.0 CMTS when UDCs are enabled, only the UDC parameters will be utilized by the CM. When a DOCSIS 3.0 CM registers with a Pre-3.0 DOCSIS CMTS, or a Pre-3.0 DOCSIS CM is registered with a DOCSIS 3.0 CMTS, only the IP filters configured in the CM configuration file are used.<sup>173</sup>

### F.1 Filtering Mechanisms

The legacy DOCSIS filters are subdivided into two (2) filtering layers (LLC and IP) at the CM. The two legacy classification/filtering layers at the CM are docsDevFilterIpTable and docsDevFilterLlcTable. Classifiers cover both the LLC and IP criteria, matching much of the functionality of the legacy filtering mechanisms. However, classifier LLC criteria are complimentary and not designed to fully displace the legacy LLC filtering mechanism. See Section F.1.4.1 for comparisons and other considerations.

#### F.1.1 LLC Filters<sup>174</sup>

The CM MUST apply LLC filters (from [RFC 4639]), to layer-2 frames entering from any interface. The CM MUST NOT apply LLC filters from docsDevFilterLLCTable (i.e., ARP requests, SNMP responses) for traffic sourced from the CM. The CM MUST support a minimum of 10 LLC protocol filter entries in the docsDevFilterLLCTable.

CMs may have multiple interfaces. If LLC filters are applied to CM IfIndex 1, the CM MUST apply the same filters to the "Additional CPE interfaces" (see Section 7.1.3.3.1).

<sup>172</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

<sup>173</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

<sup>174</sup> Section modified per OSSIV3.0-N-08.0612-4 on 4/10/08 by KN.

## F.1.2 Special filters<sup>175</sup>

Special filters include IP spoofing filters, inter-eSAFE and eSAFE to CPE communications and SNMP access filters such as SNMPv1/v2c NmAccess mode (see Section 8.5.4.2) and SNMP CPE Access Control (see Section 8.5.4.9).

### F.1.2.1 IP Spoofing Filters

DOCSIS 3.0 CMs MAY implement an IP spoofing filter as specified in [RFC 4639]. IP spoofing filters MUST only be applied to packets entering the CM from CMCI interface(s). If a CM supports the IP spoofing filter functionality specified in [RFC 4639], the CM MUST adhere to the following requirements:

- Implement all MIB objects in the docsDevCpeGroup.
- The default value of docsDevCpeIpMax = -1.

### F.1.2.2 Additional requirement on dot1dTpFdbTable [RFC 4188]

CM CPE MAC addresses learned via the CM configuration file MUST set the dot1dTpFdbStatus to "mgmt". It is assumed that the number of "mgmt"-configured CM CPE MAC addresses is less than, or equal to, the TLV type-18 value (Maximum Number of CPE).

### F.1.2.3 SNMP Access Filter

When the CM is operating in SNMPv1/v2c NmAccess mode, the CM MUST apply the SNMP access filters to SNMP packets entering from any interface and destined for the CM. The CM MUST apply SNMP access filters after IP spoofing filters for the packets entering the CM from the CMCI interface. Since SNMP access filter function is controlled by docsDevNmAccessTable, SNMP access filter is available and applies only when the CM is in SNMP v1/v2c NmAccess mode.

When the CM is operating in SNMP Coexistence mode, SNMP access MUST be controlled and specified by the MIB objects in [RFC 3411] through [RFC 3415], and [RFC 3584].

CMs may have multiple interfaces. If SNMP access filters are applied to CM IfIndex 1, the CM MUST apply the same filters to the "Additional CPE interfaces" (see Section 7.1.3.3.1).

#### F.1.2.3.1 docsDevNmAccessIP and docsDevNmAccessIpMask<sup>176</sup>

A CM that implements docsDevNmAccessTable MUST apply the following rules in order to determine whether to permit SNMP access from a given source IP address (SrcIpAddr):

1. If (docsDevNmAccessIp == "255.255.255.255"), the CM MUST permit the access from any SrcIpAddr. 2.  
If ((docsDevNmAccessIp AND docsDevNmAccessIpMask) == (SrcIpAddr AND docsDevNmAccessIpMask)), the CM MUST permit the access from SrcIpAddr.
3. If (docsDevNmAccessIp == "0.0.0.0" AND docsDevNmAccessIpMask != '255.255.255.255'), the CM MUST permit access from any SrcIpAddr.
4. If neither #1, #2, or #3 is applied, the CM MUST NOT permit the access from SrcIpAddr.

The CM's default value of the docsDevNmAccessIpMask MUST be set to "0.0.0.0".

The following table contains sample MIB values and the access granted by those values.

**Table F-1 - Sample docsDevNmAccessIp Values**

docsDevNmAccessIp	docsDevNmAccessIpMask	Access
255.255.255.255	Any IP Address Mask	Any NMS
Any IP Address	0.0.0.0	Any NMS
Any IP Address except 255.255.255.255	255.255.255.255	Single NMS
0.0.0.0	255.255.255.255	No NMS (disables all access)
0.0.0.0	Any IP Address Mask except 255.255.255.255	Any NMS

<sup>175</sup> Revised per OSSlv3.0-N-07.0400-1 by ab on 5/4/07.

<sup>176</sup> Revised per OSSlv3.0-N-07.0477-2 by ab on 7/10/07 and per OSSlv3.0-N-09.0854-3 on 12/7/09 by JB.

If the CMTS implements docsDevNmAccessTable, the same rules as stated above for the CM are followed.

### F.1.3 IP Protocol Filtering<sup>177</sup>

The CM MUST support the SNMP table docsDevFilterIpTable for all interfaces. The CM MUST support a minimum of 64 IP filter rules.

If the CMTS enables Upstream Drop Classifiers during registration (see Upstream Drop Classifiers section of [MULPI]), the CM MUST make the docsDevFilterIpTable inaccessible and report an error 'noSuchName' for SNMPv1 PDU requests or 'inconsistentName' error for SNMPv2 PDU requests.

The objects docsDevFilterIpSourcePortLow, docsDevFilterIpSourcePortHigh, docsDevFilterIpDestPortLow, and docsDevFilterIPDestPortHigh within the CM MUST be applied to TCP or UDP packets, as opposed to applying only when docsDevFilterIpProtocol is set to udp(17) or tcp(6) as specified in [RFC 4639]. Thus, if a packet is TCP or UDP, these MIB objects represent the inclusive lower and upper bounds of the transport-layer source and destination port ranges that are to be matched; otherwise, they are ignored during matching.

To match TCP and UDP packets only, it is recommended to create two filter entries in the docsDevFilterIpTable, one with docsDevFilterIpProtocol set to tcp(6) and one set to udp(17), each with the appropriate docsDevFilterIp\*Port\* values. Creating a single entry with docsDevFilterIpProtocol set to "any" (using value 256, all 255 IP protocols are affected) and appropriate docsDevFilterIp\*Port\* values may not lead to the desired behavior as such entry could also match any non-TCP and non-UDP packets.

CMs may have multiple interfaces. If IP filters are applied to CM IfIndex 1, the CM MUST apply the same filters to the "Additional CPE interfaces" (see Section 7.1.3.3.1).

### F.1.4 Protocol Classification through Upstream Drop Classifiers<sup>178</sup>

The Upstream Drop Classifier (UDC) is a structural convention re-using the definition of upstream classifiers from [MULPI]. A unique top-level TLV (Upstream Drop Packet Classification Encoding, TLV 60) defines UDCs and distinguishes this type of classifier from the QoS classifier type (Upstream Packet Classification Encoding, TLV 22). UDCs are used to discard a packet matched to the classifier rule criteria. See the Upstream Drop Packet Classification Encoding section in the Common Radio Frequency Interface Encodings Annex of [MULPI] for more details.

UDCs are not assigned service flows by the CMTS in the manner that QoS classifiers are, the packet discard function is implicit whenever the top-level TLV (TLV 60) is used. Care needs to be taken to avoid conflicts in the configuration and management of rule order priority due to the use of a common priority numbering space that is shared between QoS and Upstream Drop Classifiers.

The classifier TLVs, 22 and 60, are used to construct a hierarchy of static and/or dynamic rules by priority rule order to classify against L2 (MAC addresses, VLAN tags, Cable Modem Interface Mask (CMIM), etc), L3 (source/destination IP address or prefix) or L4 criteria (TCP, UDP and other IP protocol types). Classifier rules (UDCs) may be configured on the CM dynamically using the DSC MAC Management Message (MMM).

Further requirements for UDCs as they pertain to the CM are specified in the Upstream Drop Classifiers section of [MULPI]. For more information regarding DOCSIS 3.0 CMTS requirements with regards to capability signaling in the MDD MAC Management Message, refer to the CMTS Upstream Drop Classifier Capability section of [MULPI]. For more information regarding DOCSIS 3.0 CM requirements with regards to the capability signaling in the REG-REQ or REG-REQ-MP MAC Management Message, refer to the Upstream Drop Classifiers section of [MULPI].<sup>179</sup>

The CM MUST support a minimum of 64 UDC rules.

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<sup>177</sup> Revised per OSSIV3.0-N-07.0385-1 on 5/3/07, OSSIV3.0-N-07.0477-2 on 7/12/07, and per OSSIV3.0-N-07.0510-1 by ab on 10/11/07. Revised per OSSIV3.0-N-08.0612-4 on 4/22/08 by KN.

<sup>178</sup> Revised per OSSIV3.0-N-07.0385-1 by ab on 5/3/07.

<sup>179</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

The following section is informational regarding similarities in criteria for IP classification between IP filters and UDC classifiers at the CM.

#### **F.1.4.1 Comparison of UDCs to IP Filters**

The similarities and differences between UDCs and IP Filtering (docsDevIpFilterTable) are as follows:<sup>180</sup>

##### **F.1.4.1.1 IP Version and Protocol Type Support**

- IP filters support only IPv4 protocols with support for rules for UDP, TCP (but not both) or all IP protocols.
- UDCs support IPv6, IPv4 and can have rules for TCP, UDP, both TCP and UDP, or all IP protocols.

##### **F.1.4.1.2 Purposes for IP Filtering**

- IP filters provide limited protection to other customer's CPE within the local IP subnet (IPv4) by virtue of discarding undesirable or disruptive traffic generated by CPE connected to the CM.
- UDCs provide limited protection to other customer's CPE within the local IP subnet and/or prefix (IPv4/IPv6) by virtue of discarding undesirable or disruptive traffic generated by CPE connected to the CM.

##### **F.1.4.1.3 Direction of Filtering/Classification**

- IP filters can be configured to operate bi-directionally and are associated with an ifIndex to apply to any interface.
- UDCs primarily protect the operator's network from untrusted customer CPEs and play no role in the downstream (inbound) direction and apply only to the RF interface.
- The CMIM provides the UDC with the ability to filter against specific CPE in the direction of flow to the RF interface.
- Conditional CPE to eSAFE or eSAFE to eSAFE protocol filtering is performed by special filters in either scenario, which is separate and distinct from either IP filters or UDCs.

##### **F.1.4.1.4 Filtering of traffic from the CM**

- IP filters do not filter traffic generated from or destined to the CM host stack.
- UDC filters classify traffic generated from the CM host stack, with UDCs behaving like QoS classifiers in this regards as defined in the Service Flows and Classifiers section of [MULPI].

##### **F.1.4.1.5 Other Features Unique to UDCs**

- All L2 LLC/MAC criteria.
- Subscriber Management (delegation) and PCMM Integration (automation and dynamic operation).

#### **F.1.4.2 Comparison of QoS and Upstream Drop Classifiers**

The primary difference between QoS classifiers and Upstream Drop Classifiers is that QoS classifiers use a reference to a Service Flow with the Service Flow ID actually assigned by the CMTS, while the UDCs are not associated with any service flow at all. UDCs utilize a new top level TLV, TLV 60, which duplicates parameters from TLV 22 (upstream QoS settings) to identify that the classifier is a UDC. The use of these parameters within TLV 60 establishes that all packets matched to the classifier rule will be immediately dropped without further processing or queuing. As a result of this design, the CMTS does not track UDCs and holds no state information as to their operation, which differs significantly from the requirements for a QoS classifier and its associated service flow.

Dynamic reconfiguration of UDC rules is accomplished by the DSC (Dynamic Service Change) MAC Management Message from the CMTS. There is no SNMP writable object within the docsQoSPTClassTable and thus only a

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<sup>180</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

MMM message such as DSC can change variables in the table.<sup>181</sup> The method by which a CMTS receives commands to send a DSC message to a given CM is outside of the scope of this specification.

#### F.1.4.3 Upstream Drop Classifiers<sup>182</sup>

The Upstream Drop Classifier configuration structure is strictly designed to discard packets before they reach the output queue of the RFI interface and does not require attributes such as PHS or QoS. Upstream Drop Classifiers have a many-to-one relationship between UDC rules and the packet discard function. UDCs operate only within the local context of the CM. Any packet matched by a classifier rule is immediately discarded.

The CM will ignore UDC parameters which are incompatible with the packet discard function when they are configured in the CM configuration file.

#### F.1.4.4 IP Classification Rule Order Priority<sup>183</sup>

QoS rule priority generally supersedes drop rules, though this is a configuration decision and not dictated in these specifications. For example, during a viral outbreak or DoS attack, it may be preferable to apply drop rules with higher priority relative to QoS rules to more efficiently drop packets that match those associated with a virus, worm, or DoS attack.

For the purposes of classifying IP protocols, the following objects listed in Table F-2 (second column) are encoded within TLV 60 and shown in comparison with [RFC 2669] (first column in Table F-2) to construct L3/L4 rule criteria to enforce the operator's security policy.

**Table F-2 - Mapping of docsDevFilterIpTable [RFC 2669] to UDCs for Layer 3 & 4 Criteria<sup>184</sup>**

IP Filters [RFC 2669]	UDC TLV 60 encodings	Description
docsDevFilterIpIndex	Id	Rule index
docsDevFilterIpControl	- no equivalent	discard, accept, policy(*1)
docsDevFilterIpIfIndex	CMIM	CM interface(s)(*2)
docsDevFilterIpDirection	- no equivalent	inbound, outbound, both(*3)
docsDevFilterIpBroadcast	- no equivalent	Broadcast and multicast or all packets
- no equivalent	Rule priority	Directs order of processing
docsDevFilterIpStatus	- no equivalent	Activation state(*4)
docsDevFilterIpProtocol	IpProtocol	IP transport type, e.g., TCP, UDP
- no equivalent	FlowLabel	IPv6 flow label
docsDevFilterIpSaddr	IpSourceAddr	IP source address/prefix
docsDevFilterIpSmask	IpSourceMask	IP source mask/prefix length
docsDevFilterIpDaddr	IpDestAddr	IP dest. Address/prefix
docsDevFilterIpDmask	IpDestMask	IP dest. mask/prefix length
docsDevFilterIpTos	IpTosLow	Legacy type of service range low
	IpTosHigh	Legacy type of service range high
docsDevFilterIpTosMask	IpTosMask	Legacy type of service mask
docsDevFilterIpSourcePortLow	SourcePortStart	TCP/UDP source port range start
docsDevFilterIpSourcePortHigh	SourcePortEnd	TCP/UDP source port range end
docsDevFilterIpDestPortLow	DestPortStart	TCP/UDP source port range start
docsDevFilterIpDestPortHigh	DestPortEnd	TCP/UDP source port range end

<sup>181</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

<sup>182</sup> Revised per OSSIV3.0-N-07.0497-2 by ab on 7/17/07.

<sup>183</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07, and per OSSIV3.0-N-07.0497-2 by ab on 7/17/07.

<sup>184</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

IP Filters [RFC 2669]	UDC TLV 60 encodings	Description
docsDevFilterIpContinue	- no equivalent	Continue comparing rules on matches <sup>(*5)</sup>
docsDevFilterIpPolicyId	- no equivalent	Extensions for other criterion
<b>NOTES:</b>		
(*1) UDCs only perform discard actions.		
(*2) CMIM allows for multiple interfaces per rule, while [RFC 2669] aggregates only CPE interface.		
(*3) UDCs only perform upstream filtering.		
(*4) UDCs are always active. The SNMP docsDevFilterIpTable table provides RowStatus for controlling the activation state of IP filters.		
(*5) UDCs do not continue performing packet comparisons after a match.		

The SNMP table docsQosPktClassTable from DOCS-QOS3-MIB of Annex Q is used for reporting of both QoS Classifiers and Drop Classifiers at the CM. The docsQosPktClassPkts object within docsQosPktClassTable is used to count packet matches to each classifier rule.<sup>185</sup>

#### F.1.4.5 LLC/MAC Classification through UDCs<sup>186</sup>

L2 criteria such as MAC address source and destination, header type, 802.1p/q VLAN tag or user\_priority and Cable Modem Interface Mask (CMIM) may be classified and discarded as deemed necessary by the operator. This capability is an augmentation of the LLC filtering, though unlike UDC IP filtering, is not designed to fully replace legacy LLC filtering. The legacy LLC filtering takes place at an earlier stage than the QoS engine that also controls UDCs and is typically very efficient, if somewhat limited in rule entries (typically no more than ten LLC rules). If the number of LLC rules required exceeds ten, or otherwise might benefit from dynamic operation via a Policy Server based PCMM framework, UDCs need to be considered.

For the purposes of classifying MAC protocols, the following variables listed in Table F-3 (second column) are encoded within TLV 60 and shown in comparison with [RFC 2669] (first column in Table F-3)<sup>187</sup>. The variables described here are used to construct L2 rule criteria to enforce the operator's security policy. Note that this LLC filtering criteria does not rule out the LLC filters from [RFC 2669], but complements LLC filtering to include other criterion such as VLAN ID and user priority.

**Table F-3 - Upstream Drop Classification Values for LLC/MAC Classification**

LLC Filters [RFC 2669]	UDC TLV 60 encodings	Description
docsDevFilterLLCIndex	Id	Rule index
docsDevFilterLLCIflIndex	CMIM	CM interface
- no equivalent	Rule priority	Directs order of processing
docsDevFilterLLCStatus	- no equivalent	Activation state
- no equivalent	SourceMacAddr	Source MAC address
- no equivalent	DestMacAddr	Destination MAC address
docsDevFilterLLCProtocolType	EnetProtocolType	Ethernet protocol type
docsDevFilterLLCProtocol	EnetProtocol	Ethernet protocol
- no equivalent	802.1p User priority low	Ethernet user priority range low
- no equivalent	802.1p User priority high	Ethernet user priority range high
- no equivalent	VLAN ID	12 bit Ethernet VLAN ID

The SNMP table docsQosPktClassTable from DOCS-QOS3-MIB is used for reporting of both QoS Classifiers and Drop Classifiers at the CM. The docsQosPktClassPkts object within docsQosPktClassTable is used to count packet matches to each classifier rule.

<sup>185</sup> Revised per OSSIV3.0-N-07.0442-3 on 5/9/07 by PO.

<sup>186</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

<sup>187</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

#### F.1.4.6 Example of IP Protocol Filtering and Upstream Drop Classification

Each classifier rule will have a unique priority level that will instruct the CM as to the order in which those rules are compared against a given packet. The IP protocol filtering takes place in a specific table within the CM. The two modes are mutually exclusive and should not be configured concurrently.

While UDC classification and IP protocol filtering techniques cannot be used concurrently, QoS classifiers can and do co-exist with IP Protocol Filtering parameters. The processing of packets through IP filters or classifiers proceeds as follows:

- A packet enters the CMCI interface from the CPE destined for the RFI interface,
- LLC packet processing occurs in the LLC filter table if parameters are specified against L2 criteria (MAC address, 802.1p/Q VLAN ID or user\_priority flags, etc.),
- The packet's IP contents are compared against EITHER the parameters in the IP Filter Table or QoS Classifier Table,
  - if IP Filters then:
    - each packet is compared with each of the rules in the IP filter table by index entry order (lowest to highest) until a match occurs and the packet is dropped,
    - if there is no match against the configured IP filter rules, the packet is then passed to the QoS engine to be processed by any QoS classification rules and the packet assigned to a service flow.
  - if UDCs then:<sup>188</sup>
    - each packet is compared with the rules in the QoS classification table by rule priority order (from highest priority to lowest in the range of 0-255):
    - The first classifier rule match against a packet directs the packet to the appropriate service flow or the packet is immediately discarded based on the type of Classifier:
    - a packet matching an Upstream Drop Classifier (TLV type-60) rule will be discarded without queuing or further processing
    - a packet matching a QoS classifier rule will be directed to a service flow ID assigned by the CMTS and the packet queued for the next upstream burst opportunity
    - a packet which does not match any of the static or dynamic classifier rules for either QoS or Upstream Drop Classifiers is directed to the primary service flow and the packet queued for the next upstream burst opportunity

## F.2 Subscriber Management and CM Policy Delegation

The Subscriber Management capabilities of the CMTS may be leveraged to control groups of CMs for the upstream and downstream direction of flow independently. Through configuration of group labels in the CM's configuration profile, a given CM's upstream and downstream filtering can be enforced directly at the CMTS, or delegated (in the case of the upstream direction only) to the CM.

<sup>188</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

## Annex G DIAGNOSTIC LOG (Normative)

### G.1 Overview

The Diagnostic Log allows operators to diagnose and troubleshoot potential problems with Cable Modems (CMs), CMTS cable interfaces, or the cable plant by detecting and tracking CMs that have intermittent connectivity problems or unstable operations including:

- CM repeated registration
- Station Maintenance retry

Only detected CMs are reported in the Diagnostic Log for further analysis. Diagnostic Log entries are aged out based on the configuration of the specific aging attributes.

### G.2 Object Definitions

This section describes the object definitions for the Diagnostic Log object model.

The DOCSIS Diagnostic Log object model is depicted in Figure G-1. This diagram graphically presents the individual DOCSIS Diagnostic Log objects and their attributes. The DOCSIS Diagnostic Log MIB and the DOCSIS Diagnostic Log IPDR Service Definition schema, are derived from the object model.

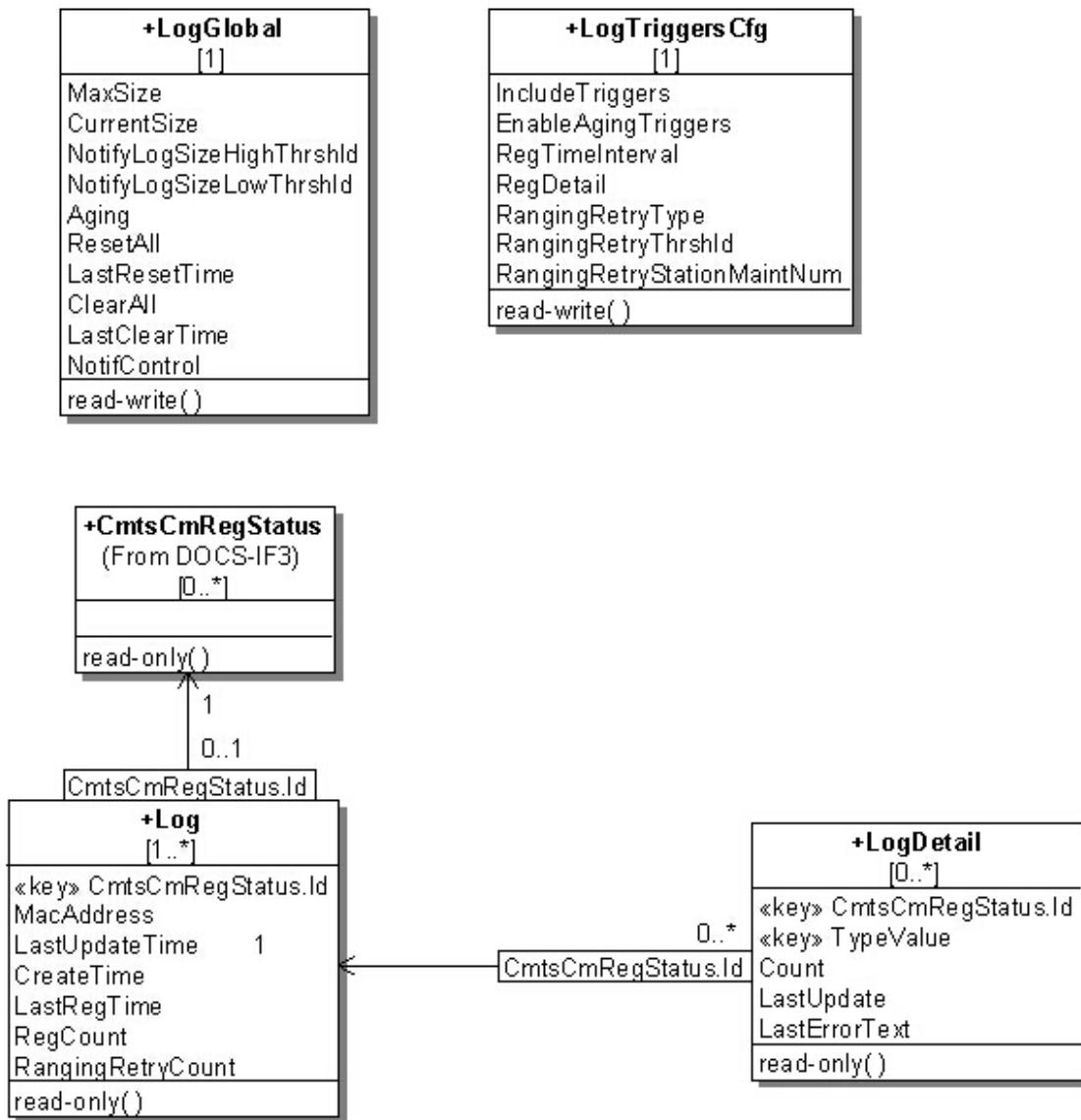


Figure G-1 - Diagnostic Log Object Model Diagram

## G.2.1 Type Definitions

This section defines data types used in the object definitions for the Diagnostic Log object model.

**Table G-1 - Data Type Definitions**<sup>189</sup>

Data Type Name	Base Type	Permitted Values
TriggerFlag	EnumBits	registration(0) rangingRetry(1)
RegistrationDetailFlag	EnumBits	other(0) initialRanging(1) rangingAutoAdjComplete(2) startEae(3) startDhcpv4(4) startDhcpv6(5) dhcpv4Complete(6) dhcpv6Complete(7) startConfigFileDownload(8) configFileDownloadComplete(9) startRegistration(10) registrationComplete(11) bpInit(12) operational(13)

### G.2.1.1 TriggerFlag

This data type defines the union of Diagnostic Log trigger types. Bit 0 represents the registration trigger, Bit 1 represents the ranging retry trigger.

### G.2.1.2 RegistrationDetailFlag<sup>190</sup>

This data type defines an enumerated union of CM states used for the registration trigger detection.

The named bits associated with this type correspond to a subset of the names for the enumerations in CmtsCmRegState data type.

## G.2.2 LogGlobal Object

This object defines the parameters to manage and control the instantiation of CMs in the Diagnostic Log object.

The CMTS MUST persist the values of the attributes of the LogGlobal object across reinitializations.

**Table G-2 - LogGlobal Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
MaxSize	unsignedInt	read-write	1..4294967295	instances	100
CurrentSize	Gauge32	read-only	0..4294967295	instances	N/A
NotifyLogSizeHighThrshld	unsignedInt	read-write	1..4294967295	instances	80
NotifyLogSizeLowThrshld	unsignedInt	read-write	1..4294967295	instances	60
Aging	unsignedInt	read-write	15..86400	minutes	10080
ResetAll	boolean	read-write		N/A	N/A
LastResetTime	dateTime	read-only		N/A	N/A
ClearAll	boolean	read-write		N/A	N/A

<sup>189</sup> Table modified per OSSIV3.0-N-07.0602-1 on 1/29/08 by KN.

<sup>190</sup> This section revised per OSSIV3.0-N-07.0410-4 #21 on 5/8/07 by KN.

Attribute Name	Type	Access	Type Constraints	Units	Default
LastClearTime	dateTime	read-only		N/A	N/A
NotifCtrl	EnumBits	read-write	highThresholdReached(0) lowThresholdReached(1) full(2)	N/A	"H

#### G.2.2.1 **MaxSize**

This attribute indicates the maximum number of CM instances that can be reported in the Log.

#### G.2.2.2 **CurrentSize**

This attribute indicates the number of CM instances currently reported in the Log. It will not exceed MaxSize.

#### G.2.2.3 **NotifyLogSizeHighThrshld**<sup>191</sup>

This attribute is the Log high threshold value. When the number of instances in the Log exceeds this value, the CMTS will trigger a HighThreshold event.

#### G.2.2.4 **NotifyLogSizeLowThrshld**<sup>192</sup>

This attribute is the Log low threshold value. When the number of instances in Log drops to this value, the CMTS will trigger a LowThreshold event, but only if the Log number of instances previously exceeded the NotifyLogSizeHighThrshld value.

#### G.2.2.5 **Aging**

This attribute defines a period of time after which an instance in the Log and its corresponding LogDetail instance (if present) are removed unless the Log instance is updated by an enabled trigger detection process.

#### G.2.2.6 **ResetAll**

This attribute, when set to 'true', causes all counter attributes for all instances in Log and LogDetail to be reset to zero. When read, this attribute always returns 'false'.

#### G.2.2.7 **LastResetTime**

This attribute returns the date and time that all the counters in the Log, LogDetail and all the trigger related objects were reset to 0 due to the ResetAll attribute being set to 'true'. The special value of all '00'Ns indicates that the entries in the Log have never been reset.

#### G.2.2.8 **ClearAll**

This attribute, when set to 'true', removes all instances from the Log and LogDetail. When read, this attribute always returns 'false'.

#### G.2.2.9 **LastClearTime**

This attribute returns the date and time that all the instances in the Log and LogDetail, and all trigger-related objects were removed due to the ClearAll attribute being set to 'true'. The special value of all '00'Ns indicates that the entries in the Log have never been destroyed.

#### G.2.2.10 **NotifCtrl**

This attribute is used to enable diagnostic log related notifications. Setting bit 0 enables notification for reaching log size high threshold. Setting bit 1 enables notification for returning back to log size low threshold after reaching log size high threshold. Setting bit 2 enables notification for Diagnostic Log size full.

### G.2.3 LogTriggersCfg Object

This object defines the parameters to configure the Diagnostic Log triggers. One or more triggers can be configured to define the actions of creating or updating CM entries into the Diagnostic Log.

<sup>191</sup> Revised per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

<sup>192</sup> Revised per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

The CMTS MUST persist the values of the attributes of the LogTriggersCfg object across reinitializations.

**Table G-3 - LogTriggersCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IncludeTriggers	TriggerFlag	read-write		N/A	'C0'H
EnableAgingTriggers	TriggerFlag	read-write		N/A	"H
RegTimeInterval	unsignedInt	read-write	60..86400	seconds	90
RegDetail	RegistrationDetailFlag	read-write		N/A	"H
RangingRetryType	Enum	read-write	consecutiveMiss(1) missRatio(2)	N/A	1
RangingRetryThreshld	unsignedByte	read-write	3..12	N/A	6
RangingRetryStationMaintNum	unsignedShort	read-write	60..65535	N/A	90

#### **G.2.3.1    *IncludeTriggers***

This attribute turns individual diagnostic triggers on and off at a given time when each trigger is set to '1' or '0' respectively.

#### **G.2.3.2    *EnableAgingTriggers***

This attribute enables and disables the aging of individual triggers at a given time when each trigger is set to '1' or '0' respectively. If a log entry is added by multiple triggers, and aging is disabled for one of those triggers, the CMTS MUST NOT age out such entry.

#### **G.2.3.3    *RegTimeInterval***

This attribute is an operator empirically derived, worst-case number of seconds which the CM requires to complete registration. If the CM has not completed the registration stage within this registration time interval, the CM will be added to the Diagnostic Log.

#### **G.2.3.4    *RegDetail***

This attribute provides for setting a bit representing a CM registration state to enable counting the number of times the CMTS determines that such CM reaches that state as the last state before failing to proceed further in the registration process and within the time interval considered for the CM registration trigger detection.

#### **G.2.3.5    *RangingRetryType***

This attribute selects the type of ranging retry trigger to be enable in the Diagnostic Log. A CM failure to perform ranging when a ranging opportunity is scheduled by the CMTS is counted as ranging miss. The ranging retry trigger can be configured to either look at consecutive ranging misses or ranging miss ratio over total number of station maintenance opportunities for a certain time period. Setting this object to 'consecutiveMiss' will select consecutive ranging misses as ranging retry trigger criteria. Setting this object to 'missRatio' will select ranging miss ratio as ranging retry criteria.

#### **G.2.3.6    *RangingRetryThreshld***

This attribute indicates the maximum number of consecutive intervals in which the CMTS does not detect a CM acknowledgement of a MAC-layer station maintenance message before the CM is added to the Diagnostic Log. The value of RangingRetryType decides if consecutive ranging miss or ranging miss ratio is used as trigger.

#### **G.2.3.7    *RangingRetryStationMaintNum***

This attribute indicates the number of station maintenance opportunities to monitor for the ranging retry trigger. This value implies time intervals in a certain range. DOCSIS specifies that the CMTS schedules ranging opportunities to CMs be sufficiently smaller than T4. There is no fixed formula to derive at a fixed time interval, that is, how many ranging opportunities may be offered to a CM by the CMTS; hence, using the number of station maintenance opportunities provides a ratio with the fixed denominators, while also taking the time factor into consideration.

## G.2.4 Log Object

This object represents the diagnostic information for a CM. An instance of this object represents a single CM summary of the diagnostic information detected by one or more triggers. When the CM object instance already exists and a trigger occurs, the LastUpdateTime and corresponding counter attributes are updated for that CM.

**Table G-4 - Log Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
CmMacAddr	MacAddress	read-only		N/A	N/A
LastUpdateTime	dateTime	read-only		N/A	N/A
CreateTime	dateTime	read-only		N/A	N/A
LastRegTime	dateTime	read-only		N/A	N/A
RegCount	Counter32	read-only		flaps	N/A
RangingRetryCount	Counter32	read-only		retries	N/A

### G.2.4.1 Id

This attribute contains an instance of the CmtsCmRegStatusId (Annex N).

### G.2.4.2 CmMacAddr

This attribute is the MAC address of the CM.

### G.2.4.3 LastUpdateTime

This attribute is the date and time value that indicates when this instance was last updated.

### G.2.4.4 CreateTime

This attribute is the date and time value that indicates when this instance was created. When a CM is detected by one of the diagnostic triggers, a new instance will be created provided that there is not already an instance for that CM. If an instance is removed and then re-created, there may be a discontinuity in the statistical objects associated with the instance. This timestamp can be used to detect those discontinuities.

### G.2.4.5 LastRegTime

This attribute indicates the last date and time the CM registered.

### G.2.4.6 RegCount

This attribute counts the number of times the registration trigger condition was detected for the CM.

### G.2.4.7 RangingRetryCount

This attribute counts the number of times the ranging retry trigger condition was detected for the CM.

## G.2.5 LogDetail Object

This object represents the detailed diagnostic information for a CM. There may be multiple instances for a given CM if more than one state from DetailType is enabled.

This object extends the Log object.

**Table G-5 - LogDetail Object**

<b>Attribute Name</b>	<b>Type</b>	<b>Access</b>	<b>Type Constraints</b>	<b>Units</b>	<b>Default</b>
Id	unsignedInt	key	1..4294967295	N/A	N/A
TypeValue	CmtsCmRegState	key		N/A	N/A
Count	Counter32	read-only		last state	N/A
LastUpdate	dateTime	read-only		N/A	N/A
LastErrorText	AdminString	read-only		N/A	N/A

**G.2.5.1    *Id***

This attribute contains an instance of the Id attribute from the Log object.

**G.2.5.2    *TypeValue***

This attribute indicates the detail type this instance is tracking and logging information for a particular CM. For the registration trigger, this list indicates the CM registration state prior to the trigger occurrence. There are no enumerated values for the ranging retry trigger.

**G.2.5.3    *Count***

This attribute counts the number of times a particular state or process is detected by a trigger to be the last state or process before it failed to proceed further within the threshold values of that trigger.

**G.2.5.4    *LastUpdate***

This attribute indicates the date and time when this instance was last updated.

**G.2.5.5    *LastErrorText***

This attribute indicates the Event ID and Event Text (DOCSIS-defined or vendor-specific) of the event condition that triggered the update of the LogDetail object for the TypeValue this instance represents.

The CMTS MAY leave the Event ID empty if the Event ID is not defined.

The format to represent the error text is <Event ID> Event Text

Examples:

<2500001> Failure during state X

◇ Unspecified

References: Annex E.

## Annex H Requirements for DOCS-IFEXT2-MIB (Normative) <sup>193</sup>

```

DOCS-IFEXT2-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32,
    Gauge32
        FROM SNMPv2-SMI
    TruthValue
        FROM SNMPv2-TC
    OBJECT-GROUP,
    MODULE-COMPLIANCE
        FROM SNMPv2-CONF
    ifIndex
        FROM IF-MIB
    docsIfCmtsCmStatusIndex,
    TenthdBmV,
    TenthdB
        FROM DOCS-IF-MIB
    clabProjDocsis
        FROM CLAB-DEF-MIB;

docsIfExt2Mib MODULE-IDENTITY
LAST-UPDATED      "201106231700Z" -- June 23, 2011
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
"
    Postal: Cable Television Laboratories, Inc.
    400 Centennial Parkway
    Louisville, Colorado 80027-1266
    U.S.A.
    Phone: +1 303-661-9100
    Fax: +1 303-661-9199
    E-mail: mibs@cablelabs.com"
DESCRIPTION
"This MIB module contains the management objects that enhance
DOCSIS 2.0 feature set.
It includes SCDMA capability of limiting the number of codes
assigned to a CM over the total active codes, referred as
Maximum Scheduled Codes (MSC)."
REVISION "201106231700Z"
DESCRIPTION
"Revised version includes ECN OSSIV3.0-N-11.0997-1
and published as I15."
REVISION "201010081700Z"
DESCRIPTION
"Revised version includes ECN OSSIV3.0-N-10.0934-1
and published as I13."
REVISION "200406231700Z"
DESCRIPTION
"Initial version of this MIB module."
REVISION "200411101700Z"
DESCRIPTION
"Re-rooted to clabProjDocsis.5"
::= { clabProjDocsis 5 }

-----

```

<sup>193</sup> Revised per OSSIV3.0-N-10.0934-1 on 9/24/10, and per OSSIV3.0-N-11.0997-1 on 6/3/11 by JB.

```
-- Textual Conventions
-- -----
-- Main Groups
-- -----
docsIfExt2Notifications OBJECT IDENTIFIER ::= { docsIfExt2Mib 0}
docsIfExt2MibObjects OBJECT IDENTIFIER ::= { docsIfExt2Mib 1}
docsIfExt2BaseObjects OBJECT IDENTIFIER ::= { docsIfExt2MibObjects 1 }
docsIfExt2CmObjects OBJECT IDENTIFIER ::= { docsIfExt2MibObjects 2 }
docsIfExt2CmtsObjects OBJECT IDENTIFIER ::= { docsIfExt2MibObjects 3 }

-- -----
-- Base Group Objects
-- Applicable to both CM and CMTS
-- -----
-- CM Group Objects
-- -----
-- CM Maximum Scheduled Codes
-- docsIfExt2CmMscStatusTable extends docsIfUpstreamChannelTable
-- -----
docsIfExt2CmMscStatusTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIfExt2CmMscStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table extends the docsIfUpstreamChannelTable to report
         the CM MSC status."
    ::= { docsIfExt2CmObjects 1 }

docsIfExt2CmMscStatusEntry OBJECT-TYPE
    SYNTAX      DocsIfExt2CmMscStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "As an extension of docsIfUpstreamChannelTable this table has
         entries for each ifEntry with an ifType of
         docsCableUpstream(129)
         This entry is instantiated by the CM only if the
         CM is currently in SCDMA mode."
    INDEX { ifIndex }
    ::= { docsIfExt2CmMscStatusTable 1 }

DocsIfExt2CmMscStatusEntry ::= SEQUENCE
{
    docsIfExt2CmMscStatusState                      INTEGER,
    docsIfExt2CmMscStatusPowerShortfall             TenthdB,
    docsIfExt2CmMscStatusCodeRatio                  Unsigned32,
    docsIfExt2CmMscStatusMaximumScheduledCodes       Unsigned32,
```

```

docsIfExt2CmMscStatusPowerHeadroom          TenthdB,
docsIfExt2CmMscStatusEffectivePower        TenthdBmV,
docsIfExt2CmMscStatusIUC2Control           INTEGER
}

```

docsIfExt2CmMscStatusState OBJECT-TYPE

```

SYNTAX      INTEGER {
            channelEnabled(1),
            channelDisabled(2),
            active(3),
            inactive(4),
            unknown(5)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Indicates the current state of the Maximum Scheduled Codes
     feature on the CM.

channelEnabled(1) S-CDMA Maximum Scheduled Codes
                  is enabled in the UCD TLV-17.

channelDisabled(2) S-CDMA Maximum Scheduled Codes
                  is disabled in the UCD TLV-17 or a UCD has been
                  received that does not contain that TLV.

Active(3) The CM has received a Ranging Response that
          contains a non-zero TLV-10
          and therefore has MSC activated. This state
          overrides the channelEnabled(1) state.

Inactive(4) The CM has received a Ranging Response that
            does not contain TLV-10 or has it
            set to 0. This state overrides the
            channelEnabled(1) state.

Unknown(5) CM has not yet received a UCD to determine
            if MSC is enabled or disabled on that channel."
DEFVAL { unknown }
 ::= { docsIfExt2CmMscStatusEntry 1 }

```

docsIfExt2CmMscStatusPowerShortfall OBJECT-TYPE

```

SYNTAX      TenthdB
UNITS      "TenthdB"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Indicates the Power Shortfall at the CM, in units of
     tenth dB.
    The value is provided by the CM and is sent in the RNG-REQ
    message. It is internally calculated in units of quarter
    dB and is rounded upward for this MIB object to the nearest
    tenth dB. A value of zero indicates that the CM has no power
    shortfall."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 8.3.5"

```

```

DEFVAL { 0 }
 ::= { docsIfExt2CmMscStatusEntry 2 }

docsIfExt2CmMscStatusCodeRatio OBJECT-TYPE
    SYNTAX      Unsigned32 ( 2 | 8 | 16 | 32)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the maximum ratio of number of active codes to
         Maximum Scheduled Codes that the CM can support, as
         reported in the Ranging Request."
    REFERENCE
        "Data-Over-Cable Service Interface Specifications: Radio
         Frequency Interface Specification Section 8.3.5"
    ::= { docsIfExt2CmMscStatusEntry 3 }

docsIfExt2CmMscStatusMaximumScheduledCodes OBJECT-TYPE
    SYNTAX      Unsigned32 (0 | 4..128)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the Maximum Scheduled Codes in use by the CM.
         The value is provided by the CMTS through a TLV value in
         the RNG-RSP message. Note that not all values from 4..128
         are valid.
         A value of zero when docsIfExt2CmMscStatusState is active(3)
         indicates there is no maximum scheduled codes value. This
         object should remain at zero when
         docsIfExt2CmMscStatusState is not active(3)."
    REFERENCE
        "Data-Over-Cable Service Interface Specifications: Radio
         Frequency Interface Specification Section 8.3.6"
    DEFVAL { 0 }
    ::= { docsIfExt2CmMscStatusEntry 4 }

docsIfExt2CmMscStatusPowerHeadroom OBJECT-TYPE
    SYNTAX      TenthdB
    UNITS      "TenthdB"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the Maximum Scheduled Codes Power Headroom in
         use by the CM, in units of tenth dB. The value is
         provided by the CMTS in units of quarter dB through
         TLV-11 in the RNG-RSP message and is rounded upward for
         this MIB object to the nearest tenth dB. A value of zero
         indicates the CMTS provided no Power Headroom. This
         object should remain at zero when
         docsIfExt2CmMscStatusState is not active(3)."
    REFERENCE
        "Data-Over-Cable Service Interface Specifications: Radio
         Frequency Interface Specification Section 8.3.6"
    DEFVAL { 0 }
    ::= { docsIfExt2CmMscStatusEntry 5 }

docsIfExt2CmMscStatusEffectivePower OBJECT-TYPE
    SYNTAX      TenthdBmV
    UNITS      "TenthdBmV"
    MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
  "Indicates the Effective Transmit Power of the CM. This is
   the power that would result hypothetically if, in a
   spreader-on frame, the CM were to transmit on all active
   codes with 64QAM modulation. This object should be equal
   to docsIfCmStatusTxPower when docsIfExt2CmMscStatusState
   is not active(3)."
REFERENCE
  "Data-Over-Cable Service Interface Specifications: Radio
   Frequency Interface Specification Section 6.2.18.2.2"
 ::= { docsIfExt2CmMscStatusEntry 6 }

```

```

docsIfExt2CmMscStatusIUC2Control OBJECT-TYPE
  SYNTAX      INTEGER {
    noIUC2(1),
    limitedIUC2(2),
    freeIUC2(3)
  }
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "The CM usage of IUC2 when MSC is enabled:
     noIUC2(1): CM usage of IUC2 is prohibited
     limitedIUC2(2): CM is allowed to use IUC2 as long as
     the CM does not exceed MSC
     freeIUC2(3): CM is allowed to use IUC2 without regard
     for MSC.
     With limitedIUC2(2), there may be cases where a CM cannot
     ensure that the use of IUC2 would not exceed MSC. In these
     cases, the CM MUST NOT use IUC2."
  REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 6.2.11.6"
  DEFVAL { noIUC2 }
  ::= { docsIfExt2CmMscStatusEntry 7 }

```

```

-- -----
-- CM Clear Learned MAC Addresses
-- This configuration control object clears the learned MAC addresses.
-- -----

```

```

docsIfExt2CmClearLearnedMacAddresses OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "If set to 'true', the CM clears all entries in the CM
     forwarding database for all learned MAC addresses that
     are not eSAFE or provisioned MAC addresses. Reading
     this object always returns 'false'."
  DEFVAL { false }
  ::= { docsIfExt2CmObjects 2 }

```

```

-- -----
-- CMTS Group Objects
-- -----

```

```

docsIfExt2CmtsMscGlobalEnable OBJECT-TYPE
  SYNTAX      TruthValue

```

```

MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "Indicates the global state of the Maximum Scheduled Code
     feature on the CMTS. The value true(1) indicates that this
     feature can be enabled on individual logical channels on
     the CMTS. The value false(2) indicates that the feature is
     not in operations on the CMTS. Note that the MIB object
     docsIfExt2CmtsUpChannelMscState exists to enable or disable
     Maximum Scheduled Codes on a per logical channel basis."
DEFVAL { false }
 ::= { docsIfExt2CmtsObjects 1 }

-- -----
-- CMTS reported Cm's Maximum Scheduled Codes
-- docsIfExt2CmtsCmMscStatusTable extends docsIfCmtsCmStatusTable
-- -----


docsIfExt2CmtsCmMscStatusTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIfExt2CmtsCmMscStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table extends the docsIfCmtsCmStatusTable to report
         CM MSC status."
    ::= { docsIfExt2CmtsObjects 2 }

docsIfExt2CmtsCmMscStatusEntry OBJECT-TYPE
    SYNTAX      DocsIfExt2CmtsCmMscStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry for MSC CM status report. Only CMs allocated
         to SCDMA upstream channels are included in this table."
    INDEX { docsIfCmtsCmStatusIndex }
    ::= { docsIfExt2CmtsCmMscStatusTable 1 }

DocsIfExt2CmtsCmMscStatusEntry ::= SEQUENCE
{
    docsIfExt2CmtsCmMscStatusPowerShortfall          TenthdB,
    docsIfExt2CmtsCmMscStatusCodeRatio              Unsigned32,
    docsIfExt2CmtsCmMscStatusMaximumScheduledCodes Unsigned32,
    docsIfExt2CmtsCmMscStatusPowerHeadroom          TenthdB,
    docsIfExt2CmtsCmMscStatusMeasuredSNR           TenthdB,
    docsIfExt2CmtsCmMscStatusEffectiveSNR          TenthdB
}

docsIfExt2CmtsCmMscStatusPowerShortfall OBJECT-TYPE
    SYNTAX      TenthdB
    UNITS      "TenthdB"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates the Power Shortfall at the CM, in units of
         tenth dB.
         The value is provided by the CM and is sent in the
         RNG-REQ message. It is internally calculated in units
         of quarter dB and is rounded upward for this MIB object"

```

```

        to the nearest tenth dB.
        A value of zero indicates that the CM has no power
        shortfall."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 8.3.5"
DEFVAL { 0 }
 ::= { docsIfExt2CmtsCmMscStatusEntry 1 }

docsIfExt2CmtsCmMscStatusCodeRatio OBJECT-TYPE
SYNTAX      Unsigned32 (2 | 8 | 16 | 32)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Indicates the maximum ratio of number of active codes to
     Maximum Scheduled Codes that the CM reported in the
     Ranging Request."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 8.3.5"
 ::= { docsIfExt2CmtsCmMscStatusEntry 2 }

docsIfExt2CmtsCmMscStatusMaximumScheduledCodes OBJECT-TYPE
SYNTAX      Unsigned32 (0 | 4..128)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Indicates the Maximum Scheduled Codes value in use by
     the CM. The value is provided by the CMTS through a TLV
     in the RNG-RSP message. Note that not all values from
     4..128 are valid.
    A value of zero indicates there is no Maximum Scheduled
    Codes, or that the CM does not support the Maximum
    Scheduled Codes feature."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 8.3.6"
DEFVAL { 0 }
 ::= { docsIfExt2CmtsCmMscStatusEntry 3 }

docsIfExt2CmtsCmMscStatusPowerHeadroom OBJECT-TYPE
SYNTAX      TenthdB
UNITS       "TenthdB"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "Indicates the Maximum Scheduled Codes Power Headroom
     in use by the CM, in units of tenth dB. The value is
     provided by the CMTS in units of quarter dB through a
     TLV value in the RNG-RSP message and is rounded upward
     for this MIB object to the nearest tenth dB. A value of zero
     indicates the CMTS provided no Power Headroom."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 8.3.6"
DEFVAL { 0 }
 ::= { docsIfExt2CmtsCmMscStatusEntry 4 }

docsIfExt2CmtsCmMscStatusMeasuredSNR OBJECT-TYPE

```

```

SYNTAX      TenthdB
UNITS      "TenthdB"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The signal to noise ratio perceived for this cable modem
     on the upstream logical channel as of the last station
     maintenance."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 6.2.18.2.2"
::= { docsIfExt2CmtsCmMscStatusEntry 5 }

```

```

docsIfExt2CmtsCmMscStatusEffectiveSNR OBJECT-TYPE
SYNTAX      TenthdB
UNITS      "TenthdB"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The signal to noise ratio estimated for this cable modem
     on the upstream logical channel, referenced to 64QAM
     modulation. It is defined as the measured SNR at the
     last station maintenance, minus the CM power shortfall,
     plus the Power Headroom, minus the constellation gain of
     the station maintenance burst.
    Note that the value of the object
    docsIfCmtsCmStatusSignalNoise will be identical to the
    value of this object when Maximum Scheduled Codes
    is enabled."
REFERENCE
    "Data-Over-Cable Service Interface Specifications: Radio
     Frequency Interface Specification Section 6.2.18.2.2"
::= { docsIfExt2CmtsCmMscStatusEntry 6 }

```

```

-- -----
-- CMTS MSC Upstream Logical Channel State
-- docsIfExt2CmtsUpChannelMscTable extends docsIfUpstreamChannelTable
-- -----

```

```

docsIfExt2CmtsUpChannelMscTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIfExt2CmtsUpChannelMscEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This table extends the docsIfUpstreamChannelTable to report
     CM MSC status."
::= { docsIfExt2CmtsObjects 3 }

```

```

docsIfExt2CmtsUpChannelMscEntry OBJECT-TYPE
SYNTAX      DocsIfExt2CmtsUpChannelMscEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "An entry for MSC upstream status report. Only SCDMA logical
     upstream channels (i.e., ifType=docsCableUpstreamChannel(205)
     and docsIfUpChannelType=scdma(3)) are included in this table."
INDEX { ifIndex }
::= { docsIfExt2CmtsUpChannelMscTable 1 }

```

```

DocsIfExt2CmtsUpChannelMscEntry ::= SEQUENCE
{
    docsIfExt2CmtsUpChannelMscState          INTEGER,
    docsIfExt2CmtsUpChannelMSCTotalCMs       Gauge32,
    docsIfExt2CmtsUpChannelMSCLimitIUC1      Unsigned32,
    docsIfExt2CmtsUpChannelMSCMinimumValue   Unsigned32
}

docsIfExt2CmtsUpChannelMscState OBJECT-TYPE

    SYNTAX      INTEGER {
        channelEnabled(1),
        channelDisabled(2),
        dormant(3)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Indicates the state of the Maximum Scheduled Codes feature
         for an individual logical channel on the CMTS.
         The state will transition automatically from dormant(5) to
         ChannelEnabled(1) and vice-versa when the feature is
         globally enabled by the object
         docsIfExt2CmtsMscGlobalEnable.

        channelEnabled(1) S-CDMA Maximum Scheduled Codes
                        is enabled in the UCD TLV-17.

        channelDisabled(2) S-CDMA Maximum Scheduled Codes
                        is disabled in the UCD TLV-17 or a UCD has been
                        sent that does not contain that TLV.

        Dormant(3) The CMTS channel is being set to
                    channelEnabled(2) but MSC is globally disabled
                    (docsIfExt2CmtsMscGlobalEnable is false(2) )."
                    This value is explicitly read-only."
    DEFVAL { channelDisabled }
    ::= { docsIfExt2CmtsUpChannelMscEntry 1 }

docsIfExt2CmtsUpChannelMSCTotalCMs OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Total number of CMs with docsIfCmtsCmStatusValue of
         registrationComplete with MSC active."
    ::= { docsIfExt2CmtsUpChannelMscEntry 2 }

docsIfExt2CmtsUpChannelMSCLimitIUC1 OBJECT-TYPE
    SYNTAX      Unsigned32 (0..128)
    UNITS      "codes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Indicates that, in order to prevent
         CMs from exceeding MSC, the CMTS will limit the scheduling of
         broadcast IUC1 to at most this many SCDMA codes per SCMDA

```

```

        frame."
 ::= { docsIfExt2CmtsUpChannelMscEntry 3 }

docsIfExt2CmtsUpChannelMSCMinimumValue OBJECT-TYPE
    SYNTAX      Unsigned32 (4..128)
    UNITS      "codes"
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "When Maximum Scheduled Codes is enabled, instructs the
         CMTS to assign cable modems MSC values no less than this value."
    DEFVAL   { 4 }
 ::= { docsIfExt2CmtsUpChannelMscEntry 4 }

-----
-- CMTS Upstream Logical Channel Extension
-- docsIfExt2CmtsUpChannelTable extends docsIfUpstreamChannelTable
-----

docsIfExt2CmtsUpChannelTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIfExt2CmtsUpChannelEntry
    MAX-ACCESS  not-accessible
    STATUS     current
    DESCRIPTION
        "This table extends the docsIfUpstreamChannelTable to report
         additional upstream status information."
 ::= { docsIfExt2CmtsObjects 4 }

docsIfExt2CmtsUpChannelEntry OBJECT-TYPE
    SYNTAX      DocsIfExt2CmtsUpChannelEntry
    MAX-ACCESS  not-accessible
    STATUS     current
    DESCRIPTION
        "An entry for upstream status information."
    INDEX { ifIndex }
 ::= { docsIfExt2CmtsUpChannelTable 1 }

DocsIfExt2CmtsUpChannelEntry ::= SEQUENCE
{
    docsIfExt2CmtsUpChannelTotalCMs      Gauge32
}

docsIfExt2CmtsUpChannelTotalCMs OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "Total number of CMs with docsIfCmtsCmStatusValue of
         registrationComplete."
 ::= { docsIfExt2CmtsUpChannelEntry 1 }

-----
-- Conformance definitions
-----

```

```

docsIfExt2Conformance      OBJECT IDENTIFIER ::= { docsIfExt2Mib 2 }
docsIfExt2Compliances      OBJECT IDENTIFIER ::= { docsIfExt2Conformance 1 }
docsIfExt2Groups           OBJECT IDENTIFIER ::= { docsIfExt2Conformance 2 }

docsIfExt2Compliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The compliance statement for DOCSIS 2.0 enhanced features."

MODULE -- docsIfExt2Mib

-- conditionally mandatory groups

GROUP docsIfExt2CmGroup
    DESCRIPTION
        "Group of objects of enhanced DOCSIS 2.0 features
         applicable to CMs only."

-- conditionally optional groups
GROUP docsIfExt2CmtsGroup
    DESCRIPTION
        "Group of objects of enhanced DOCSIS 2.0 features
         applicable to CMTSes only. It is optional for a
         CMTS to implement the MIB objects in this group.

::= { docsIfExt2Compliances 1}

docsIfExt2CmGroup OBJECT-GROUP
    OBJECTS {
        docsIfExt2CmMscStatusState,
        docsIfExt2CmMscStatusPowerShortfall,
        docsIfExt2CmMscStatusCodeRatio,
        docsIfExt2CmMscStatusMaximumScheduledCodes,
        docsIfExt2CmMscStatusPowerHeadroom,
        docsIfExt2CmMscStatusEffectivePower,
        docsIfExt2CmMscStatusIUC2Control,
        docsIfExt2CmClearLearnedMacAddresses
    }
    STATUS      current
    DESCRIPTION
        "Group of objects implemented in Cable Modems."
    ::= { docsIfExt2Groups 1 }

docsIfExt2CmtsGroup OBJECT-GROUP
    OBJECTS {
        docsIfExt2CmtsMscGlobalEnable,
        docsIfExt2CmtsCmMscStatusPowerShortfall,
        docsIfExt2CmtsCmMscStatusCodeRatio,
        docsIfExt2CmtsCmMscStatusMaximumScheduledCodes,
        docsIfExt2CmtsCmMscStatusPowerHeadroom,
        docsIfExt2CmtsCmMscStatusMeasuredSNR,
        docsIfExt2CmtsCmMscStatusEffectiveSNR,
        docsIfExt2CmtsUpChannelMscState,
        docsIfExt2CmtsUpChannelMSCTotalCMs,
        docsIfExt2CmtsUpChannelMSCLimitIUC1,
        docsIfExt2CmtsUpChannelMSCMinimumValue,
    }

```

```
docsIfExt2CmtsUpChannelTotalCMs
}
STATUS      current
DESCRIPTION
  "Group of objects implemented in Cable Modem Termination
   Systems."
::= { docsIfExt2Groups 2 }
END
```

## Annex I Load Balancing Requirements (Normative)<sup>194</sup>

### I.1 Overview

This annex defines management object extensions for load balancing operations.

The [MULPI] specification Autonomous Load Balancing section defines two modes of operation for the CMTS to load balance cable modems:

- Autonomous Load Balancing

Autonomous Load Balancing refers to an algorithm implemented at the CMTS whereby the CMTS directly takes actions to manage the distribution of CMs across the available channels. The specifics of the Load Balancing algorithm is left for vendor definition. Cable modems can be provisioned (either by the CM config file, or optionally, by management objects defined here) to be assigned to Restricted Load Balancing Groups, or can be automatically assigned to General Load Balancing Groups (See [MULPI] General Load Balancing Groups and Restricted Load Balancing Groups sections).

In addition to assignment to a Load Balancing Group, each CM has certain load balancing parameters. The load balancing parameters for a CM can be configured in the CM's configuration file, optionally configured directly in the CMTS, or inherited from the configuration of the Load Balancing Group to which the CM is assigned. The CM load balancing parameters help the CMTS determine which CMs are likely candidates to be balanced across the network, as well as the initialization technique to be used in the balancing operation. The Load Balancing Group defines the service group or list of channels over which the CM is allowed to be balanced within a MAC Domain. The CMTS could also provide load balancing capabilities across MAC Domains. (See [MULPI] Autonomous Load Balancing section for more details). The management objects defined here provide a global (CMTS-wide) enable/disable for Autonomous Load Balancing, as well as the ability to enable/disable Autonomous Load Balancing on a Group-by-Group basis.

During Autonomous Load Balancing operations, changes to plant topology, MAC Domain structure, Channel Sets, Load Balancing Groups, etc. could produce unexpected results on those operations. Therefore, it might be advisable or even required by the CMTS implementation for the operator to disable Autonomous Load Balancing prior to making such changes. Moreover, an attempt to enable Load Balancing could be rejected if the CMTS detects configuration issues that would prevent normal Load Balancing operation.

- Externally-Directed Load Balancing

The Externally-Directed Load Balancing operation is performed via a management interface where the operator directs the CMTS to move a particular CM from its current channel configuration to a new channel configuration. Since Externally-Directed Load Balancing has the potential to run at cross-purposes with Autonomous Load Balancing, the CMTS is not required to support Externally-Directed Load Balancing when the Autonomous Load Balancing operation is enabled. The process of externally directing a CM to a different set of channels is also referred to as the "change-over" operation.

#### I.1.1 Load Balancing Groups

There are two types of Load Balancing Groups: Restricted Load Balancing Groups and General Load Balancing Groups. The Restricted Load Balancing Groups are a list of channels where the CM is confined to be balanced by the CMTS. By definition a Restricted Load Balancing Group needs to consist of a subset of channels of a single CM-SG. The General Load Balancing Group comprises all the channels within a MD-CM-SG, and as such there is a one-to-one relationship between General Load Balancing Groups and MD-CM-SGs.

<sup>194</sup> Revised per OSSIV3.0-N-07.0481-2 by ab on 7/17/07, per OSSIV3.0-N-07.0522-7 by ab on 11/5/07, and per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN.

### I.1.2 DOCSIS 2.0 and 3.0 Load Balancing Differences

As in DOCSIS 2.0, the Externally-Directed Load Balancing functionality supports single (us & ds) change-over operations (via DCC/UCC) for CMs not operating in Multiple Receive Channel mode. For CMs operating in Multiple Receive Channel mode, the DOCSIS 3.0 CMTS also supports channel-set change-over operations (via DBC or DCC and REG-RSP-MP) (see [MULPI]).

Another difference in load balancing operation between DOCSIS 2.0 and DOCSIS 3.0 is the interpretation of General and Restricted Load Balancing Groups. In DOCSIS 2.0, General Load Balancing Groups are configured explicitly by the operator. In DOCSIS 3.0, General Load Balancing Groups are generated automatically by the CMTS based on the MD-CM-SGs described in the CMTS topology configuration. In DOCSIS 2.0, the operator configures Restricted Load Balancing Groups either to resolve ambiguous plant topologies (essentially, topologies where the MD-CM-SG cannot be uniquely determined solely by the US/DS channel pair used in Initial Ranging) or to implement service-related restrictions on the set of channels available to a particular CM (e.g., business vs. residential). In DOCSIS 3.0, the topology resolution algorithm effectively eliminates the first purpose for defining Restricted Load Balancing Groups; operators would then only configure Restricted Load Balancing Groups to effect service-related restrictions. (See [MULPI]).

## I.2 Object Definitions

This section defines the objects associated with load balancing operations.

### I.2.1 Type Definitions

This section defines data types used in the object definitions for the load balancing object model.<sup>195</sup>

**Table I-1 - Data Type Definitions**

Data Type Name	Base Type	Permitted Values
ChChgInitTechMap	Enum	reinitializeMac(0) broadcastInitRanging(1) unicastInitRanging(2) initRanging(3) direct(4)

#### I.2.1.1 ChChgInitTechMap

This data type enumerates the allowed initialization techniques for Dynamic Channel Change (DCC) and Dynamic Bonding Change (DBC) operations. The techniques are represented by the 5 most significant bits (MSB). Bits 0 through 4 map to initialization techniques 0 through 4.

Each bit position represents the internal associated technique as described below:

- 'reinitializeMac'  
Reinitialize the MAC
- 'broadcastInitRanging'  
Perform Broadcast initial ranging on new channel before normal operation
- 'unicastInitRanging'  
Perform unicast ranging on new channel before normal operation
- 'initRanging'  
Perform either broadcast or unicast ranging on new channel before normal operation

<sup>195</sup> Paragraph modified per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

- 'direct'

Use the new channel(s) directly without re-initializing or ranging

Multiple bits may be set to 1 to allow the CMTS to select the most suitable technique in a proprietary manner.

An empty value or a value with all bits in '0' means no channel changes allowed

References: MULPI Initialization Technique.

## I.2.2 Load Balancing Objects

This section defines the load balancing related objects.

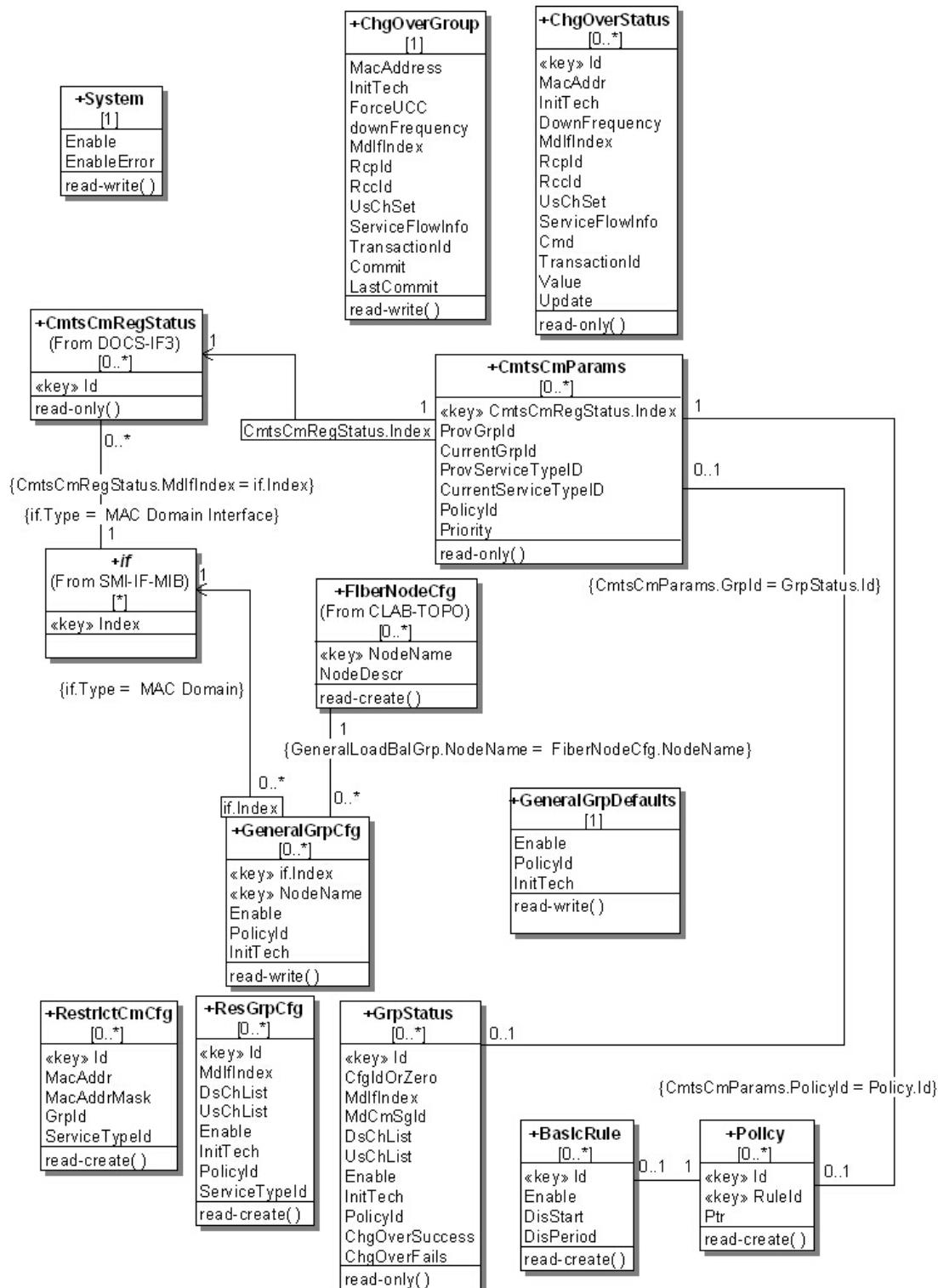


Figure I-1 - Load Balancing Object Model Diagram

### I.2.2.1 System Object

This object represents the control and status of Autonomous Load Balancing Operations.

**Table I-2 - System Object<sup>196</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Enable	boolean	read-write		N/A	true
EnableError	AdminString	read-only	SIZE(0..255)	N/A	"H

#### I.2.2.1.1 Enable

This attribute when set to 'true' enables Autonomous Load Balancing operation on the CMTS, otherwise Autonomous Load Balancing is disabled. A failure to enable Autonomous Load Balancing operation is registered in the EnableError attribute.

When Autonomous Load Balancing is enabled, the CMTS may reject Externally-Directed Load Balancing operations. However, even when Autonomous Load Balancing is disabled, the CMTS is required to assign load balancing parameters to CMs as provisioned in the configuration file and/or RestrictCM object.

This attribute value persists after system reinitialization. There might be cases where this attribute reports a failure and Load Balancing is enabled, for example after system reinitialization where Load Balancing was previously set to enabled but there are issues with the CMTS configuration.

#### I.2.2.1.2 EnableError

This attribute represents a text message that describes a failure to enable load balancing due configuration errors, or other considerations. The zero-length string indicates no errors occurred during the last Autonomous Load Balancing activation.

### I.2.2.2 ChgOverGroup Object<sup>197</sup>

This object represents the Externally-Directed Load Balancing command interface. This object provide the controls of change-over operations for CMs. A change-over operation consist of externally-initiated requests to change the CM downstream and/or upstream channel configuration using DOCSIS MAC Message mechanism such as UCC, DCC, DBC or combinations of them. Committed change-over operations are reported in the ChgOverStatus object.

**Table I-3 - ChgOverStatus Object<sup>198</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
MacAddress	MacAddress	read-write	Mandatory	N/A	'000000000000'H
InitTech	ChChgInitTechMap	read-write		N/A	'F8'H
ForceUCC	boolean	read-write		N/A	false
DownFrequency	unsignedInt	read-write		Hertz	0
MdflIndex	InterfaceIndexOrZero	read-write		N/A	0
RcpId	RcpId	read-write		N/A	'0000000000'H
RccId	unsignedByte	read-write		N/A	0
UsChSet	ChannelList	read-write		N/A	"H
ServiceFlowInfo	hexBinary	read-write	SIZE (0..128)	N/A	"H
TransactionId	unsignedShort	read-write		N/A	0
Commit	boolean	read-write		N/A	'false'
LastCommit	TimeStamp	read-only		N/A	0

<sup>196</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

<sup>197</sup> Section revised per OSSIV3.0-N-08.0643-1 on 4/25/08 by KN.

<sup>198</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

#### *I.2.2.2.1 MacAddress*

This attribute represents the MAC address of the cable modem that the CMTS instructs to move to a new downstream and/or upstream channel set.

#### *I.2.2.2.2 InitTech*

This attribute represents the initialization technique that the cable modem is instructed to use when performing multiple-channel change-over operation. The value of this attribute applies to all upstream channels in the channel set.

#### *I.2.2.2.3 ForceUCC<sup>199</sup>*

This attribute when set to 'true' indicates that the CMTS forces UCC messages instead of DCC messages in those scenarios that are allowed as defined in the "Upstream Channel Change Request (UCC-REQ)" section of [MULPI]. In some cases the CMTS may still use UCC commands even though this attribute value is 'false', for example in an upstream-only change-over operation directed to a CM that the CMTS is aware is only capable of UCC, but the operator is not aware of the CM capabilities. This attribute value is ignored when the target CM for the change-over operation is in MRC mode, or the UsChSet attribute is the zero-length string, or the operation includes changes for downstream channels.

#### *I.2.2.2.4 DownFrequency*

This attribute represents a single-downstream frequency to which the cable modem is instructed to move using a DCC request. The value zero indicates that this attribute is ignored during a commit operation.

#### *I.2.2.2.5 MdIfIndex*

This attribute describes the MAC Domain Interface index of the triplet: Mac Domain, RCP-ID and RCC Status Index of the RccStatus object that represents the RCC used in the change-over operation. This MAC Domain Interface Index is also used to provide context for the UsChSet and ServiceFlowInfo attributes.

#### *I.2.2.2.6 RpclId*

This attribute describes the RCP-ID of the triplet: Mac Domain, RCP-ID and RCC Status Index of the RccStatus object that represents the RCC used in the change-over operation.

#### *I.2.2.2.7 RccId*

This attribute describes the RCC Status Index of the triplet: Mac Domain, RCP-ID and RCC Status Index of the RccStatus object that represents the RCC used in the change-over operation.

#### *I.2.2.2.8 UsChSet*

This attribute describes the Channel list (within the context of the MAC domain identified by MdIfIndex) that represents the final TCS expected from the change-over operation.

When the operation is intended for an RCC-only, this attribute is set to zero and the attribute InitTech is ignored.

#### *I.2.2.2.9 ServiceFlowInfo*

This attribute provides a list of Service Flow ID-Channel Set ID pairs used to control Service Flow assignment in the change-over operation. This is intended as an override to the normal assignment based on SF attributes. This attribute is encoded as a series of 32-bit pairs as follows:

- The first four bytes correspond to the value of the Service Flow ID (attribute Id of the ServiceFlow object of the DOCSIS QOS objects).
- The last four bytes correspond to the value of the attribute ChSetId of the UsChSet or DsChSet object of the CMTS Bonding Objects.

If this attribute does not include tuples for some of the CM's Service Flows, the CMTS determines the respective channels based on SF attributes. Service Flow ID-Channel Set ID pairs matching upstream service flows are ignored

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<sup>199</sup> Revised per OSSIV3.0-N-09.0871-4 on 1/5/10 by JB.

if the change-over operation does not affect the TCC of the CM. Similarly, Service Flow ID-Channel Set ID pairs matching downstream service flows are ignored if the change-over operation does not affect the RCC of the CM.

#### *I.2.2.2.10 TransactionId*

This attribute represents an operator identifier for the change-over operation to be used to correlate logged information in the ChangeOver3 Status object. The CMTS uses this value as the Transaction ID in the DBC-REQ or DCC-REQ message transmitted in association with this operation. If this value is set to zero the CMTS defines its own MAC message Transaction ID value.

#### *I.2.2.2.11 Commit<sup>200</sup>*

This attribute when set to 'true' triggers the change-over operation for Externally-Directed Load Balancing.

Setting this attribute to 'true' is known as a commit operation. A commit operation is considered successful if the CMTS considers that the entered information is valid and the transaction can be initiated. It does not imply that the channel-change operation itself (i.e., UCC, DCC, DBC transaction) reports success or completion. A commit operation is considered unsuccessful if the CMTS determines that there are invalid attributes values in the ChangeOver object such that the change-over operation cannot be initiated.

Some examples for a change-over that cannot be initiated are:

- Attempt to send a DBC for MRC that does not fit the CM RCP.
- Attempt to send a DCC while a previous one is still in progress.
- Attempt to send a UCC to a channel ID that is not defined.

After system initialization all ChangeOver object parameters are set to default values.

After a successful commit operation all ChangeOver object parameters are set to default values with the exception of this attribute (commit) that is set to 'true'. An unsuccessful commit operation is rejected and this attribute reports false in subsequent value queries.

After a successful commit operation, the CMTS initiates the change-over transaction using the most appropriate technique. The potential techniques are:

- UCC - For upstream-channel-only changes on CMs not operating in MRC mode.
- DCC - For upstream and/or downstream channel changes on CMs not operating in MRC mode, as well as upstream only change for CMs operating in MRC mode but with no TCS conveyed during registration.
- DCC followed by channel assignment in REG-RSP-MP - For MAC Domain re-assignment on CMs operating in MRC mode. In this case, the change-over command might only include a downstream frequency, or might include an RCC defined in the target MAC domain. The upstream channel set may or may not be provided. The only applicable Initialization Technique for this operation is 'reinitializeMAC'.
- DBC - For change in the TCS and/or RCS on CMs operating in MRC mode.

#### *I.2.2.2.12 LastCommit*

The value of sysUpTime when the attribute Commit was last set to true. Zero if never set.

### ***I.2.2.3 ChgOverStatus Object***

This object reports the status of cable modems instructed to move to a new downstream and/or upstream channel or channel sets when commanded either by an operation in the ChgOver object. An instance in this object is created for each change-over operation committed successfully. If the instance value attribute is not final (the change-over operation is still pending completion), this instance is expected to be updated at some point later to reflect the final state of the change-over operation.

<sup>200</sup> Revised per OSSIV3.0-N-09.0775-3 on May 11, 2009 by JB and per OSSIV3.0-N-09.0871-4 on 1/5/10 by JB.

**Table I-4 - ChgOverStatus Object<sup>201</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key		N/A	N/A
MacAddr	MacAddress	read-only		N/A	N/A
InitTech	ChChgInitTechMap	read-only		N/A	N/A
DownFrequency	unsignedInt	read-only		N/A	N/A
MdflIndex	InterfaceIndexOrZero	read-only	Interface Index of the MAC interface	N/A	N/A
RcpId	RcpId	read-only		N/A	N/A
Rcld	unsignedByte	read-only		N/A	N/A
UsChSet	ChannelList	read-only		N/A	N/A
ServiceFlowInfo	hexBinary	read-only		N/A	N/A
Cmd	Enum	read-only	ucc(1) dcc(2) dbc(3) crossMD(4)	N/A	N/A
TransactionId	unsignedShort	read-write		N/A	N/A
Value	Enum	read-only	messageSent(1) noOpNeeded(2) modemDeparting(3) waitToSendMessage(4) cmOperationRejected(5) cmtsOperationRejected(6) timeOutT13(7) timeOutT15(8) rejectinit(9) success(10) dbcTimeout(11)	N/A	N/A
Update	TimeStamp	read-only		N/A	N/A

#### I.2.2.3.1 Id

This key represents a monotonically increasing value for the record that stores the status of the change-over operation. When the ChgOverStatus object exceeds the size limit of this object the lowest Id value instances are removed so that the total number of entries no longer exceeds the size limit allowing the CMTS to maintain the most current entries.

#### I.2.2.3.2 MacAddr

This attribute represents the Mac address set in the ChgOver object commit operation.

#### I.2.2.3.3 InitTech

The initialization technique set in change-over operation.

#### I.2.2.3.4 DownFrequency

This attribute represents the Downstream frequency set in the ChgOver object commit operation, or zero

#### I.2.2.3.5 MdflIndex

This attribute represents the MAC Domain Interface index set in the ChgOver object commit operation, or zero.

#### I.2.2.3.6 RcpId

This attribute represents the RCP-ID set in the MultipleChgOver object commit operation, or all zeros RCP-ID value.

<sup>201</sup> Table title added and table text modified per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

#### *I.2.2.3.7 RccId*

This attribute represents the RCC Status Index set in the ChgOver object commit operation, or zero.

#### *I.2.2.3.8 UsChSet*

This attribute represents the Upstream Channel Set in the ChgOver object commit operation, or zero.

#### *I.2.2.3.9 ServiceFlowInfo*

This attribute represents the list of Service Flow-Channel Set ID pairs set in the ChgOver object commit operation, or zero-length string.

#### *I.2.2.3.10 Cmd*

The load balancing MAC Management Message exchange type used by the CMTS for the change-over operation in the ChgOver object commit operation.

- 'ucc' indicates the usage of Upstream Channel Change (UCC) messages exchange.
- 'dcc' indicates the usage of Dynamic Channel Change (DCC) messages exchange.
- 'dbc' indicates the usage of Dynamic Bonding Change (DCC) messages exchange
- 'crossMD' although this term does not correspond to a MAC Management Message type, it indicates the movement of a CM to a different MAC Domain that includes a sequence of different MAC Management Messages types (i.e., DCC to move the CM to the correct MAC Domain, followed by channel assignment in REG-RSP-MP).

#### *I.2.2.3.11 TransactionId*

This attribute represents the transaction Id value used in the change-over operation.

#### *I.2.2.3.12 Value*

This attribute represents the status of the specified change-over operation. The enumerations are:

Change-over using DCC message exchange:

- 'modemDeparting'

The cable modem has responded with a change-over response of either a DCC-RSP with a confirmation code of depart(180) or a UCC-RSP.

- 'timeOutT13'

Failure due to no DCC-RSP with confirmation code depart(180) received prior to expiration of the T13 timer.

- 'timeOutT15'

T15 timer timed out prior to the arrival of a bandwidth request, RNG-REQ message, or DCC-RSP message with confirmation code of arrive(181) from the cable modem.

Change-over using DBC message exchange:

- 'dbcTimeout'

The number of DBC-REQ retries was exceeded and no DBC-RSP was received

Change-over CMTS verifications:

- 'messageSent'

The CMTS has sent a DOCSIS MAC message request to instruct the CM to do the change-over operation.

- 'noOpNeed'

A change-over operation was requested in which neither the DS and US channels where the CM is operational changed.

- 'waitForSendMessage'

The specified operation is active and CMTS is waiting to send the channel change message with channel info to the cable modem.

- 'cmOperationRejected'

Channel Change operation was rejected by the cable modem.

- 'cmtsOperationRejected'

Channel Change operation was rejected by the Cable Modem Termination System.

- 'rejectInit'

Operation rejected due to unsupported initialization tech requested.

- 'success'

CMTS received an indication that the CM successfully completed the change-over operation. e.g., If an initialization technique of re-initialize the MAC is used, success is indicated by the receipt of a DCC-RSP message with a confirmation code of depart(180) or DBC confirmation code ok/success. In all other DCC cases, success is indicated by: (1) the CMTS received a DCC-RSP message with confirmation code of arrive(181) or (2) the CMTS internally confirms the presence of the CM on the new channel(s).

#### *I.2.2.3.13 Update*

The value of sysUpTime when the attribute Value of this instance was last updated.

#### **I.2.2.4 CmtsCmParams Object**

This object represents the autonomous load balancing parameters provisioned for cable modem. The CMTS selects the cable modem Load Balancing Group (GrpId attribute of this object) from multiple sources by following the rules and sequence described below:

The CMTS selects the assignment of the CM to a Load Balancing Group by determining first if the CM is in a Restricted Load Balancing Group or in its absence to the General Load Balancing group that corresponds to the MD-CM-SG of the CM. The selection of the Restricted Load Balancing group is achieved by first matching the CM in the RestrictCmCfg Object and if no match is found, by selecting the best match within the ResGrpCfg object.

The best match within the ResGrpCfg follows the MULPI requirements on precedences of the CM signaled TLVs: ServiceType ID and Load Balancing Group ID (for backward compatibility of provisioned Group IDs)

References: [MULPI], Channel Assignment During Registration section.

**Table I-5 - CmtsCmParams Object<sup>202</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedInt	read-only		N/A	N/A
ProvGrpId	unsignedInt	read-only		N/A	N/A
CurrentGrpId	unsignedInt	read-only		N/A	N/A
ProvServiceTypeID	string	read-only	SIZE (0..16)	N/A	N/A
CurrentServiceTypeID	string	read-only	SIZE (0..16)	N/A	N/A
PolicyId	unsignedInt	read-only		N/A	N/A
Priority	unsignedInt	read-only		N/A	N/A

<sup>202</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 and table revised per OSSIV3.0-N-08.0643-1 on 4/25/08 by KN.

*I.2.2.4.1 CmtsCmRegStatusId*

This key is the CMTS generated unique identifier of a CM for status report purposes.

*I.2.2.4.2 ProvGrpId*

This attribute indicates the provisioned Load Balancing Group ID TLV the CM signaled to the CMTS during registration, or zero if not provisioned in the CM.

*I.2.2.4.3 CurrentGrpId*

This attribute references the Load Balancing Group Identifier (Id attribute from the GrpStatus object) associated with the cable modem after the CMTS validates the CM Load Balancing Group ID TLV, Service Type ID TLV and Restricted CM list. The value zero indicates that the Load Balancing Group is invalid, or the General Load Balancing Group is invalid due ambiguous topology resolution.

*I.2.2.4.4 ProvServiceTypeID*

This attribute indicates the provisioned Service Type ID TLV the CM signaled to the CMTS during registration, or the zero-length string if not provisioned in the CM.

*I.2.2.4.5 CurrentServiceTypeID*

This attribute represents the Service Type ID the CMTS picked from the Restricted Group of Restricted CM list, or the Service Type Id TLV the CM signaled to the CMTS during registration, or the zero-length string if none was used.

*I.2.2.4.6 PolicyId*

This attribute references the Load Balancing Policy ID associated to the cable modem either from the configuration file or from the general or Restricted Load Balancing Groups CMTS configuration.

*I.2.2.4.7 Priority*

This attribute references the Load Balancing Priority associated to the cable modem either from the configuration file or from the General or Restricted Load Balancing Groups CMTS configuration.

*I.2.2.5 GeneralGrpDefaults Object<sup>203</sup>*

This object provides the default load balancing parameters for General Load Balancing Groups (MD-CM-SGs) that are used when instances of GeneralGrpCfg are created by the CMTS.

**Table I-6 - GeneralGrpDefaults Object<sup>204</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Enable	boolean	read-write		N/A	'true'
PolicyId	unsignedInt	read-write		N/A	0
InitTech	ChChgInitTechMap	read-write		N/A	'F8'H

*I.2.2.5.1 Enable*

This attribute represents the default value for the Enable attribute of the GeneralGrpCfg object.

*I.2.2.5.2 PolicyId*

This attribute represents the default value for the PolicyId attribute of the GeneralGrpCfg object.

*I.2.2.5.3 InitTech*

This attribute represents the default value for the InitTech attribute of the GeneralGrpCfg object.

<sup>203</sup> Section revised per OSSIV3.0-N-08.0643-1 on 4/25/08 and OSSIV3.0-N-08.0645-4 on 5/1/08 by KN.

<sup>204</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 and table revised per OSSIV3.0-N-08.0645-5 on 5/1/08 by KN.

### I.2.2.6 GeneralGrpCfg Object<sup>205</sup>

This object allows configuration of load balancing parameters for General Load Balancing Groups by way of MAC Domain-Fiber Node pairs. In many deployments, a MAC Domain-Fiber Node pair will equate to an MD-CM-SG (which always equates to a GLBG). In the case where an MD-CM-SG spans multiple Fiber Nodes, there will be multiple instances of this object that represent the General Load Balancing Group (MD-CM-SG). The CMTS MUST enforce that such instances all have the same attribute values. Any time a fiber node is associated to a MAC Domain, an instance of this object is defined by the CMTS and populated with either the same values as the other fiber nodes associated with the same MD-CM-SG (if any exist) or default values from the GeneralGrpDefaults object. Similarly when a fiber node is no longer paired with a MAC Domain the corresponding instance is deleted from the object.

The CMTS MUST persist all instances of the GeneralGrpCfg object across reinitializations.

**Table I-7 - GeneralGrpCfg Object<sup>206</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of the MAC interface	N/A	N/A
NodeName	NodeName	key		N/A	N/A
Enable	boolean	read-write		N/A	N/A
PolicyId	unsignedInt	read-write		N/A	0
InitTech	ChChgInitTechMap	read-write		N/A	N/A

#### I.2.2.6.1 ifIndex

This key represents the MAC Domain Interface index being associated with a fiber node.

#### I.2.2.6.2 NodeName

This key represents the fiber node name being associated with a MAC Domain.

#### I.2.2.6.3 Enable

This attribute when set to 'true' enables Autonomous Load Balancing for the General Load Balancing Group associated with this instance. When set to 'false' Autonomous Load Balancing is disabled.

#### I.2.2.6.4 PolicyId

This attribute defines the default load balancing policy for the General Load Balancing Group associated with this instance.

#### I.2.2.6.5 InitTech

This attribute defines the load balancing initialization technique for the General Load Balancing Group associated with this instance.

### I.2.2.7 ResGrpCfg Object

This object represents the configuration of Restricted Load Balancing Groups.

The CMTS MUST persist all instances of the ResGrpCfg object across reinitializations.

**Table I-8 - ResGrpCfg Object<sup>207</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key		N/A	N/A
MdlfIndex	InterfaceIndex	read-create	Interface Index of the MAC interface	N/A	N/A
DsChList	ChannelList	read-create		N/A	"H

<sup>205</sup> Section revised per OSSIV3.0-N-08.0645-5 on 5/1/08 by KN and OSSIV3.0-N-08.0700-4 on 1/12/09 by JS.

<sup>206</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

<sup>207</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 and table revised per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN.

Attribute Name	Type	Access	Type Constraints	Units	Default
UsChList	ChannelList	read-create		N/A	"H
Enable	boolean	read-create		N/A	True
InitTech	ChChgInitTechMap	read-create		N/A	'F8'H
PolicyId	unsignedInt	read-create		N/A	0
ServiceTypeid	TagList	read-create		N/A	""

#### I.2.2.7.1 *Id*

This key represents a unique index assigned to the Restricted Load Balancing Group by the user for provisioning purposes. This value is unique within a CMTS and is matched with the CM signaled Load Balancing Group ID TLV value when determining the CM Load Balancing Group assignment based on such TLV value.

References: [MULPI], Channel Assignment During Registration section.

#### I.2.2.7.2 *MdlfIndex*

This attribute represents the MAC domain where the Restricted Load balancing Group applies. The value zero is allowed to indicate that vendor-specific mechanisms are used to define the Restricted Load Balancing Group. For example, to provide Load Balancing Groups across MAC domains.

#### I.2.2.7.3 *DsChList*

This attribute contains the list of downstream channels of the Restricted Load Balancing Group.

#### I.2.2.7.4 *UsChList*

This attribute contains the list of upstream channels of the Restricted Load Balancing Group.

#### I.2.2.7.5 *Enable*

This attribute when set to 'true' enables Autonomous Load Balancing on this Restricted Load Balancing Group. The value 'false' disables the load balancing operation on this group.

#### I.2.2.7.6 *InitTech*

This attribute represents the initialization techniques that the CMTS can use to load balance cable modems in the Load Balancing Group. By default this object is initialized with all the defined bits having a value of '1'.

#### I.2.2.7.7 *PolicyId*

This attribute represents the default load balancing policy of this Restricted Load Balancing Group. A policy is described by a set of conditions (rules) that govern the load balancing process for a cable modem. The CMTS assigns this Policy ID value to a cable modem associated with the group ID when the cable modem does not signal a Policy ID during registration. The Policy ID value is intended to be a numeric reference to an instance of the Policy object. However, It is not required to have an existing or active policy instance in which case it indicates no policy is associated with the Load Balancing Group. The Policy ID of value 0 is reserved to indicate no policy is associated with the load balancing group.

#### I.2.2.7.8 *ServiceTypeid*

This attribute represent a space separated list of ServiceType IDs that will be compared against the cable modem provisioned Service Type ID to determine the most appropriate Restricted Load Balancing Group.

References: [MULPI], Channel Assignment During Registration section

#### I.2.2.8 *GrpStatus Object*

This object represents the status of all General and Restricted Load Balancing Groups in this CMTS. This object summarizes the load balancing parameters that applies to CMTS system wide Load Balancing Groups. The Load Balancing Groups defined in this object include the configured Restricted Load Balancing Groups and the General Load Balancing Groups derived from the GeneralGrpCfg object.

**Table I-9 - GrpStatus Object<sup>208</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	read-only		N/A	N/A
CfgIdOrZero	unsignedInt	read-only		N/A	N/A
MdIfIndex	InterfaceIndexOrZero	read-only	Interface Index of the MAC interface	N/A	N/A
MdCmSgId	unsignedInt	read-only		N/A	N/A
DsChList	ChannelList	read-only		N/A	N/A
UsChList	ChannelList	read-only		N/A	N/A
Enable	boolean	read-only		N/A	N/A
InitTech	ChChgInitTechMap	read-only		N/A	N/A
PolicyId	unsignedInt	read-only		N/A	N/A
ChgOverSuccess	Counter32	read-only		N/A	N/A
ChgOverFails	Counter32	read-only		N/A	N/A

*I.2.2.8.1 Id*

This key represents an unique identifier of a Load Balancing Group in the CMTS.

*I.2.2.8.2 CfgIdOrZero*

This attribute references the Id attribute of the instance of the ResGrpCfg this instance corresponds to. The value zero indicates that the instance corresponds to a General Load Balancing Group.

*I.2.2.8.3 MdIfIndex*

This attribute represents the MAC domain where the Load Balancing Group applies. The value zero is allowed to indicate that vendor-specific mechanisms are used in load balancing operations. For example, to provide Load Balancing Groups across MAC domains.

*I.2.2.8.4 MdCmSgId*

This attribute corresponds to the MD-CM-SG-ID that includes all the upstream and downstream channels of the Load Balancing Group. The value zero indicates that this instance corresponds to a Restricted Load Balancing Group. If there are vendor-specific Load Balancing Groups configuration (e.g., MdIfIndex set to zero), this attribute value might not be meaningful.

*I.2.2.8.5 DsChList*

This attribute contains the list of downstream channels of the Load Balancing Group. If there are vendor-specific Load Balancing Groups configuration (e.g., MdIfIndex set to zero), this attribute value might not be meaningful.

*I.2.2.8.6 UsChList*

This attribute contains the list of the upstream channels of the Load Balancing Group. If there are vendor-specific Load Balancing Groups configuration (e.g., MdIfIndex set to zero), this attribute value might not be meaningful.

*I.2.2.8.7 Enable*

This attribute when set to 'true' indicates that load balancing is enabled on this group, or disabled if set to 'false'.

*I.2.2.8.8 InitTech*

This attribute indicates the initialization techniques that the CMTS can use when load balancing cable modems that are associated with the Load Balancing Group.

*I.2.2.8.9 PolicyId*

This attribute indicates the Policy that the CMTS can use when load balancing cable modems that are associated with the Load Balancing Group.

<sup>208</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

#### *I.2.2.8.10 ChgOverSuccess*

This attribute counts the number of successful Autonomous Load Balancing operations associated with this Load Balancing Group.

#### *I.2.2.8.11 ChgOverFails*

This attribute counts the number of failed Autonomous load balancing operations associated with this Load Balancing Group.

### ***I.2.2.9 RestrictCmCfg Object***

This object describes the list of cable modems being statically provisioned at the CMTS to a Restricted Load Balancing Group. When a CM registers it is either assigned to

***Table I-10 - RestrictCmCfg Object<sup>209</sup>***

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	read-create		N/A	
MacAddr	MacAddress	read-create			'000000000000'H
MacAddrMask	OctetString	read-create		N/A	"H
GrpId	unsignedInt	read-create		N/A	0
ServiceTypeId	string	read-create	SIZE (0..16)	N/A	""

#### *I.2.2.9.1 Id*

This key represents the unique identifier of an instance in this object. the CMTS maintains an unique instance per MAC Address/MAC Address Mask combination

#### *I.2.2.9.2 MacAddr*

This attribute represents the Mac Address of the cable modem within the Restricted Load Balancing Group.

#### *I.2.2.9.3 MacAddrMask*

This attribute corresponds to a bit mask acting as a wild card to associate a cable modem MAC addresses to a Restricted Load Balancing Group ID referenced by a restricted group Id or a Service Type ID. The cable modem matching criteria is performed by bit-ANDED the cable modem MAC address with the MacAddrMask attribute and being compared with the bit-ANDED of attributes MacAddr and MacAddrMask. A cable modem MAC address look up is performed first with instances containing this attribute value not null, if several entries match, the largest consecutive bit match from MSB to LSB is used. Empty value is equivalent to the bit mask all in ones.

#### *I.2.2.9.4 GrpId*

The attribute represents the Restricted Load Balancing Group identifier of this entry associated with the cable modem MAC address - MAC address mask combination. The value zero indicates that the instance is matched only against the ServiceTypeId value.

#### *I.2.2.9.5 ServiceTypeId*

This attribute represents the Service Type Id associated with this cable modem MAC address - MAC Address mask combination. The zero-length string indicates that the instance is matched only against the GrpId value, if both GrpId and this attribute are not present the instance is ignored for matching purposes.

### ***I.2.2.10 Policy Object***

This object describes the set of load balancing policies. Instances from this object might be referenced by GrpStatus object. All the rules contained in a load balancing policy apply to an Autonomous Load Balancing operations. Load balancing rules are defined within this specification or can be vendor-defined as well.

The CMTS MUST persist all instances of Policy object across reinitializations.

<sup>209</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

**Table I-11 - Policy Object<sup>210</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key		N/A	N/A
RuleId	unsignedInt	key		N/A	N/A
Ptr	URL	read-create		N/A	N/A

**I.2.2.10.1 Id**

This key represents the identifier of a load balancing policy.

**I.2.2.10.2 RuleId**

This key represents a rule contained within a balancing policy.

**I.2.2.10.3 Ptr**

This attribute represents a reference to an instance in a rule or other policy object like BasicRule object.

**I.2.2.11 BasicRule Object**

This object represents a basic ruleset applicable to a load balancing policy that references it.

The CMTS MUST persist all instances of BasicRule object across reinitializations.

**Table I-12 - BasicRule Object<sup>211</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key		N/A	
Enable	Enum	read-create	enabled(1) disabled(2) disabledPeriod(3)	N/A	'disabled'
DisStart	unsignedInt	read-create		N/A	0
DisPeriod	unsignedInt	read-create		N/A	0

**I.2.2.11.1 Id**

This key represents a unique identifier for balancing ruleset of this object.

**I.2.2.11.2 Enable**

This attribute when set to 'enabled' enables Autonomous Load Balancing (independently of the load balancing group enable/disable state), the rule set is disabled if set to 'disabled', or is disabled during a period of time it set to 'disabledPeriod'.

**I.2.2.11.3 DisStart**

This attribute disables load balancing from the time stated by this attribute when the attribute Enable is set to 'disablePeriod'. The time is defined in seconds since midnight.

**I.2.2.11.4 DisPeriod**

This attribute disables load balancing until the time stated by this attribute when the attribute Enable is set to 'disablePeriod'. The time is defined in seconds of the wall clock since midnight.

<sup>210</sup> Table title added and table text modified per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

<sup>211</sup> Table title added per OSSIV3.0-N-07.0602-1 on 1/30/08 by KN.

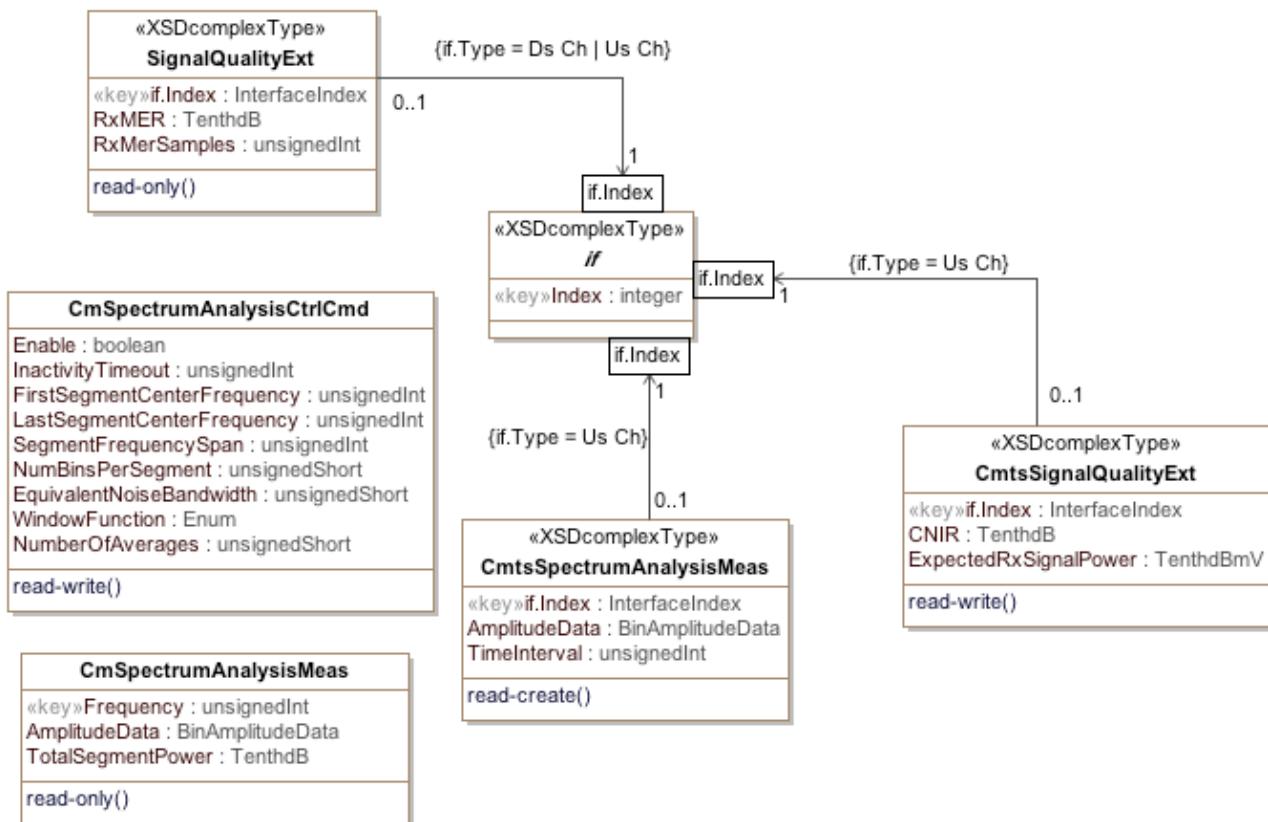
## Annex J Enhanced Signal Quality Monitoring Requirements (Normative)

### J.1 Overview

This annex addresses the Enhanced Signal Quality Monitoring requirements for plant conditions.

### J.2 Object Definitions

This section defines the Enhanced Signal Quality Monitoring objects including the associated attributes.



**Figure J-1 - Signal Quality Monitoring Object Model Diagram<sup>212</sup>**

#### J.2.1 Type Definitions

This section defines data types used in the object definitions for the Enhanced Signal Quality Monitoring object model.

**Table J-1 - Data Type Definitions**

Data Type Name	Base Type	Permitted Values
BinAmplitudeData	hexBinary	SIZE(0   20..65535)

<sup>212</sup> This figure replaced per OSSIV3.0-N-07.0445-3, #1 on 5/10/07 by KN, replaced per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

### J.2.1.1 ***BinAmplitudeData***<sup>213</sup>

This data type represents a sequence of spectral amplitudes. Each spectral amplitude value corresponds to a bin.

The format of the bin measurement is as follows.

Sequence of:

4 bytes: ChCenterFreq

The center frequency of the upstream channel.

4 bytes: FreqSpan

The width in Hz of the band across which the spectral amplitudes characterizing the channel are measured.

4 bytes: NumberOfBins

The number of data points or bins that compose the spectral data. The leftmost bin corresponds to the lower band edge, the rightmost bin corresponds to the upper band edge, and the middle bin center is aligned with the center frequency of the analysis span.

4 bytes: BinSpacing

The frequency separation between adjacent bin centers. It is derived from the frequency span and the number of bins or data points. The bin spacing is computed from

$$\text{BinSpacing} = \frac{\text{FrequencySpan}}{\text{NumberOfBins} - 1}$$

The larger the number of bins the finer the resolution.

4 bytes: ResolutionBW

The resolution bandwidth or equivalent noise bandwidth of each bin. If spectral windowing is used (based on vendor implementation), the bin spacing and resolution bandwidth would not generally be the same.

n bytes: Amplitude (2 bytes \* NumberOfBins)

A sequence of two byte elements. Each element represents the spectral amplitudes in relation to the received signal power of a bin, for the expected commanded received signal power at the CMTS input, assuming QPSK0 modulation, in units of 0.01dB. That is, a test CMTS input signal with square-root raised-cosine spectrum, bandwidth equal to the expected received signal bandwidth, and power equal to the expected received signal power, which is present for the entire spectrum sampling period, will exhibit a spectrum measurement of 0 dB average power in each bin of the signal passband.

Each bin element amplitude value format is 2's complement which provides a range of -327.68 dB to 327.67 dB amplitude value for the bin measurement.

## J.2.2 **SignalQualityExt Object**

This object provides an in-channel received modulation error ratio metric for CM and CMTS.

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<sup>213</sup> Revised per OSSIV3.0-N-07.0539-1 by ab on 11/6/07.

**Table J-2 - SignalQualityExt Object<sup>214</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of downstream channel or logical upstream channel	N/A	N/A
RxMER	TenthdB	read-only	-2147483648..2147483647	TenthdB	N/A
RxMerSamples	unsignedInt	read-only		N/A	N/A

**J.2.2.1 IfIndex**

This key represents the interface index of the downstream channel for the CM or the logical upstream channel for the CMTS to which this instance applies.

**J.2.2.2 RxMER**

RxMER provides an in-channel received Modulation Error Ratio (MER). RxMER is defined as an estimate, provided by the demodulator, of the ratio:

$$\text{(average constellation energy with equally likely symbols) / (average squared magnitude of error vector)}$$

RxMER is measured just prior to FEC (trellis/Reed-Solomon) decoding. RxMER includes the effects of the HFC channel as well as implementation effects of the modulator and demodulator. Error vector estimation may vary among demodulator implementations. The CMTS RxMER is averaged over a given number of bursts at the burst receiver, which may correspond to transmissions from multiple users. In the case of S-CDMA mode, RxMER is measured on the de-spread signal.

**J.2.2.3 RxMerSamples**

RxMerSamples is a statistically significant number of symbols for the CM, or bursts for the CMTS, processed to arrive at the RxMER value. For the CMTS, the MER measurement includes only valid bursts that are not in contention regions.

**J.2.3 CmtsSignalQualityExt Object**

This object provides metrics and parameters associated with received carrier, noise and interference power levels in the upstream channels of the CMTS.

The CMTS MUST persist the configurable values of all instances of CmtsSignalQualityExt across reinitialization.

**Table J-3 - CmtsSignalQualityExt Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of logical upstream channel	N/A	N/A
CNIR	TenthdB	read-only		TenthdB	N/A
ExpectedRxSignalPower	TenthdBmV	read-write		TenthdBmV	N/A

**J.2.3.1 IfIndex**

This key represents the interface index of the logical upstream of the CMTS to which this instance applies.

**J.2.3.2 CNIR<sup>215</sup>**

This attribute provides an upstream in-channel Carrier-to-Noise plus Interference Ratio (CNIR). CNIR is defined as the ratio of the expected commanded received signal power at the CMTS input, assuming QPSK0 modulation, to the noise plus interference in the channel. This measurement occurs prior to the point at which the desired CM signal, when present, is demodulated. The measurement includes the effect of the receive matched filter but does not

<sup>214</sup> Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

<sup>215</sup> Revised per OSSIV3.0-N-07.0539-1 by ab on 11/6/07.

include the effect of any ingress filtering. Both the signal power and noise/interference power are referenced to the same point, e.g., CMTS input.

### J.2.3.3 *ExpectedRxSignalPower*

This attribute provides the power of the expected commanded received signal in the channel, referenced to the CMTS input.

## J.2.4 CMTS Spectrum Analysis Objects<sup>216</sup>

This group of objects provides an upstream in-channel spectrum analysis capability, indicating how much noise and interference there is within the channel, as well as where in the channel the interference is located. A measurement here is a data collection event that provides frequency content information of the energy within the channel without the contribution of the actual CM signal. This measurement is updated at a rate that is no greater than a given time interval. The frequency bins are a discrete set of frequencies with values that provide the amount of energy represented in that frequency content of the signal. A worst case spectrum estimation frequency bin spacing of 25 kHz has been defined for spans of 6.4 MHz or less; finer resolutions are acceptable. This measurement occurs prior to the point at which the desired CM signal, when present, is demodulated. The measurement spectrum may or may not include the effect of the receive matched filter. The measured spectrum does not include the effect of any ingress filtering.

### J.2.4.1 *CmtsSpectrumAnalysisMeas Object*

This object is used to configure the logical upstream interfaces to perform the spectrum measurements. This object supports creation and deletion of instances.

The CMTS is not required to persist instances of this object across reinitializations.

**Table J-4 - *CmtsSpectrumAnalysisMeas Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key		N/A	N/A
AmplitudeData	BinAmplitudeData	read-only		N/A	N/A
TimeInterval	unsignedInt	read-only		milliseconds	N/A

#### J.2.4.1.1 *IfIndex*

IfIndex is a key which represents the interface identifier (e.g., ifIndex) of the CMTS logical upstream channel. The CMTS MAY provide simultaneous measurements of logical upstream channels within a single upstream physical interface.

#### J.2.4.1.2 *AmplitudeData*

This attribute provides a list of the spectral amplitudes corresponding to the frequency bins ordered from lowest to highest frequencies covering the frequency span. Information about the center frequency, frequency span, number of bins and resolution bandwidth are included to provide context to the measurement point

The CMTS MUST support the number of bins as an odd number in order to provide a spectrum representation that is symmetric about the middle data point or bin. The CMTS MUST support a number of bins greater than or equal to 257 for frequency spans greater than or equal to 6.4 MHz.

The CMTS MUST NOT exceed 25 kHz bin spacing for measurement of frequency spans less than or equal to 6.4 MHz.

The bins measurements are updated periodically at time intervals given by the TimeInterval attribute.

#### J.2.4.1.3 *TimeInterval*

TimeInterval is the CMTS estimated average repetition period of measurements. This attribute defines the average rate at which new spectra can be retrieved.

<sup>216</sup> Revised per OSSIV3.0-N-07.0539-1 by ab on 11/6/07.

## J.2.5 CM Spectrum Analysis Objects

This group of objects provides a CM downstream spectrum analysis function. Each measurement is a data collection event that provides the energy content of the signal at each frequency within a specified range. The result of a measurement is a table consisting of one or more rows. Each row corresponds to a capture of spectral data across a specified segment bandwidth. The frequency range of each segment is divided into bins, which are a discrete set of evenly spaced frequencies across the band. The width of each bin (resolution bandwidth) is generally equal to or slightly greater than the spacing between bins. Each bin has an associated amplitude value in the table, which represents the amount of energy measured in that frequency bin. The segments are constrained to be contiguous; that is, the start frequency of each segment equals the end frequency of the previous segment plus the bin spacing. Thus, the concatenation of all segments results in a wideband spectral analysis. The measurement table is updated at a rate that is vendor specific. The measurement generally occurs prior to the point at which the received signal is demodulated. The measurement spectrum may or may not include the effects of receiver processing such as gain control, RF filtering, and matched filtering.

The CM SHOULD implement the CmSpectrumAnalysisCtrlCmd object.

The CM SHOULD implement the CmSpectrumAnalysisMeas object.

### J.2.5.1.1 *CmSpectrumAnalysisCtrlCmd Object*

This object is used to configure the frequency spectral analysis in the CM.

**Table J-5 - CmSpectrumAnalysisCtrlCmd Object<sup>217</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Enable	boolean	read-write		N/A	false
InactivityTimeout	unsignedInt	read-write	0..86400	seconds	300
FirstSegmentCenterFrequency	unsignedInt	read-write		Hz	93000000
LastSegmentCenterFrequency	unsignedInt	read-write		Hz	993000000
SegmentFrequencySpan	unsignedInt	read-write	1000000..900000000	Hz	7500000
NumBinsPerSegment	unsignedShort	read-write	2 to 2048	bins-per-segment	256
EquivalentNoiseBandwidth	unsignedShort	read-write	50 to 500	Hundredths of bin spacing	150
WindowFunction	Enum	read-write	other(0), hann(1), blackmanHarris(2), rectangular(3), hamming(4), flatTop(5), gaussian(6), chebyshev(7)		
NumberOfAverages	unsignedShort	read-write	1 to 1000		1

### J.2.5.1.2 *Enable<sup>218</sup>*

This attribute is used to enable or disable the spectrum analyzer feature. Setting this attribute to true triggers the CM to initiate measurements for the spectrum analyzer feature based on the other configuration attributes for the feature. By default, the feature is disabled unless explicitly enabled. Note that the feature may be disabled by the system under certain circumstances if the spectrum analyzer would affect critical services. In such a case, the attribute will

<sup>217</sup> Table updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

<sup>218</sup> Updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

return 'false' when read, and will reject sets to 'true' with an error. Once the feature is enabled, any configuration operations (e.g., write operations to configuration objects) might not be effective until the feature is re-enabled.

#### **J.2.5.1.3 *InactivityTimeout***

This attribute controls the length of time after the last spectrum analysis measurement before the feature is automatically disabled. If set to a value of 0, the feature will remain enabled until it is explicitly disabled.

#### **J.2.5.1.4 *FirstSegmentCenterFrequency***

This attribute controls the center frequency of the first segment for the spectrum analysis measurement.

The frequency bins for this segment lie symmetrically to the left and right of this center frequency. If the number of bins in a segment is odd, the segment center frequency lies directly on the center bin. If the number of bins in a segment is even, the segment center frequency lies halfway between two bins.

Changing the value of this object may result in changes to the CmSpectrumAnalysisMeas object, as described in the description field for the object.

Note that if this object is set to an invalid value, the device may return an error of inconsistentValue, or may adjust the value of the object to the closest valid value.

#### **J.2.5.1.5 *LastSegmentCenterFrequency***

This attribute controls the center frequency of the last segment of the spectrum analysis measurement.

The frequency bins for this segment lie symmetrically to the left and right of this center frequency. If the number of bins in a segment is odd, the segment center frequency lies directly on the center bin. If the number of bins in a segment is even, the segment center frequency lies halfway between two bins.

The value of the LastSegmentCenterFrequency is typically equal to the FirstSegmentCenterFrequency plus an integer number of segment spans as determined by the SegmentFrequencySpan.

Changing the value of this object may result in changes to the CmSpectrumAnalysisMeas object, as described in the description field for the object

Note that if this attribute is set to an invalid value, the device may return an error of inconsistentValue, or may adjust the value of the attribute to the closest valid value.

#### **J.2.5.1.6 *SegmentFrequencySpan*<sup>219</sup>**

This attribute controls the frequency span of each segment (instance) of the CmSpectrumAnalysisMeas object. If set to a value of 0, then a default span will be chosen based on the hardware capabilities of the device. Segments are contiguous from the FirstSegmentCenterFrequency to the LastSegmentCenterFrequency and the center frequency for each successive segment is incremented by the SegmentFrequencySpan. The number of segments is  $(\text{LastSegmentCenterFrequency} - \text{FirstSegmentCenterFrequency})/\text{SegmentFrequencySpan} + 1$ . A segment is equivalent to an instance in the CmSpectrumAnalysisMeas object. The chosen SegmentFrequencySpan affects the number of instances in the CmSpectrumAnalysisMeas object. A more granular SegmentFrequencySpan may adversely affect the amount of time needed to query the instances in addition to possibly increasing the acquisition time.

Changing the value of this object may result in changes to the CmSpectrumAnalysisMeas object, as described in the description field for the object

Note that if this attribute is set to an invalid value, the device may return an error of inconsistentValue, or may adjust the value of the attribute to the closest valid value.

#### **J.2.5.1.7 *NumBinsPerSegment***

This attribute controls the number of bins collected by the measurement performed for each segment (instance) of the CmSpectrumAnalysisMeas object.

Note that if this attribute is set to an invalid value, the device may return an error of inconsistentValue, or may adjust the value of the attribute to the closest valid value.

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<sup>219</sup> Updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

#### J.2.5.1.8 *EquivalentNoiseBandwidth*

This attribute allows the user to request an equivalent noise bandwidth for the resolution bandwidth filter used in the spectrum analysis. This corresponds to the spectral width of the window function used when performing a discrete Fourier transform for the analysis.

The window function which corresponds to a value written to this attribute may be obtained by reading the value of the WindowFunction attribute.

If an unsupported value is requested, the device may return an error of inconsistentValue, or choose the closest valid value to the one which is requested. If the closest value is chosen, then a subsequent read of this attribute will return the actual value which is in use.

#### J.2.5.1.9 *WindowFunction*<sup>220</sup>

This attribute controls or indicates the windowing function which will be used when performing the discrete Fourier transform for the analysis. The WindowFunction and the EquivalentNoiseBandwidth are related. If a particular WindowFunction is selected, then the EquivalentNoiseBandwidth for the function which is in use, will be reported by the EquivalentNoiseBandwidth attribute. Alternatively, if an EquivalentNoiseBandwidth value is chosen then if a WindowFunction function representing that EquivalentNoiseBandwidth is defined in the CM, that value will be reported in the WindowFunction object, or a value of 'other' will be reported. Use of "modern" windowing functions not yet defined will likely be reported as 'other'.

Note that all window functions may not be supported by all devices. If an attempt is made to set the attribute to an unsupported window function, or if writing of the WindowFunction object is not supported by an implementation, an error will be returned.

#### J.2.5.1.10 *NumberOfAverages*

This attribute controls the number of averages that will be performed on spectral bins. The average will be computed using the "leaky integrator" method, where reported bin value = alpha\*accumulated bin values + (1-alpha)\*current bin value. Alpha is one minus the reciprocal of the number of averages. For example, if N=25, then alpha = 0.96. A value of 1 indicates no averaging. Re-writing the number of averages will restart the averaging process. If there are no accumulated values, the accumulators are made equal to the first measured bin amplitudes.

The number of averages will be set by writing NumberOfAverages attribute. If an attempt is made to set the attribute to an unsupported number of averages, an error of inconsistentValue will be returned.

### J.2.5.2 *CmSpectrumAnalysisMeas Object*

This object provides a list of the spectral amplitude measurements taken across the requested range of center frequencies. The table represents a full scan of the spectrum with each row corresponding to a spectral capture of one segment of the spectrum.

**Table J-6 - CmSpectrumAnalysisMeas Object<sup>221</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Frequency	unsignedInt	key		N/A	N/A
AmplitudData	BinAmplitudeData	read-only		dB	N/A
TotalSegmentPower	TenthdB	read-only		TenthdB	N/A

#### J.2.5.2.1 *Frequency*

This key indicates the center frequency of the spectral analysis segment which is represented by this instance.

<sup>220</sup> Updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

<sup>221</sup> Table updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

#### J.2.5.2.2 *AmplitudeData*

This attribute provides a list of the spectral amplitudes as measured at the center frequency specified by the Frequency attribute.

The frequency bins are ordered from lowest to highest frequencies covering the frequency span. Information about the center frequency, frequency span, number of bins and resolution bandwidth are included to provide context to the measurement point.

Bin Amplitudes are reported in units of 0.01dB.

#### J.2.5.2.3 *TotalSegmentPower*<sup>222</sup>

This attribute provides the total RF power present in the segment with the center frequency equal to the Frequency index and the span equal to the SegmentFrequencySpan. The value represents the sum of the spectrum power in all of the associated bins. The value is computed by summing power (not dB) values and converting the final sum to TenthdB.

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<sup>222</sup> Updated per OSSIV3.0-13.1093-3 on 3/20/13 by PO.

## Annex K DOCSIS 3.0 Data Type Definitions (Normative)

### K.1 Overview

This specification has requirements for the SNMP protocol and IPDR Service Definitions for network management functions.

In previous OSSi specification versions, SNMP SMIv2 has been used as the methodology to represent DOCSIS managed objects. This approach is valid for SNMP as the protocol for the management interface. However, as new paradigms such as IPDR are introduced for DOCSIS management interfaces, protocol-agnostic representation of management information is necessary.

This Annex includes the data type definitions for the object models defined for use in DOCSIS 3.0. The Unified Modeling Language (UML) is used for modeling the management requirements in DOCSIS 3.0. The data types defined in this Annex are mapped for use with both SNMP and IPDR XML schemas.

Basic UML notation used in this specification and explained in Appendix VI.

### K.2 Data Types Mapping

XML is becoming the standard for data definition models. With XML data transformations can be done with or without a model (DTD or Schema definition). DTDs and XML schemas provides additional data validation layer to the applications exchanging XML data. There are several models to map formal notation constructs like ASN.1 to XML [ITU-T X.692], UML to XML, or XML by itself can be used for modeling purposes.

Each area of data information interest approaches XML and defines data models and/or data containment structures and data types. Similarly, SNMP took and modified a subset of ASN.1 for defining the Structured Management Information SMIv1 and SMIv2.

Due to the lack of a unified data model and data types for Network Management a neutral model would be appropriated to allow capturing specific requirements and methodologies from existing protocols and allow forward or reverse engineering of those standards like SNMP to the general object model and vice versa.

#### K.2.1 Data Types Requirements and Classification

The object model has to provide seamless translation for SMIv2 requirements, in particular when creating MIB modules based on the object model, this specification needs to provide full support of [RFC 2578], [RFC 2579] and the clarifications and recommendations of [RFC 4181].

The object model has to provide seamless translation for IPDR modeling requirements which is by itself a subset of XML representations with some IPDR extensions.

Thus, there are two data type groups defined for modeling purposes and mapping to protocol data notation roundtrip:<sup>223</sup>

##### 1. General Data types

Required data types to cover all the management syntax and semantic requirement for all OSSi supported data models. In this category are data types defined in SNMP SMIv2 [RFC 2578] and IPDR data types [IPDR/XDR] and [IPDR/SSDG].<sup>224</sup>

<sup>223</sup> SNMP [RFC 2578], XML-schema, [W3 XSD1.0] and IPDR –e.g., XDR specification [IPDR/XDR] - define "Primitive", "Derived", "Base", "Application" types, etc. For the purpose of the OSSi data model, General Data types and Extended Data types terms are used.

<sup>224</sup> Revised per OSSIv3.0-N-11.1010-3 on 11/7/11 by JB.

## 2. Extended Data types

Management protocols specialization based on frequent usage or special semantics. Required data types to cover all the syntax requirement for all OSSl supported data models. In this category are SNMP TEXTUAL-CONVENTION clauses [RFC 2579] of mandatory or recommended usage by [RFC 2579] and [RFC 4181] when modeling for SNMP MIB modules.

### K.2.2 Data Types Mapping Methodology

The specification "XML Schema Part 2: Data types Second Edition" is based on [ISO 11404] which provides a language-independent data types (see XML Schema reference). The mapping proposed below uses a subset of the XML schema data types to cover both SNMP forward and reverse engineering and as well IPDR types. Any additional protocol being added should be feasible to provide the particular mappings.

SMIV2 has an extensive experience of data types for management purposes, for illustration consider Counter32 and Counter64 SMIV2 types [RFC 2578]. The XML schema data types makes no distinction of derived 'decimal' types and the semantics that are associated to counters, e.g., counters do not necessarily start at 0.

Since the object model needs to cover the mapping of objects to SNMP, the mapping in Section K.2.4 is heavily based on most common SNMP TEXTUAL-CONVENTION descriptors [RFC 2579] and others IETF commonly used type definitions as well as DOCSIS already defined types in MIB modules required by this specification.

Most of the SNMP information associated to data types are reduced to size and range constraints and specialized enumerations.

### K.2.3 General Data Types

The Table K-1 represents the mapping between the OSSl object model General Types and their equivalent representation for SNMP MIB Modules and IPDR Service Definitions. The permitted values for the data types are indicated in terms of value ranges and string length when applicable. The OM Data Type column includes the data types to map either to IPDR or SNMP or both, using the appropriated type in the corresponding protocol if applicable or available. The SNMP Mapping references to SNMP data types are defined in [RFC 2578] or as described below. The IPDR Mappings are referenced in [IPDR/XDR] and [IPDR/SSDG], or as specified below.

Note that SNMP does not provide float, double or long XML-Schema data types. Also, SNMP might map a type to a SNMP subtyped value. For example, unsignedByte data type maps to Unsigned32 subtyped to the appropriate range indicated by the Permitted Values (0..255 in this case). Other data types are mapped to SNMP TEXTUAL-CONVENTIONS as indicated by the references.

**Table K-1 - General Data Types**

OM Data Type	XML-Schema data type	Permitted Values	SNMP Mapping	IPDR Mapping
Enum	int	-2147483648..2147483647	INTEGER	integer
EnumBits	hexBinary		BITS	hexBinary
Int	int	-2147483648..2147483647	Integer32	int
unsignedInt	unsignedInt	0..4294967295	Unsigned32	unsignedInt
long	long	-9223372036854775808..-9223372036854775807	N/A	long
unsignedLong	unsignedLong	0..18446744073709551615	CounterBasedGauge64 [RFC 2856]	unsignedLong
Float	float	IEEE single-precision 32-bit floating point type IEEE 754-1985	N/A	float
double	double	IEEE double-precision 64-bit floating point type IEEE 754-1985	N/A	double
Base64Binary	base64Binary		SnmpAdminString [RFC 3411]	base64Binary
hexBinary	hexBinary		OCTET STRING	hexBinary

OM Data Type	XML-Schema data type	Permitted Values	SNMP Mapping	IPDR Mapping
string	string		SnmpAdminString [RFC 3411]	string
boolean	boolean		TruthValue [RFC 2579]	boolean
Byte	byte	-128..127	Integer32	byte
unsignedByte	unsignedByte	0..255	Unsigned32	unsignedByte
Short	short	-32768..32767	Integer32	short
unsignedShort	unsignedShort	0..65535	Unsigned32	unsignedShort
TimeTicks	unsignedInt		OBJECT IDENTIFIER	
TimeTicks	unsignedInt		TimeTicks	
Gauge32,	unsignedInt		Gauge32	
Counter32,	unsignedInt		Counter32	
Counter64	unsignedLong		Counter64	
IpAddress	hexBinary	SIZE (4)	IpAddress	
Opaque	hexBinary		Opaque	
dateTime	dateTime		DateAndTime	dateTime
dateTimeMsec	unsignedLong		CounterBasedGauge64 [RFC 2856]	ipdr:dateTimeMsec
InetAddressIPv4	hexBinary	SIZE (4)	InetAddressIPv4 [RFC 4001]	ipdr:ipV4Addr
InetAddressIPv6	hexBinary	SIZE (16)	InetAddressIPv6 [RFC 4001]	ipdr:ipV6Addr
InetAddress			InetAddress [RFC 4001]	N/A
InetAddressType			InetAddressType [RFC 4001]	N/A
Uuid	hexBinary		OCTET STRING	ipdr:uuid
dateTimeUsec	unsignedLong		CounterBasedGauge64 [RFC 2856]	ipdr:dateTimeUsec
MacAddress	hexBinary	SIZE (6)	MacAddress	ipdr:macAddress

#### K.2.4 Extended Data Types<sup>225</sup>

There are two sources of Extended Data Types: Protocol specific data types, and OSSi data types.

The subset of IPDR derived DataTypes [IPDR/SSDG] and [IPDR/XDR] are included in the General Data Types section as they are few. SNMP derived types are defined in SNMP MIB Modules. The most important are in [RFC 2579] which is part of SNMP STD 58 and are considered in many aspects part of the SNMP protocol. Other MIB modules TEXTUAL-CONVENTION definitions have been adopted and recommended (e.g., [RFC 4181]) for re-usability and semantics considerations in order to unify management concepts; some relevant RFCs that include common used textual conventions are [RFC 4001], [RFC 2863], [RFC 3411], and [RFC 3419] among others (see [RFC 4181]).

Table K-2 includes the most relevant data types taken from SNMP to provide a direct mapping of the OSSi object model to SNMP MIB modules. A few have taken a more general name as they are used across the object models and may apply to IPDR high level modeling as well. For example, TagList comes from [RFC 3413] SnmpTaglist and preserves its semantics, AdminString comes from [RFC 3411] SnmpAdminString.

In general when an OSSi object model needs to reference an existing SNMP textual convention for the purpose of round trip design from UML to SNMP, these textual conventions can be added to this list. Other sources of textual conventions not listed here are from MIB modules specific to DOCSIS either as RFCs or Annex documents in this specification. Some of those are [RFC 4546], Annex H, and Annex I.

<sup>225</sup> Revised per OSSIv3.0-N-07.0480-3 by ab on 7/12/07.

OSSI data types are also defined in this specification in the Data Type section of OSSI annexes; for example, Annex A, Annex O, and Annex M.

**Table K-2 - Extended Data Types<sup>226</sup>**

OM Data Type	XML-Schema data type	Permitted Values	SNMP Mapping	IPDR Mapping
PhysicalIndex	unsignedInt	1..2147483647	Integer32	unsignedInt
PhysicalIndexOrZero	unsignedInt	0..2147483647	Integer32	unsignedInt
TagValue	string	SIZE (0..255)	SnmpTagValue	string
TagList	string	SIZE (0..255)	SnmpTagList	string
AdminString	string	SIZE (0..255)	SnmpAdminString	string
PhysAddress	hexBinary		PhysAddress	hexBinary
TestAndIncr	unsignedInt	0..2147483647	TestAndIncr	unsignedInt
anyURI	string		AutonomousType	string
AttributeReference	anyURI		VariablePointer	string
ObjectReference	anyURI		RowPointer	string
RowStatus	int		RowStatus	int
TimeStamp	unsignedInt		TimeStamp	unsignedInt
duration	unsignedInt	0..2147483647	TimeInterval	unsignedInt
StorageType	int		StorageType	int
TDomain	anyURI		TDomain	anyURI
TAddress	hexBinary	SIZE (1..255)	TAddress	hexBinary
DisplayString	string	SIZE (0..255)	DisplayString	string
TransportAddress	hexBinary	SIZE (0..255)	TransportAddress	hexBinary
InetAddressPrefixLength	unsignedInt	0..2040	Unsigned32	unsignedInt
InetPortNumber	unsignedInt	0..65535	Unsigned32	unsignedInt
InetVersion	int		INTEGER	int
IANAifType	int		INTEGER	int
DocsisQosVersion	int		DocsisQosVersion [RFC 4546]	int
DocsisUpstreamType	int		DocsisUpstreamType [RFC 4546]	int
DocsEqualizerData	hexBinary		DocsEqualizerData [RFC 4546]	hexBinary
TenthdBmV	int		TenthdBmV [RFC 4546]	int
TenthdB	int		TenthdB [RFC 4546]	int

<sup>226</sup> Table revised per OSSIV3.0-N-07.0447-2, #8 on 5/10/07 by KN, and per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

## Annex L Security Requirements (Normative)

### L.1 Overview

This Annex addresses the security requirements from the Operational Support System perspective and defines the object model for DOCSIS 3.0 security managed objects. Refer to [SEC] for detailed security requirements.

### L.2 Object Definitions

This section defines the security objects including the associated attributes.

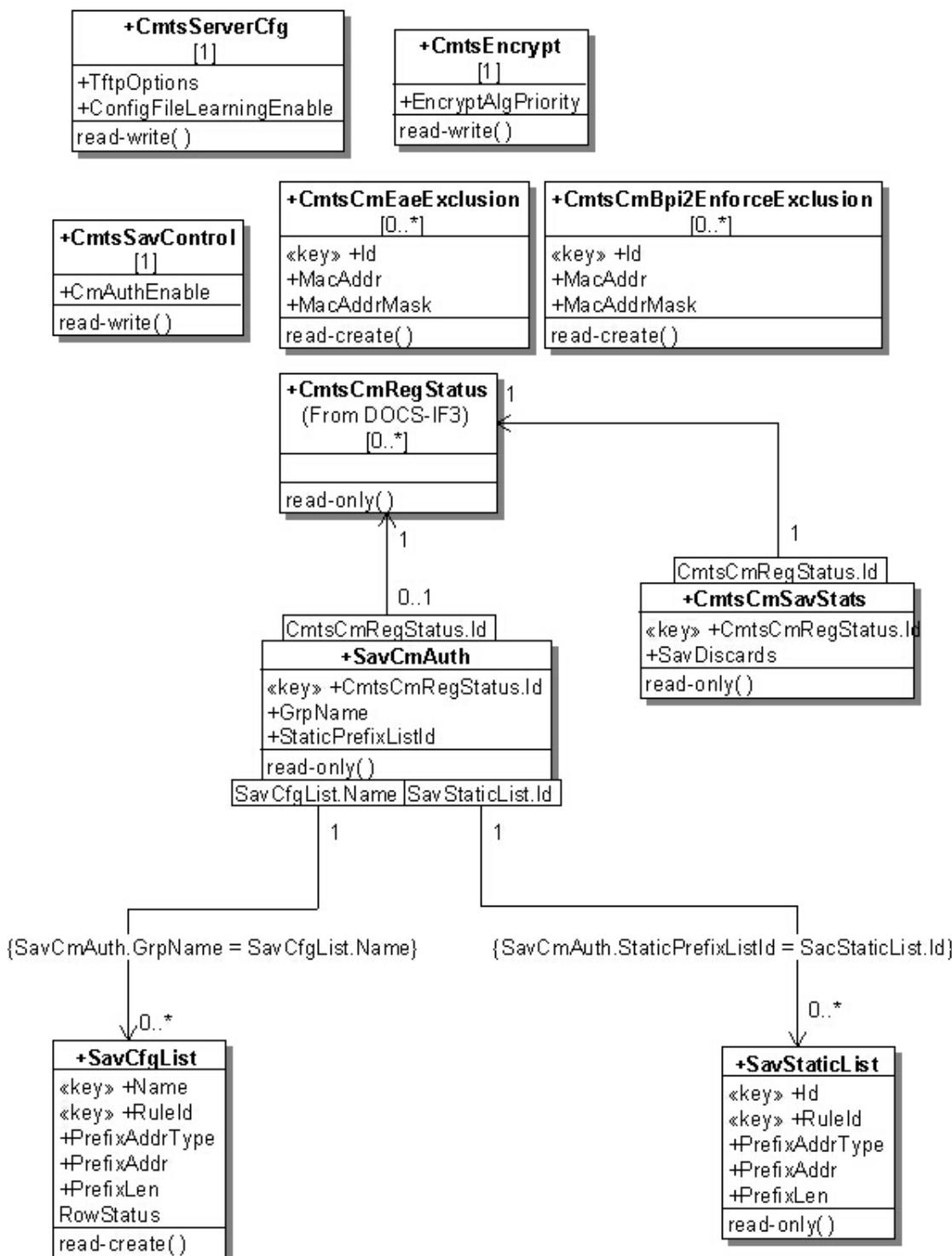


Figure L-1 - Security Object Model Diagram

## L.2.1 CmtsServerCfg Object

This object defines attributes for configuring TFTP Configuration File Security features.

The CMTS MUST persist the values of the attributes of the CmtsServerCfg object across reinitializations.

**Table L-1 - CmtsServerCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
TftpOptions	EnumBits	read-write	hwAddr(0) netAddr(1)	N/A	"H"
"ConfigFileLearningEnable	boolean	read-write		N/A	true

### L.2.1.1 TftpOptions

This attribute instructs the CMTS to insert the source IP address and/or MAC address of received TFTP packets into the TFTP option fields before forwarding the packets to the Config File server.

This attribute is only applicable when the TftpProxyEnabled attribute of the MdCfg object is 'true'.

References: Annex O, MdCfg Object Section.

### L.2.1.2 ConfigFileLearningEnable

This attribute enables and disables Configuration File Learning functionality.

If this attribute is set to 'true' the CMTS will respond with Authentication Failure in the REG-RSP message when there is a mismatch between learned config file parameters and REG-REQ parameters. If this attribute is set to 'false', the CMTS will not execute config file learning and mismatch check.

This attribute is only applicable when the TftpProxyEnabled attribute of the MdCfg object is 'true'.

References: Annex O, MdCfg Object Section; [SEC] Secure Provisioning Section; [MULPI].

## L.2.2 CmtsEncrypt Object

This object includes an attribute which defines the order in which encryption algorithms are to be applied.

The CMTS MUST persist the values of the attributes of the CmtsEncrypt object across reinitializations.

**Table L-2 - CmtsEncrypt Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
EncryptAlgPriority	TagList	read-write	aes128CbcMode des56CbcMode des40CbcMode	N/A	"aes128CbcMode des56CbcMode des40CbcMode"

### L.2.2.1 EncryptAlgPriority

This attribute allows for configuration of a prioritized list of encryption algorithms the CMTS will use when selecting the primary SAID encryption algorithm for a given CM. The CMTS selects the highest priority encryption algorithm from this list that the CM supports. By default the following encryption algorithms are listed from highest to lowest priority (left being the highest): 128 bit AES, 56 bit DES, 40 bit DES.

An empty list indicates that the CMTS attempts to use the latest and robust encryption algorithm supported by the CM. The CMTS will ignore unknown values or unsupported algorithms.

## L.2.3 CmtsSavCtrl Object

This object defines attributes for global Source Address Verification (SAV) configuration.

The CMTS MUST persist the values of the attributes of the CmtsSavCtrl object across reinitializations.

References: [SEC] Secure Provisioning Section.

**Table L-3 - CmtsSavCtrl Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmAuthEnable	boolean	read-write		N/A	true

**L.2.3.1 CmAuthEnable**

This attribute enables or disables Source Address Verification (SAV) for CM configured policies in the SavCmAuth object. If this attribute is set to 'false', the CM configured policies in the SavCmAuth object are ignored.

This attribute is only applicable when the SrcAddrVerificationEnabled attribute of the MdCfg object is 'true'.

References: Annex O, MdCfg Object Section.

**L.2.4 CmtsCmEaeExclusion Object**

This object defines a list of CMs or CM groups to exclude from Early Authentication and Encryption (EAE). This object allows overrides to the value of EAE Control for individual CMs or group of CMs for purposes such as debugging. The CMTS MUST support a minimum of 30 instances of the CmtsCmEaeExclusion object.

This object is only applicable when the EarlyAuthEncryptCtrl attribute of the MdCfg object is enabled.

This object supports the creation and deletion of multiple instances.

The CMTS MUST persist all instances of CmtsCmEaeExclusion across reinitializations.

References: Annex O, MdCfg Object Section; [SEC] Early Authentication and Encryption Section.

**Table L-4 - CmtsCmEaeExclusion Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
MacAddr	MacAddress	read-create		N/A	'000000000000'H
MacAddrMask	MacAddress	read-create		N/A	'FFFFFFFFFFFF'H

**L.2.4.1 Id**

This key uniquely identifies the exclusion MAC address rule.

**L.2.4.2 MacAddr**

This attribute identifies the CM MAC address. A match is made when a CM MAC address bitwise ANDed with the MacAddrMask attribute equals the value of this attribute.

**L.2.4.3 MacAddrMask**

This attribute identifies the CM MAC address mask and is used with the MacAddr attribute.

**L.2.5 SavCmAuth Object**

This object defines a read-only set of SAV policies associated with a CM that the CMTS will use in addition to the CMTS verification of an operator assigned IP Address being associated with a CM. When the CMTS has not resolved a source address of a CM CPE, the CMTS verifies if the CM CPE is authorized to pass traffic based on this object. These object policies include a list of subnet prefixes (defined in the SavStaticList object) or a SAV Group Name that could reference a CMTS configured list of subnet prefixes (defined in SavCfgList object) or vendor-specific policies. The CMTS populates the attributes of this object for a CM from that CM's config file.

This object is only applicable when the SrcAddrVerificationEnabled attribute of the MdCfg object is 'true' and the CmAuthEnable attribute of the CmtsSavCtrl object is 'true'.

The CMTS is not required to persist instances of this object across reinitializations.

References: Annex O, MdCfg Object Section; [SEC] Secure Provisioning Section; [MULPI] Common Radio Frequency Interface Encodings Annex.

**Table L-5 - SavCmAuth Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedInt	key	1..4294967295	N/A	N/A
GrpName	AdminString	read-only		N/A	N/A
StaticPrefixListId	unsignedInt	read-only		N/A	N/A

**L.2.5.1 CmtsCmRegStatusId**

This attribute is a key which uniquely identifies the CM. This attribute matches an index value of the CMTS CM Registration Status object.

References: Annex N, CmtsCmRegStatus Object Section.

**L.2.5.2 GrpName**

This attribute references the Name attribute of the SavCfgList object of a CM. If the CM signaled group name is not configured in the CMTS, the CMTS ignores this attribute value for the purpose of Source Address Verification. The CMTS MUST allow the modification of the GrpName object and use the updated SAV rules for newly discovered CPEs from CMs. When a source IP address is claimed by two CMs (e.g., detected as duplicated), the CMTS MUST use the current SAV rules defined for both CMs in case the SAV GrpName rules may have been updated. In the case of a persisting conflict, it is up to vendor-implementation to decide what CM should hold the SAV authorization.

The zero-length string indicates that no SAV Group was signaled by the CM. The zero-length value or a non-existing reference in the SavCfgList object means the SavCfgListName is ignored for the purpose of SAV.

References: [MULPI] Common Radio Frequency Interface Encodings Annex.

**L.2.5.3 StaticPrefixListId**

This attribute identifies the reference to a CMTS created subnet prefix list based on the CM signaled static prefix list TLV elements. The CMTS may reuse this attribute value to reference more than one CM when those CMs have signaled the same subnet prefix list to the CMTS.

The value zero indicates that no SAV static prefix encodings were signaled by the CM.

**L.2.6 SavCfgList Object**

This object defines the CMTS configured subnet prefix extension to the SavCmAuth object.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the PrefixAddrType and PrefixAddr attributes to be set.

The CMTS MUST persist all instances of SavCfgList across reinitializations.

**Table L-6 - SavCfgList Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Name	AdminString	key	SIZE (1..16)	N/A	N/A
RuleId	unsignedInt	key	1..4294967295	N/A	N/A
PrefixAddrType	InetAddressType	read-create	ipv4(1), ipv6(2)	N/A	N/A
PrefixAddr	InetAddress	read-create		N/A	N/A
PrefixLen	InetAddressPrefixLength	read-create		N/A	0

**L.2.6.1 Name**

This attribute is the key that identifies the instance of the SavCmAuth object to which this object extension belongs.

**L.2.6.2 RuleId**

This attribute is the key that identifies a particular subnet prefix rule of an instance of this object.

**L.2.6.3 PrefixAddrType**

This attribute identifies the IP address type of this subnet prefix rule.

**L.2.6.4 PrefixAddr**

This attribute corresponds to the IP address of this subnet prefix rule in accordance to the PrefixAddrType attribute.

**L.2.6.5 PrefixLen**

This attribute defines the length of the subnet prefix to be matched by this rule.

**L.2.7 SavStaticList Object<sup>227</sup>**

This object defines a subnet prefix extension to the SavCmAuth object based on CM statically signaled subnet prefixes to the CMTS.

When a CM signals to the CMTS static subnet prefixes, the CMTS MUST create a List Id to be referenced by the CM in the SavCmAuth StaticPrefixListId attribute, or the CMTS MAY reference an existing List Id associated to previously registered CMs in case of those subnet prefixes associated with the List Id match the ones signaled by the CM.

The CMTS MAY persist instances of the SavStaticList object across reinitializations.

References: [MULPI] Common Radio Frequency Interface Encodings Annex.

**Table L-7 - SavStaticList Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
RuleId	unsignedInt	key	1..4294967295	N/A	N/A
PrefixAddrType	InetAddressType	read-only	ipv4(1), ipv6(2)	N/A	N/A
PrefixAddr	InetAddress	read-only		N/A	N/A
PrefixLen	InetAddressPrefixLength	read-only		N/A	N/A

**L.2.7.1 Id**

This key uniquely identifies the index that groups multiple subnet prefix rules. The CMTS assigns this value per CM or may reuse it among multiple CMs that share the same list of subnet prefixes.

**L.2.7.2 RuleId**

This attribute is the key that identifies a particular static subnet prefix rule of an instance of this object.

**L.2.7.3 PrefixAddrType**

This attribute identifies the IP address type of this subnet prefix rule.

**L.2.7.4 PrefixAddr**

This attribute corresponds to the IP address of this subnet prefix rule in accordance to the PrefixAddrType attribute.

**L.2.7.5 PrefixLen**

This attribute defines the length of the subnet prefix to be matched by this rule.

**L.2.8 CmtsCmSavStats Object**

This object provides a read-only list of SAV counters for different service theft indications.

<sup>227</sup> Section revised per OSSIV3.0-N-08.0613-1 on 4/10/08 by KN.

**Table L-8 - CmtsCmSavStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedInt	key	1..4294967295	N/A	N/A
SavDiscards	Counter32	read-only		N/A	N/A

**L.2.8.1 CmtsCmRegStatusId**

This key uniquely identifies the CM. This attribute matches an index value of the CMTS CM Registration Status object.

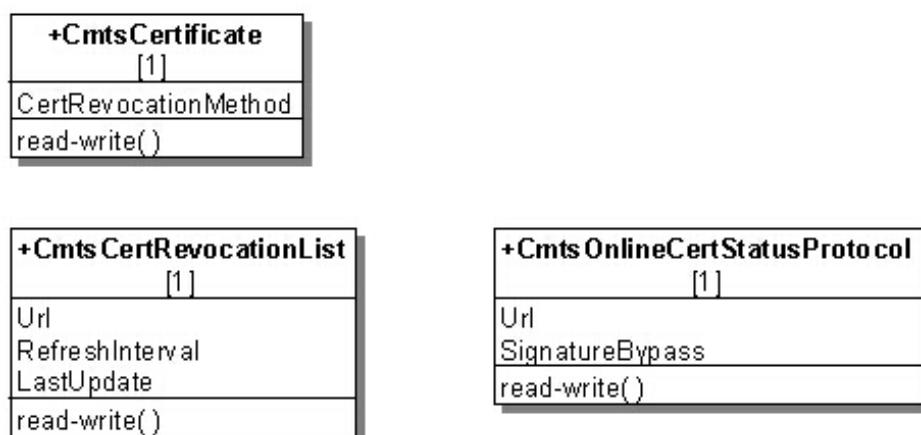
References: Annex N, CmtsCmRegStatus Object Section.

**L.2.8.2 SavDiscards**

This attribute provides the information about number of dropped upstream packets due to SAV failure.

**L.2.9 Certificate Revocation Objects**

Refer to the Certificate Revocation section of [SEC] for details on the two methods (CRL and OCSP) supported for certification revocation.

**Figure L-2 - Certificate Revocation Object Model Diagram****L.2.9.1 CmtsCertificate Object**

This object defines attributes for global certificate revocation configuration.

The CMTS MUST persist the values of the attributes of the CertificateRevocationMethod object across reinitializations.

References: [SEC] BPI+ X.509 Certificate Profile and Management Section.

**Table L-9 - CertificateRevocationMethod Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CertRevocationMethod	Enum	read-write	none(1) crl(2) ocsp(3) crlAndOcsp(4)	N/A	none

### L.2.9.1.1 *CertRevocationMethod*<sup>228</sup>

This attribute identifies which certificate revocation method is to be used by the CMTS to verify the cable modem certificate validity. The certificate revocation methods include Certification Revocation List (CRL) and Online Certificate Status Protocol (OCSP).

The following options are available:

The option 'none' indicates that the CMTS does not attempt to determine the revocation status of a certificate.

The option 'crl' indicates the CMTS uses a Certificate Revocation List (CRL) as defined by the Url attribute of the CmtsCertRevocationList object. When the value of this attribute is changed to 'crl', it triggers the CMTS to retrieve the CRL file from the URL specified by the Url attribute. If the value of this attribute is 'crl' when the CMTS starts up, it triggers the CMTS to retrieve the CRL file from the URL specified by the Url attribute.

The option 'ocsp' indicates the CMTS uses the Online Certificate Status Protocol (OCSP) as defined by the Url attribute of the CmtsOnlineCertStatusProtocol object.

The option 'crlAndOcsp' indicates the CMTS uses both the CRL as defined by the Url attribute in the CmtsCertRevocationList object and OCSP as defined by the Url attribute in the CmtsOnlineCertStatusProtocol object.

### L.2.9.2 *CmtsCertRevocationList Object*<sup>229</sup>

This object defines a CRL location URL and periodic refresh interval value. The CRL location URL defines from where the CMTS will retrieve the CRL file. The periodic refresh interval value indicates how often the CMTS will retrieve the CRL file for updates if the tbsCertList.nextUpdate attribute in the file is absent.

This object is only applicable when the CertRevocationMethod attribute of the CmtsCertificate object is set to 'crl' or 'crlAndOcsp'.

The CMTS MUST persist the values of the Url and RefreshInterval attributes of the CmtsCertRevocationList object across reinitializations.

References: [SEC] BPI+ X.509 Certificate Profile and Management section.

**Table L-10 - CmtsCertRevocationList Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Url	AdminString	read-write	Uniform Resource Locator	N/A	""
RefreshInterval	unsignedInt	read-write	1..524160	minutes	10080
LastUpdate	dateTime	read-only		N/A	N/A

### L.2.9.2.1 *Url*<sup>230</sup>

This attribute contains the URL from where the CMTS will retrieve the CRL file. When this attribute is set to a URL value different from the current value, it triggers the CMTS to retrieve the CRL file from that URL. If the value of this attribute is a zero-length string, the CMTS does not attempt to retrieve the CRL.

References: [SEC] BPI+ X.509 Certificate Profile and Management section.

### L.2.9.2.2 *RefreshInterval*

This attribute contains the refresh interval for the CMTS to retrieve the CRL (referred to in the Url attribute) with the purpose of updating its Certificate Revocation List. This attribute is meaningful if the tbsCertList.nextUpdate attribute does not exist in the last retrieved CRL, otherwise the value 0 is returned.

References: [SEC] BPI+ X.509 Certificate Profile and Management section.

<sup>228</sup> Revised per OSSIV3.0-N-0773-1 on 5/8/09 by JB.

<sup>229</sup> REQ modified per OSSIV3.0-N-0773-1 on 5/8/09 by JB.

<sup>230</sup> Revised per OSSIV3.0-N-0773-1 on 5/8/09 by JB.

**L.2.9.2.3 *LastUpdate*<sup>231</sup>**

This attribute contains the last date and time when the CRL was retrieved by the CMTS. This attribute returns January 1, year 0000, 00:00:00.0 if the CRL has not been updated.

**L.2.9.3 *CmtsOnlineCertStatusProtocol Object***

This object contains an OCSP Responder URL and an attribute to bypass signature checking of the OCSP response. The CMTS will use the URL for OCSP communications in checking a certificate's revocation status. This object is only applicable when the CertRevocationMethod attribute of the CmtsCertificate object is set to 'ocsp' or 'crlAndOcsp'.

The CMTS MUST persist the values of the attributes of the CmtsOnlineCertStatusProtocol object across reinitializations.

**Table L-11 - CmtsOnlineCertStatusProtocol Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Url	AdminString	read-write	Uniform Resource Locator	N/A	""
SignatureBypass	boolean	read-write		N/A	false

**L.2.9.3.1 *Url***

This attribute contains the URL string to retrieve OCSP information. If the value of this attribute is a zero-length string, the CMTS does not attempt to request the status of a CM certificate.

References: [SEC] BPI+ X.509 Certificate Profile and Management section; [RFC 2560].

**L.2.9.3.2 *SignatureBypass***

This attribute enables or disables signature checking on OCSP response messages.

References: [SEC] BPI+ X.509 Certificate Profile and Management section; [RFC 2560].

**L.2.10 CmtsCmBpi2EnforceExclusion Object<sup>232</sup>**

This object defines a list of CMs or CM groups to exclude from BPI+ enforcement policies configured within the CMTS. This object allows overrides to the value of BPI+ enforcement control for individual CMs or group of CMs for purposes such as debugging. The CMTS MUST support a minimum of 30 instances of the CmtsCmBpi2EnforceExclusion object.

This object supports the creation and deletion of multiple instances.

The CMTS MUST persist all instances of CmtsCmBpi2EnforceExclusion across reinitializations.

References: Annex O, MdCfg Object Section; [SEC] BPI+ Enforce Section.

**L.2.10.1 *Id***

This key uniquely identifies the exclusion MAC address rule.

**L.2.10.2 *MacAddr***

This attribute identifies the CM MAC address. A match is made when a CM MAC address bitwise ANDed with the MacAddrMask attribute equals the value of this attribute.

**L.2.10.3 *MacAddrMask***

This attribute identifies the CM MAC address mask and is used with the MacAddr attribute.

<sup>231</sup> Revised per OSSIV3.0-N-09-0773-1 on 5/8/09 by JB.

<sup>232</sup> Section added per OSSIV3.0-N-09.0872-4 on 1/5/10 by JB.

## Annex M Multicast Requirements (Normative)

### M.1 Overview

This Annex addresses the DOCSIS 3.0 management requirements for Multicast QoS and Multicast Authorization. It covers the management object models for each feature as well as the SNMP Management object definitions required for DOCSIS 3.0. Refer to [MULPI] for Multicast requirements details.

The aspects this Annex covers are:

- Multicast Authorization: The CMTS authorization module that allows operators to selectively authorize access to multicast content for subscribers,
- Multicast Configuration: Includes per multicast session policies to configure QoS, DSID-indexed Packet Header Suppression and BPI encryption of multicast sessions,
- Multicast status reporting: CM and CMTS reporting of multicast session status and statistics.

### M.2 Object Definitions

#### M.2.1 Multicast Authorization Object Model

This model provides the Multicast Conditional Access Model for the authorization of clients to join multicast sessions. The components of the Multicast Authorization model are:

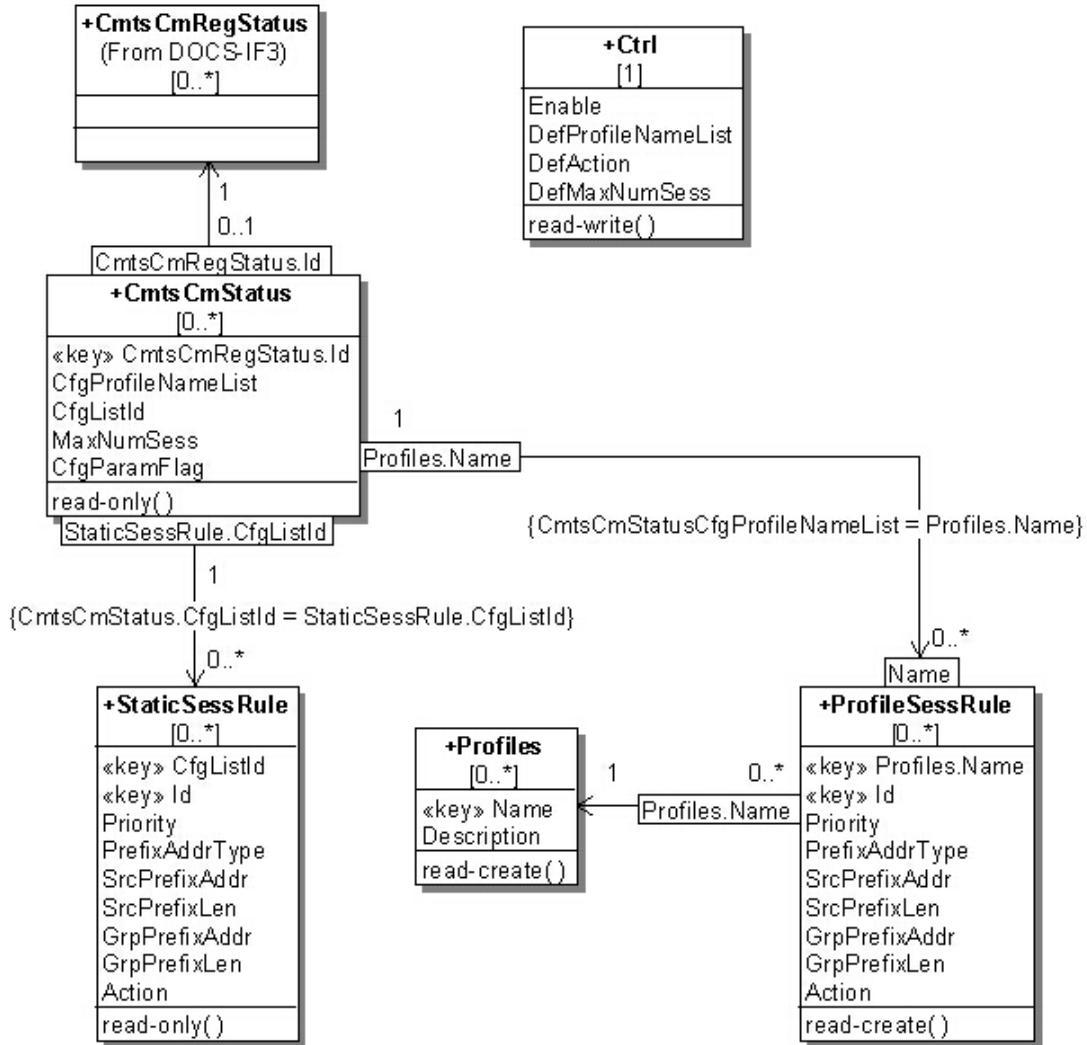
- Control, global configuration of Multicast authorization
- CmtsCmStatus, per-CM configuration of Multicast session rules for authorization
- StaticSessRule, DOCSIS static authorization
- ProfileSessRule, DOCSIS Multicast profile-based authorization

The CMTS MAY support the StaticSessRule object.

These Multicast Authorization objects and other signaling mechanisms defined in [MULPI] replace the Multicast Authorization feature defined in DOCS-IETF-BPI2-MIB module [RFC 4131], therefore, the SNMP table docsBpi2CmtsMulticastAuthTable is not required to be supported by the CMTS, and the CMTS does not require support for docsBpi2CmtsIpMulticastMapTable entry creation (see Annex A).

For the purpose of multicast authorization these terms are defined:

- A Multicast Authorization Static Session rule consists of a pair source prefix address and group prefix address, an authorization action and a priority signaled by a CM in IP Multicast Authorization Static Session Rule Subtype Encoding during registration.
- A Multicast Authorization Profile Session rule consist of a pair source and group prefix addresses, an authorization action and a priority configured in the CMTS. This rule corresponds to the expansion of the IP Multicast Authorization Profile Name Subtype encoding signaled by the CM during registration.

**Figure M-1 - Multicast Authorization Object Model Diagram****M.2.1.1 Ctrl Object**

This object defines the CMTS global behavior for Multicast Authorization. Some parameters are included as part of the CM configuration process. In absence of those parameters, default values defined by attributes of this object are used.

The CMTS MUST persist the values of the attributes of the Ctrl object across reinitializations.

**Table M-1 - Ctrl Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Enable	Enum	read-write	enable(1) disable(2)	N/A	disable
DefProfileNameList	TagList	read-write		N/A	"H
DefAction	Enum	read-write	permit(1) deny(2)	N/A	deny
DefMaxNumSess	unsignedShort	read-write		N/A	0

#### M.2.1.1.1 *Enable*

This attribute enables the enforcement of Multicast Authorization feature. When this attribute is set to 'enable', Multicast Authorization is enforced; otherwise, clients are permitted to join any IP multicast session. The factory default value of this attribute is 'disable'.

#### M.2.1.1.2 *DefProfileNameList*

This attribute indicates one or more Multicast Authorization Profiles that are used by the CMTS when CMs register with no Multicast Join Authorization encodings in the REG-REQ-(MP). When IP Multicast Authorization is enforced, this attribute provides the default set of Multicast Authorization Profiles the CMTS enforces for a CM in case the CM did not signal a set of profiles during the registration process. If the Default Multicast Authorization Group Name is a -zero-length string, the DefAction attribute determines whether a join request is authorized. If the CMTS supports more than one profile name as a default, the CMTS enforces each of the profiles in order of occurrence until the maximum number of profiles is reached.

#### M.2.1.1.3 *DefAction*

This attribute defines the default authorization action when no IP Multicast Session Rule is determined to match a client's IP multicast JOIN request. The factory default of this attribute is 'deny'.

#### M.2.1.1.4 *DefMaxNumSess*

This attribute indicates the default maximum number of multicast sessions that clients reached through a particular CM are allowed to join. A DefMaxNumSess value of 0 indicates that no dynamic joins are permitted. A Maximum Multicast Sessions Encoding value of 65535 (the largest valid value) indicates that the CMTS permits any number of sessions to be joined by clients reached through the CM.

References: [MULPI] Maximum Multicast Sessions section.

### **M.2.1.2 *ProfileSessRule Object***

This object defines Operator configured profiles to be matched during the authorization process.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the following attributes to be set:

- PrefixAddrType
- SrcPrefixAddr
- SrcPrefixLen
- GrpPrefixAddr
- GrpPrefixLen

The CMTS MUST persist all instances of the ProfileSessRule object across reinitializations.

**Table M-2 - *ProfileSessRule Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
Name	AdminString	key	SIZE (1..15)	N/A	N/A
Id	unsignedInt	key	1..4294967295	N/A	N/A
Priority	unsignedInt	read-create		N/A	0
PrefixAddrType	InetAddressType	read-create	ipv4(1) ipv6(2)	N/A	N/A
SrcPrefixAddr	InetAddress	read-create		N/A	N/A
SrcPrefixLen	InetAddressPrefixLength	read-create		N/A	N/A

Attribute Name	Type	Access	Type Constraints	Units	Default
GrpPrefixAddr	InetAddress	read-create		N/A	N/A
GrpPrefixLen	InetAddressPrefixLength	read-create		N/A	N/A
Action	Enum	read-create	accept(1) deny(2)	N/A	deny

#### M.2.1.2.1 *Name*

This attribute is a unique name that associates the IP Multicast Authorization Profile Name Subtype encoding signaled by CMs with the a set of Multicast Authorization Profile Session Rules.

#### M.2.1.2.2 *Id*

This attribute provides a unique identifier for each CMTS configured Multicast Authorization Profile Session rule within a Multicast Authorization Profile Name.

#### M.2.1.2.3 *Priority*

This attribute configures the rule priority for the static session rule. Higher values indicate a higher priority. If more than one session rule matches a joined session, the session rule with the highest rule priority determines the authorization action.

#### M.2.1.2.4 *PrefixAddrType*

This attribute identifies the address family for the multicast session (S,G) which corresponds to the SrcPrefixAddr and GrpPrefixAddr attributes respectively.

#### M.2.1.2.5 *SrcPrefixAddr*

This attribute identifies a specific Multicast Source Address defined for this rule. A Source Address that is all zeros is defined as 'all source addresses' (\*, G). Source prefix addresses are unicast addresses.

References: [RFC 3569] section 6; [RFC 3306] sections 5 and 6.

#### M.2.1.2.6 *SrcPrefixLen*<sup>233</sup>

This attribute identifies the prefix length associated with a range of Source (S) IP multicast group addresses. For Group or ASM based sessions this attribute is set to 0.

#### M.2.1.2.7 *GrpPrefixAddr*<sup>234</sup>

This attribute is the IP address corresponding to an IP multicast group.

#### M.2.1.2.8 *GrpPrefixLen*<sup>235</sup>

This attribute identifies the prefix length associated with a range of Group Destination IP multicast addresses.

#### M.2.1.2.9 *Action*

This attribute specifies the authorization action for a session join attempt that matches the session rule.

The value 'accept' indicates that the rule permits a matching multicast join request is allowed. The value 'deny' indicates that a matching multicast join request is denied.

### M.2.1.3 *Profiles Object*

This object contains the description of the Multicast Authorization profiles for administrative purposes.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the Description attribute to be set.

<sup>233</sup> Revised per OSSIV3.0-N-07.0411-3 #1 on 5/7/07 by KN.

<sup>234</sup> Revised per OSSIV3.0-N-07.0411-3 #1 on 5/7/07 by KN.

<sup>235</sup> Revised per OSSIV3.0-N-07.0411-3 #1 on 5/7/07 by KN.

The CMTS MUST persist all instances of the Profiles object across reinitializations.

**Table M-3 - Profiles Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Name	AdminString	key	SIZE (1..15)	N/A	N/A
Description	AdminString	read-create		N/A	N/A

#### M.2.1.3.1 *Name*

This attribute is a unique name or identifier for a Multicast Authorization Profile.

#### M.2.1.3.2 *Description*

This attribute is a human readable description of the Multicast Authorization Profile.

### M.2.2 Multicast Authorization Status Objects

#### M.2.2.1 *CmtsCmStatus Object*

This object maintains per-CM status of Multicast Authorization policies to be applied to this CM. The CM acquires these policy parameters through the CM registration process, or in the absence of some or all of those parameters, from the Ctrl Object.

This object is meaningful when the Ctrl Enable attribute is set to 'enable'.

In the process of authorizing a CM client's session request the CMTS MUST check rules defined in StaticSessRule object and then rules defined in ProfileSessRule object. In the case of multiple multicast session matches, the rule priority attribute defines the final selected session rule. The selection of a session rules when multiple matches have the same priority is vendor specific.

The CMTS MAY report in the CmtsCmStatus object CMs that do not signal any IP Multicast Authorization Encodings in the registration process.

**Table M-4 - CmtsCmStatus Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedInt	key	1..4294967295	N/A	N/A
CfgProfileNameList	TagList	read-only		N/A	N/A
CfgListId	unsignedInt	read-only		N/A	N/A
MaxNumSess	unsignedShort	read-only		sessions	N/A
CfgParamFlag	EnumBits	read-only	profile(0) staticMulticast(1) maxNumSessions(2)	N/A	N/A

#### M.2.2.1.1 *CmtsCmRegStatusId*

This attribute is a key which uniquely identifies the CM. This attribute matches an index value of the CMTS CM Registration Status object.

References: Annex N, CmtsCmRegStatus Object Section.

#### M.2.2.1.2 *CfgProfileNameList*

This attribute indicates the set of Profile Names associated with the CM.

This attribute indicates the CM signaled 'IP Multicast Authorization Profile Name' encodings during the CM registration process, or in the absence of instances of that config file parameter, the DefProfileNameList attribute from the Ctrl object.

References: [MULPI] IP Multicast Profile Name Subtype sections.

#### M.2.2.1.3 *CfgListId*

This attribute identifies the reference to a CMTS created Session Rule List based on the CM signaled 'IP Multicast Authorization Static Session Rule' encodings. The CMTS may reuse this attribute value to reference more than one CM that have signaled the same list of Session Rules to the CMTS.

The value zero indicates that the CM did not signal Multicast Session Rules to the CMTS or the CMTS does not support the StaticSessRule, in which case, the CMTS ignores any CM signalled Session Rule encodings during registration.

References: [MULPI] IP Multicast Join Authorization Static Session Rule Subtype section in the Common Radio Frequency Interface Encodings Annex.

#### M.2.2.1.4 *MaxNumSess*

This attribute indicates the CM signaled value in Maximum Multicast Sessions Encoding during the CM registration process. If this value is missing the DefMaxNumSess attribute of the Ctrl object is used to determine the maximum number of multicast sessions this client may forward. The value 0 indicates that no dynamic joins are permitted. The value 65535 (the largest valid value) indicates that the CMTS permits any number of sessions to be joined by clients reached through the CM.

References: [MULPI] Maximum Multicast Sessions Encoding section in the Common Radio Frequency Interface Encodings Annex.

#### M.2.2.1.5 *CfgParamFlag*

This attribute represents the functions that are activated through the registration process.

The bit 'profile' indicates whether the CM signaled 'IP Multicast Authorization Profile Name Subtype' encodings.

The bit 'staticMulticast' indicates whether the CM signaled 'IP Multicast Authorization Static Session Rule Subtype' encodings.

The bit 'maxNumSessions' indicates whether the CM signaled the 'Maximum Multicast Sessions' encoding.

### M.2.2 *StaticSessRule Object*

This object defines the Session authorization Rules based on the CM or group of CMs signaled in IP Multicast Join Authorization Static Session Subtype encoding. This object reflects the Static Session rules that were included in the CM registration request message.

The CMTS MAY persist all instances of the StaticSessRule object across reinitializations.

References: [MULPI] IP Multicast Join Authorization Static Session Rule Subtype section in the Common Radio Frequency Interface Encodings Annex.

**Table M-5 - StaticSessRule Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CfgListId	unsignedInt	key	1..4294967295	N/A	N/A
Id	unsignedInt	key	1..4294967295	N/A	N/A
Priority	unsignedByte	read-only		N/A	N/A
PrefixAddrType	InetAddressType	read-only	ipv4(1) ipv6(2)	N/A	N/A
SrcPrefixAddr	InetAddress	read-only		N/A	N/A
SrcPrefixLen	InetAddressPrefixLength	read-only		N/A	N/A
GrpPrefixAddr	InetAddress	read-only		N/A	N/A
GrpPrefixLen	InetAddressPrefixLength	read-only		N/A	N/A
Action	Enum	read-only	permit(1) deny(2)	N/A	N/A

**M.2.2.2.1 *CfgListid***

This attribute contains a CMTS-derived value for a set of multicast static session rules associated to one or more CMs.

**M.2.2.2.2 *Id***

This attribute provides an identifier for each Multicast Authorization Static Session rule in the IP Multicast Join Authorization Static Session SubType communicated by a CM or group of CMs during registration.

**M.2.2.2.3 *Priority***

This attribute defines the rule priority for the static session rule. Higher values indicate a higher priority. If more than one session rule matches a joined session, the session rule with the highest rule priority determines the authorization action.

**M.2.2.2.4 *PrefixAddrType***

This attribute identifies the address family for the multicast session (S,G) which corresponds to the SrcPrefixAddr and GrpPrefixAddr attributes respectively.

**M.2.2.2.5 *SrcPrefixAddr***

This attribute identifies a specific Multicast Source Address defined for this rule. A Source Address that is all zeros is defined as 'all source addresses (\*, G)'. Source Prefix Addresses are unicast host addresses.

References: [RFC 3569] section 6; [RFC 3306] sections 5 and 6.

**M.2.2.2.6 *SrcPrefixLen*<sup>236</sup>**

This attribute identifies the prefix length associated with a range of Source (S) IP multicast group addresses. For group or ASM-based sessions this attribute is set to 0.

**M.2.2.2.7 *GrpPrefixAddr*<sup>237</sup>**

This attribute is the IP address corresponding to an IP multicast group.

**M.2.2.2.8 *GrpPrefixLen*<sup>238</sup>**

This attribute identifies the prefix length associated with a range of Group Destination IP multicast addresses.

**M.2.2.2.9 *Action***

This attribute specifies the authorization action for a session join attempt that matches the session rule.

The value 'accept' indicates that the rule permits a matching multicast join request is allowed. The value 'deny' indicates that a matching multicast join request is denied.

**M.2.3 Multicast QoS Configuration Object Model<sup>239</sup>**

This object model defines the configuration requirements for multicast session QoS and privacy over the HFC by extending the DOCSIS QoS model [MULPI] and Baseline Privacy Interface (BPI) [SEC] requirements respectively. The components of the Multicast Configuration model are:

- CmtsGrpCfg, the Multicast Group Configuration rules for Multicast that includes QoS, Encryption and DSID-based Packet Header suppression,
- CmtsGrpQosCfg, the QoS policies for Multicast Sessions,
- GrpSvcClass, default SCN template reference for unclassified Multicast sessions,
- CmtsGrpPhsCfg, DSID-indexed PHS rules configuration for Multicast sessions,

<sup>236</sup> Revised per OSSIV3.0-N-07.0411-3 #2 on 5/7/07 by KN.

<sup>237</sup> Revised per OSSIV3.0-N-07.0411-3 #2 on 5/7/07 by KN.

<sup>238</sup> Revised per OSSIV3.0-N-07.0411-3 #2 on 5/7/07 by KN.

<sup>239</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

- CmtsGrpEncryptCfg, encryption rules configuration for Multicast sessions,
- GrpServiceFlow (see Annex O), extends the Service Flows information to report parameters of multicast service flows, known as Group Service Flows (GSFs),
- GrpPktClass (see Annex O), extends the Service Flows packet classification information to report multicast specific parameters.

The management of QoS for Multicast requires that the CMTS supports the CmtsGrpCfg, CmtsGrpQosCfg, GrpSvcClass, CmtsGrpEncryptCfg, GrpServiceFlow and GrpPktClass objects.

The representation of GSFs for management purposes is similar to unicast service flows. A GSF is a specialization of unicast service flows; therefore, the DOCSIS QOS Model [MULPI] and the QoS management model from Annex O applies to GSFs with some considerations:

- GSFs have corresponding Service Flow IDs in the downstream direction. The CMTS represents GSFs in the QoS model from Annex O, in particular, in ServiceFlow, PktClass, ParamSet, ServiceFlowStats, and ServiceFlowLog. GSFs are never signalled to the CM.
- GSFs have no corresponding mapping to CM MAC Addresses as unicast service flows; therefore, CmtsMacToSrvFlow does not contain information related to GSFs. Instead the GrpServiceFlow indicates the SFIDs of GSFs per-MAC domain.
- To complete the classification of the multicast traffic to a GSF, entries in the Group Configuration object are used to build a Group Classifier Rule (GCR) when there is a nonzero value for QosConfigId [MULPI].<sup>240</sup>
- PHS does not apply to GSF-GCR pairs, instead configurable DSID-Indexed PHS rules are defined in the CmtsGrpPhsCfg object.<sup>241</sup>

The CM does not report GSFs as part of its Service Flow information; the CM is only aware of the DSID context of a GSF (see Annex O).

<sup>240</sup> Revised per OSSIV3.0-N-07.0411-3 #5 on 5/7/07 by KN.

<sup>241</sup> Revised per OSSIV3.0-N-07.0480-3 on 1/30/08 by KN.

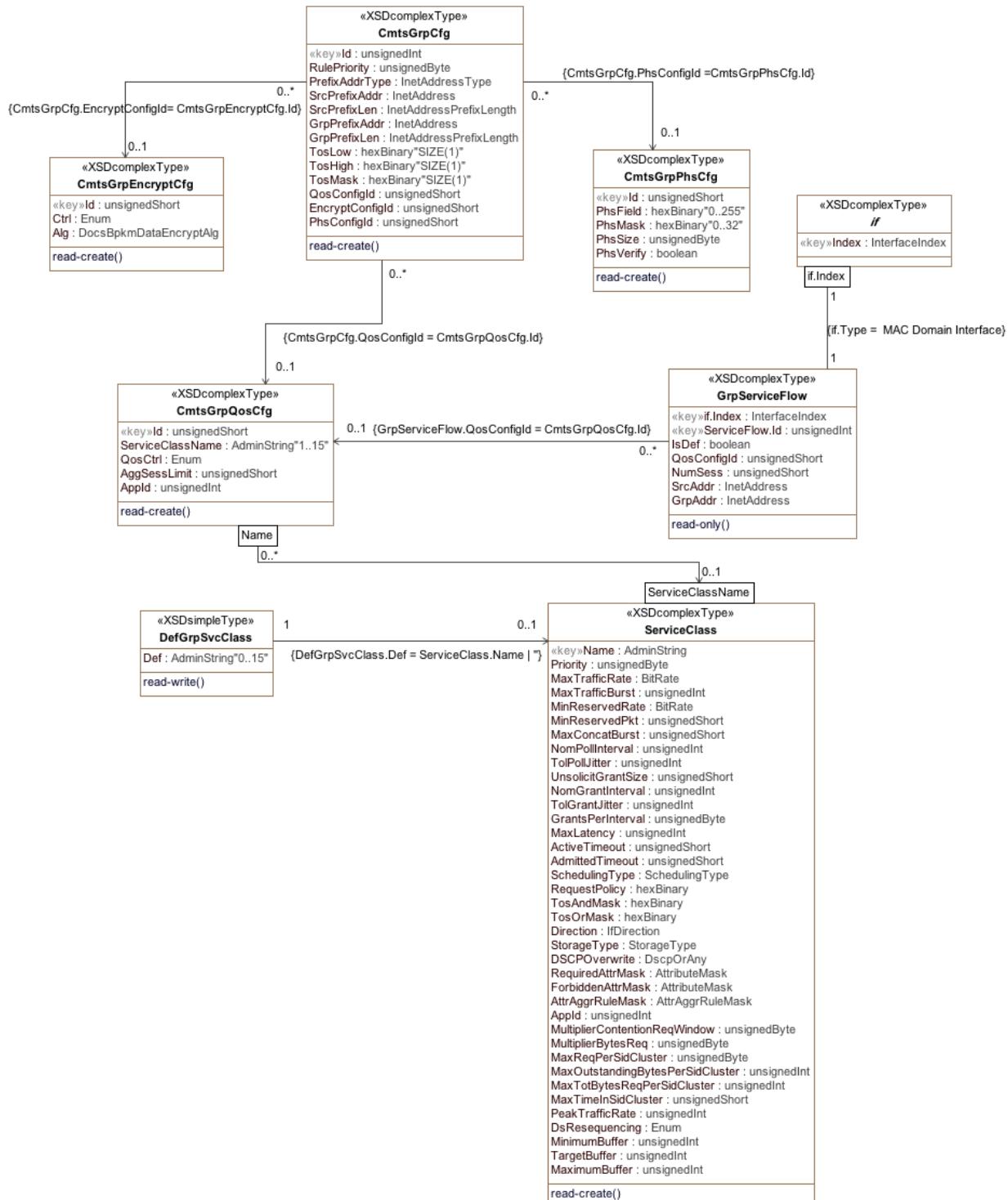


Figure M-2 - Multicast Configuration Object Model Diagram<sup>242</sup>

<sup>242</sup> Figure replaced per OSSIV3.0-N-08.0700-4 by JS on 1/12/09, and per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB; Figure replaced by OSSIV3.1-N.14.1151-2 on 7/14/14 by PO.

### **M.2.3.1 CmtsGrpCfg Object**

This object controls the QoS, PHS and encryption settings for downstream forwarding of IP multicast sessions. An IP multicast session is replicated to one or more Downstream Channel Sets (DCSs), where each DCS is either a single downstream channel or a downstream bonding group of multiple channels. The CMTS determines on which DCSs to replicate a multicast session based on IP multicast membership reports ('joins') or other vendor-specific static configuration.

The CmtsGrpCfg object allows for the configuration of a range of sessions through the SrcPrefixAddr and GrpPrefixAddr and SrcPrefixLen and GrpPrefixLen attributes.

The CmtsGrpCfg object allows for the configuration of QoS, Encryption and PHS for multicast sessions. Cable operators can specify configuration rules for a range of multicast sessions through the tuple of (SrcPrefixAddr, SrcPrefixLen, GrpPrefixAddr, GrpPrefixLen) attributes in an entry. The QosCfgId attribute identifies the QoS rule, the EncryptCfgId identifies the encryption rule and the PhsCfgId identifies the PHS rule for a particular entry. Even if an entry indicates a range of multicast sessions the Encryption and PHS rules are applied on a per-session basis. Thus, when an Operator configures PHS rules or Encryption for a given GroupConfig entry, each session has those rules applied on a per session and per replication basis. Group PHS and Group Encryption rules are indicated by using a non-zero value for the PhsCfgId and EncryptCfgId respectively.<sup>243</sup>

The CmtsGrpQosCfgQosCtrl attribute from the CmtsGrpQosCfg object is used to determine if the traffic for a range of multicast sessions identified by an entry in the CmtsGrpCfg object will be transmitted in an "Aggregate-Session" Group Service Flow or will be transmitted separately for each session using "Single-Session" Group Service Flows. Even if the range of multicast sessions are transmitted on an "Aggregate-Session" Group Service Flow, the PHS and Encryption rules are always applied individually to a multicast session on a per-session DSID basis prior to being transmitted on an "Aggregate-Session" Group Service Flow (GSF).

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the following attributes to be set.

- RulePriority
- PrefixAddrType
- SrcPrefixAddr
- SrcPrefixLen
- GrpPrefixAddr
- GrpPrefixLen
- TosLow
- TosHigh
- TosMask

The CMTS MUST persist all instances of the CmtsGrpCfg object across system reinitializations.

**Table M-6 - CmtsGrpCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
RulePriority	unsignedByte	read-create		N/A	N/A
PrefixAddrType	InetAddressType	read-create	ipv4(1) ipv6(2)	N/A	N/A
SrcPrefixAddr	InetAddress	read-create		N/A	N/A
SrcPrefixLen	InetAddressPrefixLength	read-create		N/A	N/A

<sup>244</sup> Revised per OSSIV3.0-N-07.0411-3 #4 on 5/7/07 by KN.

Attribute Name	Type	Access	Type Constraints	Units	Default
GrpPrefixAddr	InetAddress	read-create		N/A	N/A
GrpPrefixLen	InetAddressPrefixLength	read-create		N/A	N/A
TosLow	hexBinary	read-create	SIZE (1)	N/A	N/A
TosHigh	hexBinary	read-create	SIZE (1)	N/A	N/A
TosMask	hexBinary	read-create	SIZE (1)	N/A	N/A
QosCfgId	unsignedShort	read-create		N/A	0
EncryptCfgId	unsignedShort	read-create		N/A	0
PhsCfgId	unsignedShort	read-create		N/A	0

#### M.2.3.1.1 *Id*

This attribute represents the unique identifier of instances of this object. This attribute is the key that identifies unique instances of the CmtsGrpCfg Object.

#### M.2.3.1.2 *RulePriority*

This attribute indicates the priority of this entry used to resolve which instance of this object apply when a newly replicated multicast session matches multiple entries. Higher values indicate a higher priority. Valid values for this attribute are 0..63 and 192..255 in order to not conflict with CMTS internally-created instances that use the range 64..191.

#### M.2.3.1.3 *PrefixAddrType*

This attribute identifies the address family for the multicast session (S,G) of the Group Configuration (GC) which corresponds to the SrcPrefixAddr and GrpPrefixAddr attributes respectively.

#### M.2.3.1.4 *SrcPrefixAddr*

This attribute defines the IP source address prefix of the IP multicast session. Source prefix addresses are unicast host addresses.

References: [RFC 3569] section 6; [RFC 3306] sections 5 and 6.

#### M.2.3.1.5 *SrcPrefixLen*<sup>244</sup>

This attribute identifies the prefix length associated with a range of Source (S) IP multicast group addresses. For Group or ASM based sessions this attribute is set to 0.

#### M.2.3.1.6 *GrpPrefixAddr*<sup>245</sup>

This attribute is the IP address corresponding to an IP multicast group.

#### M.2.3.1.7 *GrpPrefixLen*<sup>246</sup>

This attribute identifies the prefix length associated with a range of Group Destination IP multicast addresses.

#### M.2.3.1.8 *TosLow*

This attribute identifies the low value of a range of the TOS byte value to be defined in a packet classifier this GC instantiates in the GCR in order to limit the GCR-matched traffic to a particular set of DSCPs. This applies to the IPv4 TOS byte and the IPv6 Traffic Class byte.

The IP TOS octet, as originally defined in [RFC 791], has been superseded by the 6-bit Differentiated Services Field and the 2-bit Explicit Congestion Notification Field.

References: [RFC 791]; [RFC 3260]; [RFC 3168].

<sup>244</sup> Revised per OSSIV3.0-N-07.0411-3 #3 on 5/7/07 by KN.

<sup>245</sup> Revised per OSSIV3.0-N-07.0411-3 #3 on 5/7/07 by KN.

<sup>246</sup> Revised per OSSIV3.0-N-07.0411-3 #3 on 5/7/07 by KN.

#### M.2.3.1.9 *TosHigh*

This attribute identifies the high value of a range of the TOS byte value to be defined in a packet classifier this GC instantiates in the GCR in order to limit the GCR-matched traffic to a particular set of DSCPs. This applies to the IPv4 TOS byte and the IPv6 Traffic Class byte.

The IP TOS octet, as originally defined in [RFC 791], has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]).

References: [RFC 791]; [RFC 3260]; [RFC 3168].

#### M.2.3.1.10 *TosMask*

This attribute identifies the mask value bitwise ANDed with a TOS byte value to be defined in a packet classifier this GC instantiates in the GCR in order to limit the GCR-matched traffic to a particular set of DSCPs. This applies to the IPv4 TOS byte and the IPv6 Traffic Class byte.

The IP TOS octet, as originally defined in [RFC 791], has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]).

References: [RFC 791]; [RFC 3260]; [RFC 3168].

#### M.2.3.1.11 *QosCfgId*<sup>247</sup>

This attribute identifies an instance in CmtsGrpQosCfg for configuring the QoS for the replication of the sessions matching this CmtsGrpCfg instance.

The value 0 indicates that all replications referenced by this CmtsGrpCfg instance will be forwarded to the default GSF.

#### M.2.3.1.12 *EncryptCfgId*

This attribute identifies an instance in CmtsGrpEncryptCfg for configuring the encryption of replications derived from this GC.

The value 0 indicates no encryption for all replications derived from this GC.

#### M.2.3.1.13 *PhsCfgId*

This attribute identifies an instance in CmtsGrpPhsCfg that configures DSID-indexed PHS compression for all replications derived from this GC.

The value 0 indicates no PHS compression for all replications derived from this GC.

### M.2.3.2 *DefGrpSvcClass Object*

This object provides the name of the Default Group Service Class. The CMTS instantiates a Default Group Service Flow with the QOS param Set indicated by this Service Class Name reference on every Downstream Channel Set to which it replicates multicast packets that are otherwise unclassified by a Group Classifier Rule.

The CMTS MUST persist the value of the attributes of the DefGrpSvcClass object across reinitializations.

**Table M-7 - DefGrpSvcClass Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Def	AdminString	read-write	SIZE (0..15)	N/A	"H

#### M.2.3.2.1 *Def*<sup>248</sup>

This attribute references a Service Class Name QoS Parameter Set template. This attribute is used to expand the QoS parameter Set of QoS for multicast sessions that uses a default QoS policy.

References: Annex O.

<sup>247</sup> Revised per OSSIV3.0-N-07.0499-1 by ab on 7/17/07.

<sup>248</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

### M.2.3.3 CmtsGrpQosCfg Object<sup>249</sup>

This object configures the QoS configured for Multicast sessions replicated to any Downstream Channel Set. It does not control which particular DCSs to which the CMTS replicates a multicast session.

An instance of this object is called a GQC entry. A GQC entry controls how the CMTS instantiates a Group Classifier Rule (GCR) on the DCS to match packets of the multicast session. A Group Classifier Rule (GCR) uses source and destination IP address and ToS criteria.

A GQC entry controls how and with what QoS parameters a Group Service Flow (GSF) is created on a DCS. All downstream multicast packets are scheduled on a GSF. The QoS Type attribute of the GQC entry controls whether the CMTS creates one GSF for each single IP multicast session or whether the CMTS creates one GSF for the aggregate of all sessions that match the GQC criteria. The GQC instance contains a reference to a Service Class Name QoS Parameter Set template. The Service Class defines the list of QoS parameters for the GSF(s) instantiated for the GQC entry.

A CMTS identifies one Service Class as the Default Group QoS Service Class. The CMTS instantiates a Default Group Service Flow on each single-channel DCS based on the parameters of the Default Group QoS Service Class.

The set of GCRs and GSFs instantiated on a DCS control how QoS is provided to multicast packets replicated to the DCS. For each multicast packet, the CMTS classifies the packet to the highest priority matching GCR on that DCS. The GCR refers to a single GSF, which controls the scheduling of the packets on the DCS. If the multicast packet does not match any GCR on the DCS, the packet is scheduled on the Default Group Service Flow of the DCS. The CMTS replicates unclassified multicast traffic to only DCSs consisting of a single downstream channel. Thus, the Maximum Sustained Traffic Rate QoS parameter of the Default Group Service Class limits the aggregate rate of unclassified multicast traffic on each downstream channel.

The CMTS is expected to instantiate GCRs and GSFs controlled by the entries in this table only for the duration of replication of the multicast sessions matching the entry.

This object supports the creation of multiple instances.

Creation of new instances of this object require the following objects to be set:

- SvcClassName
- QosCtrl
- AggSessLimit

The CMTS MUST persist all instances of the CmtsGrpQosCfg object across system reinitialization.

**Table M-8 - CmtsGrpQosCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedShort	key		N/A	N/A
SvcClassName	AdminString	read-create	SIZE (1..15)	N/A	N/A
QosCtrl	Enum	read-create	singleSession(1) aggregateSession(2)	N/A	
AggSessLimit	unsignedShort	read-create	1.. 65535	sessions	N/A
Appld	unsignedInt	read-create		N/A	0

#### M.2.3.3.1 Id

This attribute identifies a unique Group QoS Configuration object instance.

#### M.2.3.3.2 ServiceClassName

This attribute identifies the Service Class Name reference for the set of QoS parameters for this GQC.

<sup>249</sup> Revised per OSSIV3.0-N-07.0473-3 by ab on 7/12/07.

#### M.2.3.3.3 *QosCtrl*<sup>250</sup>

This attribute identifies how Group Classifier Rules (GCRs) and Group Service Flows (GSFs) are instantiated when multiple sessions match the (S,G) criteria of this entry. If 'singleSession', the CMTS creates a unique GCR and a unique GSF for the session. If this object's value is 'aggregateSession', all sessions matching this criterion are aggregated into the same GSF.

#### M.2.3.3.4 *AggSessLimit*<sup>251</sup>

This attribute identifies the maximum number of sessions that may be aggregated in an aggregated Service Flow. This value is ignored in case of a GQC entry with QosCtrl set to 'singleSession'.

#### M.2.3.3.5 *AppId*

This attribute allows the operator to configure a Cable Operator defined Application Identifier for multicast sessions, e.g., an Application Manager ID and Application Type. This Application Identifier can be used to influence admission control or other policies in the CMTS that are outside of the scope of this specification. This parameter is optional in defining QoS for multicast sessions.

If the value of this attribute is different from the value of the AppId in the referenced SCN for this GQC instance, the value of this attribute is used.

References: [MULPI] Application Identifier section in the Common Radio Frequency Interface Encodings Annex; [PKT-PCMM] Policy Server and CMTS Interface section.

#### M.2.3.4 *CmtsGrpPhsCfg Object*<sup>252</sup>

This object controls the configuration of DSID-indexed PHS for multicast sessions. Configuration of PHS Rules via this object are applied to individual multicast sessions even if the referenced CmtsGrpCfg object identified a GrpQosCfg instance with a QosCtrl of 'aggregateSession'.

This object supports the creation and deletion of instances.

Creation of multiple instances of this object require the following attributes to be set:

- PhsField
- PhsMask
- PhsSize

The CMTS MUST persist all instances of the CmtsGrpPhsCfg object across system reinitializations.

**Table M-9 - CmtsGrpPhsCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedShort	key	1..65535	N/A	N/A
PhsField	hexBinary	read-create	SIZE (0..255)	N/A	N/A
PhsMask	hexBinary	read-create	SIZE (0..32)	N/A	N/A
PhsSize	unsignedByte	read-create	0..255	Bytes	N/A
PhsVerify	boolean	read-create		N/A	false

#### M.2.3.4.1 *Id*

This attribute identifies the unique identifier of a PHS rule that is referenced by the GrpCfg object.

#### M.2.3.4.2 *PhsField*

This attribute defines the bytes of the DOCSIS header which must be suppressed/restored by the sending/receiving device.

<sup>250</sup> Revised per OSSIV3.0-N-07.0411-3 #7 on 5/7/07 by KN.

<sup>251</sup> Revised per OSSIV3.0-N-07.0411-3 #7 on 5/7/07 by KN.

<sup>252</sup> Revised per OSSIV3.0-N-07.0447-2 by ab on 7/10/07.

#### M.2.3.4.3 *PhsMask*

This attribute defines the bit mask which is used in combination with the PhsField to define which bytes in header must be suppressed/restored by the sending or receiving device.

Each bit of this bit mask corresponds to a byte in the PhsField, with the least significant bit corresponding to the first byte of the PhsField.

Each bit of the bit mask specifies whether or not the corresponding byte should be suppressed in the packet. A bit value of '1' indicates that the byte should be suppressed by the sending device and restored by the receiving device.

A bit value of '0' indicates that the byte should not be suppressed by the sending device or restored by the receiving device.

If the bit mask does not contain a bit for each byte in the PhsField then the bit mask is extended with bit values of '1' to be the necessary length.

#### M.2.3.4.4 *PhsSize*

This attribute specifies the number of bytes in the header to be suppressed and restored.

The value of this object matches the number of bytes the bits indicated in the PhsField attribute.

#### M.2.3.4.5 *PhsVerify*

This attribute specifies the Payload Header Suppression verification value of 'true' the sender must verify PhsField is the same as what is contained in the packet to be suppressed.

#### M.2.3.5 *CmtsGrpEncryptCfg Object*

This object controls the configuration of the Security Association (SA) and the encryption algorithm used for multicast sessions.

This object supports the creation and deletion of instances.

The CMTS MUST persist all instances of the CmtsGrpEncryptCfg object across system reinitializations.

**Table M-10 - CmtsGrpEncryptCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedShort	key		N/A	N/A
Ctrl	Enum	read-create	cmts(1) mgmt(2)	N/A	mgmt
Alg	DocsBpkmDataEncryptAlg	read-create	des56CbcMode(1) des40CbcMode(2) aes128CbcMode(4)	N/A	des56CbcMode

##### M.2.3.5.1 *Id*

This attribute specifies the unique identifier of instances of this object.

##### M.2.3.5.2 *Ctrl*

This attribute controls whether the CMTS can select the encryption algorithm or if this can be set manually using the Alg attribute. If this attribute is set to 'cmts', the CMTS can select the encryption algorithm for the Security Association (SA). If this attribute is set to 'mgmt', the Alg attribute is used to define the encryption algorithm for this SA.

##### M.2.3.5.3 *Alg*

This attribute defines which encryption algorithm will be used for an SA referenced by this object when the Ctrl is set to 'mgmt'.

### M.2.4 Multicast Status Reporting Object Model

This Model provides the replication and reporting aspects of multicast sessions for CM and CMTS. The components of the Multicast status reporting model are:

- CmtsReplSess, Multicast Sessions replications per MAC domain for the CMTS.
- CmtsDsidPhs, PHS information for DSID for CMTS.
- See Annex O for additional requirements that apply to Multicast, in particular QoS extensions for GSFs, GCRs, and DSIDs.<sup>253</sup>

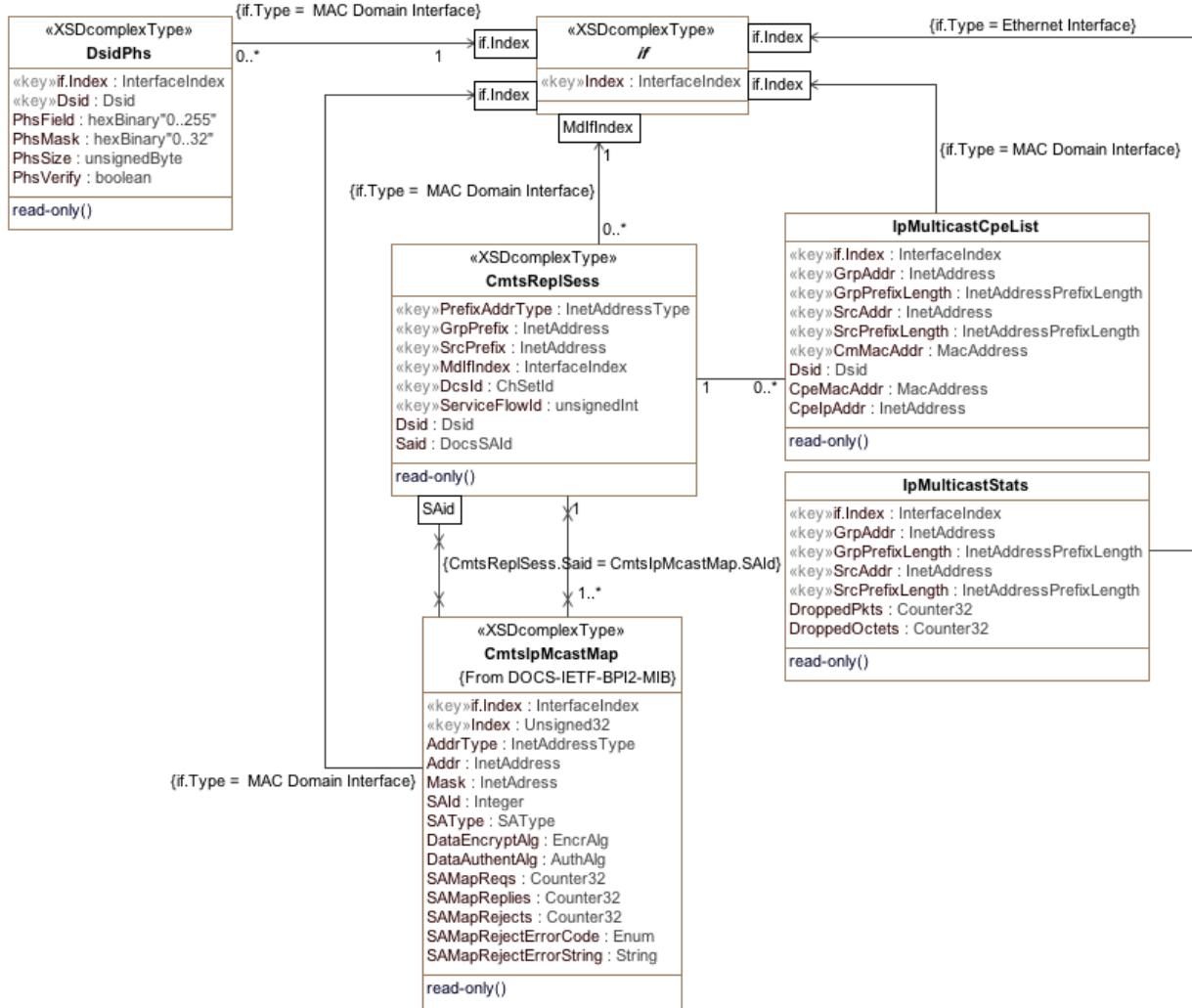


Figure M-3 - Multicast Status Reporting Object Model Diagram<sup>254</sup>

#### M.2.4.1 DsidPhs Object

This object reports the set of DSID-Indexed PHS rules that are signaled between the CMTS and CMs as part of the Multicast Sessions setup. The attributes PhsMask, PhsSize and PhsVerify comes from the configuration object

<sup>253</sup> Revised per OSSIV3.0-N-07.0411-3 #6 on 5/7/07 by KN.

<sup>254</sup> Figure replaced per OSSIV3.0-14.1151-2 on 7/15/14 by PO.

CmtsGrpPhsCfg. The value of the PhsField attribute is derived by the CMTS from the CmtsGrpCfg object parameters, and possibly other IP header information of the multicast session that the CMTS is capable of knowing prior to the multicast session setup. In cases where the PhsSize is longer than the CMTS knowledge of IP/TCP header fields, the CMTS extends the PhsMask with bits set to 0 until reaching the equivalent PhsSize value.

**Table M-11 - DsidPhs Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key		N/A	N/A
Dsid	Dsid	key		N/A	N/A
PhsField	hexBinary	read-only	SIZE (0..255)	N/A	N/A
PhsMask	hexBinary	read-only	SIZE (0..32)	N/A	N/A
PhsSize	unsignedByte	read-only	0..255	bytes	N/A
PhsVerify	boolean	read-only		N/A	false

#### M.2.4.1.1 IfIndex

This attribute represents the MAC Domain interface Index where the DSID-Indexed PHS rule applies.

#### M.2.4.1.2 Dsid

This attribute represents the 20-bit DSID associated with this PHS rule.

#### M.2.4.1.3 PhsField

This attribute defines the bytes of the header which must be suppressed/restored by the sending/receiving device.

#### M.2.4.1.4 PhsMask

This attribute defines the Payload Header Suppression mask in the header to be suppressed and restored.

#### M.2.4.1.5 PhsSize

This attribute defines the number of bytes in the header to be suppressed and restored.

#### M.2.4.1.6 PhsVerify

This attribute, when set to 'true', indicates that the sender must verify that the PHS Field attribute value is the same as what is contained in the packet to be suppressed.

### M.2.4.2 CmtsRepSess Object

This object describes the replication of IP Multicast sessions onto the different Downstream Channel Sets of a CMTS. Each DCS may be either a single downstream channel or a bonding group of multiple downstream channels. Each IP Multicast session is identified by a combination of IP source and IP Destination group address '(S,G)'. The CMTS replicates each IP packet in an (S,G) session onto one or more Downstream Channel Sets (DCSs), each of which is implemented in a MAC Domain. The CMTS assigns each replication a Downstream Service ID (DSID) that is unique per MAC Domain.

**Table M-12 - CmtsRepSess Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
PrefixAddrType	InetAddressType	key	ipv4(1) ipv6(2)	N/A	N/A
GrpPrefix	InetAddress	key		N/A	N/A
SrcPrefix	InetAddress	key		N/A	N/A
MdlfIndex	InterfaceIndex	key		N/A	N/A
DcsId	ChSetId	key		N/A	N/A

ServiceFlowId	unsignedInt	key	1..4294967295	N/A	N/A
Dsid	Dsid	read-only		N/A	N/A
Said	DocsSAid	read-only	1..16383	N/A	N/A

#### M.2.4.2.1 *PrefixAddrType*

This attribute defines the address type for the GrpPrefix and SrcPrefix addresses.

#### M.2.4.2.2 *GrpPrefix*

This attribute defines the group G of a particular (S,G) IP multicast session.

#### M.2.4.2.3 *SrcPrefix*

This attribute identifies a specific Multicast Source Address. A Source Address that is all zeros is defined as 'all source addresses (\*, G)'.

References: [RFC 3569] section 6; [RFC 3306] sections 5 and 6.

### M.2.4.3 *IpMulticastStats Object*<sup>255</sup>

This object contains statistics for the IP multicast session identified by the combination of IP source and IP destination group address (S,G).

**Table M-13 - IpMulticastStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Ethernet Interface(s)	N/A	N/A
GrpAddr	InetAddress	key		N/A	N/A
GrpPrefixLength	InetAddressPrefixLength	key		N/A	N/A
SrcAddr	InetAddress	key		N/A	N/A
SrcPrefixLength	InetAddressPrefixLength	key		N/A	N/A
DroppedPkts	Counter32	read-only		packets	N/A
DroppedOctets	Counter32	read-only		bytes	N/A

#### M.2.4.3.1 *IfIndex*

This attribute defines the Ethernet Interface index to which the (S,G) IP multicast session applies.

#### M.2.4.3.2 *GrpAddr*

This attribute defines 'G' as the group address for a particular (S,G) IP multicast session.

#### M.2.4.3.3 *GrpPrefixLength*

This attribute defines the group address prefix length of a particular (S,G) IP multicast session.

#### M.2.4.3.4 *SrcAddr*

This attribute defines 'S' as the source address for a particular (S,G) IP multicast session. For the case of Any Source Multicast (ASM), this attribute uses a value of 0.0.0.0 for IPv4 or 0::0 for IPv6.

#### M.2.4.3.5 *SrcPrefixLength*

This attribute defines the source address prefix length of a particular (S,G) IP multicast session.

<sup>255</sup> Section accepted per OSSIV3.0-14.1151-2 on 7/15/14 by PO.

<sup>255</sup> Section accepted per OSSIV3.0-14.1151-2 on 7/15/14 by PO.

**M.2.4.3.6 DroppedPkts**

This attribute returns a count of the packets dropped by the CMTS Forwarder process for a particular IP multicast session prior to replication to the outbound interface(s) (e.g., MAC domain interfaces). These packet drops can occur whenever there are no replications for this IP multicast session, or where an IP multicast packet for the specific S,G is not forwarded to the outbound interface(s).

**M.2.4.3.7 DroppedOctets**

This attribute returns a count of the octets for packets dropped by the CMTS Forwarder process for a particular IP multicast session prior to replication to the outbound interface(s).

**M.2.4.3.8 MdfIndex**

This attribute defines the MAC Domain Interface index of the channel to which the (S,G) session is replicated.

**M.2.4.3.9 DcsId**

This attribute provides the reference for the Downstream Channel within a MAC Domain that the multicast session (S,G) is replicated to.

**M.2.4.3.10 ServiceFlowId**

This attribute indicates the service flow into which packets are classified for this replication of the multicast session (S,G).

**M.2.4.3.11 Dsid**

This attribute defines the Downstream Service ID (DSID) label with which the CMTS labels all packets of the (S,G) session on the DCS of a MAC Domain. The DSID value is unique per MAC domain.

**M.2.4.3.12 Said**

This attribute defines the Security Association ID (SAID) of this multicast replication session. The value 0 indicates no SAID associated with this session.

**M.2.4.4 IpMulticastCpeList Object<sup>256</sup>**

This object contains CPE information for the IP multicast session identified by the combination of IP source and IP destination group address (S,G), MAC Domain interface and CM MAC address.

**Table M-14 - IpMulticastCpeList Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	MAC Domain interface(s)	N/A	N/A
GrpAddr	InetAddress	key		N/A	N/A
GrpPrefixLength	InetAddressPrefixLength	key		N/A	N/A
SrcAddr	InetAddress	key		N/A	N/A
SrcPrefixLength	InetAddressPrefixLength	key		N/A	N/A
CmMacAddr	MacAddress	key		N/A	N/A
Dsid	Dsid	read-only		N/A	N/A
CpeMacAddr	MacAddress	read-only		N/A	N/A
CpelpAddr	InetAddress	read-only		N/A	N/A

**M.2.4.4.1 IfIndex**

This attribute defines the MAC Domain Interface index to which the (S,G) IP multicast session applies.

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**M.2.4.4.2 *GrpAddr***

This attribute defines 'G' as the group address for a particular (S,G) IP multicast session.

**M.2.4.4.3 *GrpPrefixLength***

This attribute defines the group address prefix length of a particular (S,G) IP multicast session.

**M.2.4.4.4 *SrcAddr***

This attribute defines 'S' as the source address for a particular (S,G) IP multicast session. For the case of Any Source Multicast (ASM), this attribute uses a value of 0.0.0.0 for IPv4 or 0::0 for IPv6.

**M.2.4.4.5 *SrcPrefixLength***

This attribute defines the source address prefix length of a particular (S,G) IP multicast session.

**M.2.4.4.6 *CmMacAddr***

This attribute defines the CM MAC address of a particular (S,G) IP multicast session.

**M.2.4.4.7 *Dsid***

This attribute defines the Downstream Service ID (DSID) label with which the CMTS labels all packets of a particular (S,G) IP multicast session.

**M.2.4.4.8 *CpeMacAddr***

This attribute returns the CPE MAC address for the (S,G) IP multicast session.

**M.2.4.4.9 *CpelpAddr***

This attribute returns the CPE IP address for the (S,G) IP multicast session.

## Annex N CM and CMTS Status Reporting Requirements (Normative)<sup>257</sup>

### N.1 Overview

This Annex defines the management requirements of the operational status of both CM and CMTS.

### N.2 Object Definitions

This section defines the CM and CMTS configuration and reporting objects of the CM and CMTS operational status.

#### N.2.1 Type Definitions<sup>258</sup>

This section defines data types to represent information related to the CM registration process.

**Table N-1 - Data Type Definitions<sup>259</sup>**

Data Type Name	Base Type	Permitted Values
CmRegState	Enum	other(1) notReady(2) notSynchronized(3) phySynchronized(4) dsTopologyResolutionInProgress(21) usParametersAcquired(5) rangingInProgress(22) rangingComplete(6) eaeInProgress(14) dhcpv4InProgress(15) dhcpv6InProgress(16) dhcpV4Complete(7) dhcpV6Complete(17) todEstablished(8) securityEstablished(9) configFileDownloadComplete(10) registrationInProgress(18) registrationComplete(11) accessDenied(13) operational(12) bpInit(19) forwardingDisabled(20) rfMuteAll(23)

<sup>257</sup> Section revised per OSSIV3.0-N-08.0640 by KN on 4/24/08 by KN.

<sup>258</sup> Section revised per OSSIV3.0-N-07.0447-2 #1 on 5/10/07 by KN.

<sup>259</sup> Table revised per OSSIV3.0-N-07.0410-4, #1 on 5/8/07 by KN.

Data Type Name	Base Type	Permitted Values
CmtsCmRegState	Enum	other (1) initialRanging(2) rangingAutoAdjComplete (4) startEae (10) startDhcpV4 (11) startDhcpV6(12) dhcpV4Complete(5) dhcpV6Complete(13) startConfigFileDownload(14) configFileDownloadComplete(15) startRegistration(16) registrationComplete(6) operational (8) bpilInit (9) forwardingDisabled(17) rfMuteAll(18)
RangingState	Enum	other (1) aborted(2) retriesExceeded(3) success(4) continue(5) timeoutT4(6)
Tlv8	hexBinary	

### N.2.1.1 CmRegState<sup>260</sup>

This data type defines the CM connectivity state as reported by the CM.

References: [MULPI] Cable Modem - CMTS Interaction section.

The enumerated values associated with the CmRegState are:

- other  
'other' indicates any state not described below.
- notReady  
'notReady' indicates that the CM has not started the registration process yet.
- notSynchronized  
'notSynchronized' indicates that the CM has not initiated or completed the synchronization of the downstream physical layer
- phySynchronized  
'phySynchronized' indicates that the CM has completed the synchronization of the downstream physical layer
- dsTopologyResolutionInProgress  
'dsTopologyResolutionInProgress' indicates that the CM is attempting to determine its MD-DS-SG.

<sup>260</sup> Section revised per OSSIV3.0-N-07.0410-4, #2 on 5/8/07 by KN

- usParametersAcquired  
'usParametersAcquired' indicates that the CM has completed the upstream parameters acquisition or have completed the downstream and upstream service groups resolution, whether the CM is registering in a pre-3.0 or a 3.0 CMTS.
- rangingInProgress  
'rangingInProgress' indicates that the CM has initiated the initial ranging process.
- rangingComplete  
'rangingComplete' indicates that the CM has completed initial ranging and received a Ranging Status of success from the CMTS in the RNG-RSP message.
- eaeInProgress  
'eaeInProgress' indicates that the CM has sent an Auth Info message for EAE.
- dhcpv4InProgress  
'dhcpv4InProgress' indicates that the CM has sent a DHCPv4 DISCOVER to gain IP connectivity
- dhcpv6InProgress  
'dhcpv6InProgress' indicates that the CM has sent an DHCPv6 Solicit message.
- dhcpv4Complete  
'dhcpv4Complete' indicates that the CM has received a DHCPv4 ACK message from the CMTS.
- dhcpv6Complete  
'dhcpv6Complete' indicates that the CM has received a DHCPv6 Reply message from the CMTS.
- todEstablished  
'todEstablished' indicates that the CM has successfully acquired time of day. If the ToD is acquired after the CM is operational, this value SHOULD not be reported.
- securityEstablished  
'securityEstablished' indicates that the CM has successfully completed the BPI initialization process.
- configFileDownloadComplete  
'configFileDownloadComplete' indicates that the CM has completed the config file download process.
- registrationInProgress  
'registrationInProgress' indicates that the CM has sent a Registration Request (REG-REQ or REG-REQ-MP)
- registrationComplete  
'registrationComplete' indicates that the CM has successfully completed the Registration process with the CMTS.
- accessDenied  
'accessDenied' indicates that the CM has received a registration aborted notification from the CMTS.

- operational  
'operational' indicates that the CM has completed all necessary initialization steps and is operational.
- bpiInit  
'bpiInit' indicates that the CM has started the BPI initialization process as indicated in the CM config file. If the CM already performed EAE, this state is skipped by the CM.
- forwardingDisabled  
'forwardingDisabled' indicates that the registration process was completed, but the network access option in the received configuration file prohibits forwarding.
- rfMuteAll  
'rfMuteAll' indicates that the CM is instructed to mute all channels in the CM-CTRL-REQ message from CMTS.

The following table provides a mapping of Pre-3.0 DOCSIS and DOCSIS 3.0 registration states as reported by CM.

**Table N-2 - Pre-3.0 DOCSIS and DOCSIS 3.0 CM Registration status mapping<sup>261</sup>**

CM Pre-3.0 DOCSIS (from docslfCmStatusValue)	CM DOCSIS 3.0
other(1)	other(1)
notReady(2)	notReady(2)
notSynchronized(3)	notSynchronized(3)
phySynchronized(4)	phySynchronized(4)
	dsTopologyResolutionInProgress(21)
usParametersAcquired(5)	usParametersAcquired(5)
	rangingInProgress(22)
rangingComplete(6)	rangingComplete(6)
	eaeInProgress(14)
	dhcpv4InProgress(15)
	dhcpv6InProgress(16)
ipComplete(7)	dhcpv4Complete(7)
	dhcpv6Complete(17)
todEstablished(8)	todEstablished(8)
securityEstablished(9)	securityEstablished(9)
paramTransferComplete(10)	configFileDownloadComplete(10)
	registrationInProgress(18)
registrationComplete(11)	registrationComplete(11)
accessDenied(13)	accessDenied(13)
operational(12)	operational(12)
	bpiInit (19)
	forwardingDisabled(20)
	rfMuteAll(23)

**Note:** DOCSIS 3.0 introduces new CM registration states which are given higher enumeration values even though they are intermediate CM registration states.

<sup>261</sup> Table revised per OSSIV3.0-N-07.0410-4, #2 on 5/8/07 by KN.

### N.2.1.2 **CmtsCmRegState**<sup>262</sup>

This data type defines the CM connectivity states as reported by the CMTS.

References: [MULPI] Cable Modem - CMTS Interaction section.

The enumerated values associated with the CmtsCmRegState are:

- other  
'other' indicates any state not described below.
- initialRanging  
'initialRanging' indicates that the CMTS has received an Initial Ranging Request message from the CM, and the ranging process is not yet complete.
- rangingAutoAdjComplete  
'rangingAutoAdjComplete' indicates that the CM has completed initial ranging and the CMTS sends a Ranging Status of success in the RNG-RSP.
- startEae  
'startEae' indicates that the CMTS has received an Auth Info message for EAE from the CM.
- startDhcpv4  
'startDhcpv4' indicates that the CMTS has received a DHCPv4 DISCOVER message from the CM.
- startDhcpv6  
'startDhcpv6' indicates that the CMTS has received a DHCPv6 Solicit message from the CM.
- dhcpv4Complete  
'dhcpv4Complete' indicates that the CMTS has sent a DHCPv4 ACK message to the CM.
- dhcpv6Complete  
'dhcpv6Complete' indicates that the CMTS has sent a DHCPv6 Reply message to the CM.
- startConfigFileDownload  
'startConfigFileDownload' indicates that the CM has started the config file download. If the TFTP Proxy feature is not enabled, the CMTS may not report this state.
- configFileDownloadComplete  
'configFileDownloadComplete' indicates that the CM has completed the config file download process. If the TFTP Proxy feature is not enabled, the CMTS is not required to report this state.
- startRegistration  
'startRegistration' indicates that the CMTS has received a Registration Request (REG-REQ or REG-REQ-MP) from the CM.
- registrationComplete  
'registrationComplete' indicates that the CMTS has received a Registration Acknowledge (REG-ACK) with a confirmation code of okay/success.

<sup>262</sup> Section revised per OSSIV3.0-N-07.0410-4 on 5/8/07 by KN.

- operational  
'operational' indicates that the CM has completed all necessary initialization steps and is operational.
- bpiInit  
'bpiInit' indicates that the CMTS has received an Auth Info or Auth Request message as part of BPI Initialization.
- forwardingDisabled  
'forwardingDisabled' indicates that the CM registration process was completed, but the network access option in the received configuration file prohibits the CM from forwarding.
- rfMuteAll  
'rfMuteAll' indicates that the CM is instructed to mute all channels in the CM-CTRL-REQ message from CMTS.

The following table provides a mapping of Pre-3.0 DOCSIS and DOCSIS 3.0 registration states as reported by CMTS.

**Table N-3 - Pre-3.0 DOCSIS and DOCSIS 3.0 CMTS CM Registration status mapping**

Pre-3.0 DOCSIS (from docslfCmtsCmStatusValue)	DOCSIS 3.0
other (1)	other (1)
ranging (2)	initialRanging(2)
rangingAborted (3)	
rangingComplete (4)	rangingAutoAdjComplete (4)
	startEae (10)
	startDhcpv4 (11)
	startDhcpv6(12)
ipComplete(5)	dhcpv4Complete(5)
	dhcpv6Complete(13)
	startConfigFileDownload(14)
	configFileDownloadComplete(15)
	startRegistration(16)
registrationComplete (6)	registrationComplete(6)
accessDenied (7)	
operational (8)	operational (8)
registeredBPIInitialization (9)	bpiInit (9)
	forwardingDisabled(17)
	rfMuteAll(18)
<b>Note:</b> There are additional states introduced in DOCSIS 3.0. The new states are given a higher enumeration value though they are intermediate states in the CM registration states.	

### N.2.1.3 Tlv8

This data type represents a single TLV encoding. This first octet represents the Type of the TLV. The second octet represents an unsigned 8-bit Length of the subsequent Value part of the TLV. The remaining octets represent the value. The Value could be an atomic value or a sequence of one or more sub-TLVs.

References: [MULPI] Common Radio Frequency Interface Encodings Annex.

#### N.2.1.4 **RangingState**<sup>263</sup>

This data type defines the ranging status of the Upstream Channel.

References: [MULPI] Cable Modem - CMTS Interaction section.

The enumerated values associated with the RangingState are:

- Other
  - 'other' indicates any state not described below.
- Aborted
  - 'aborted' indicates that the CMTS has sent a ranging abort.
- retriesExceeded
  - 'retriesExceeded' indicates CM ranging retry limit has been exceeded.
- Success
  - 'success' indicates that the CMTS has sent a ranging success in the ranging response.
- Continue
  - 'continue' indicates that the CMTS has sent a ranging continue in the ranging response.
- timeoutT4
  - 'timeoutT4' indicates that the T4 timer expired on the CM.

#### N.2.2 CM Operational Status Objects<sup>264</sup>

This section defines the CM configuration and reporting of the CM operational status.

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<sup>263</sup> Section added per OSSIV3.0-N0-7.0410-4, #13 on 5/8/07 by KN.

<sup>264</sup> Section revised per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

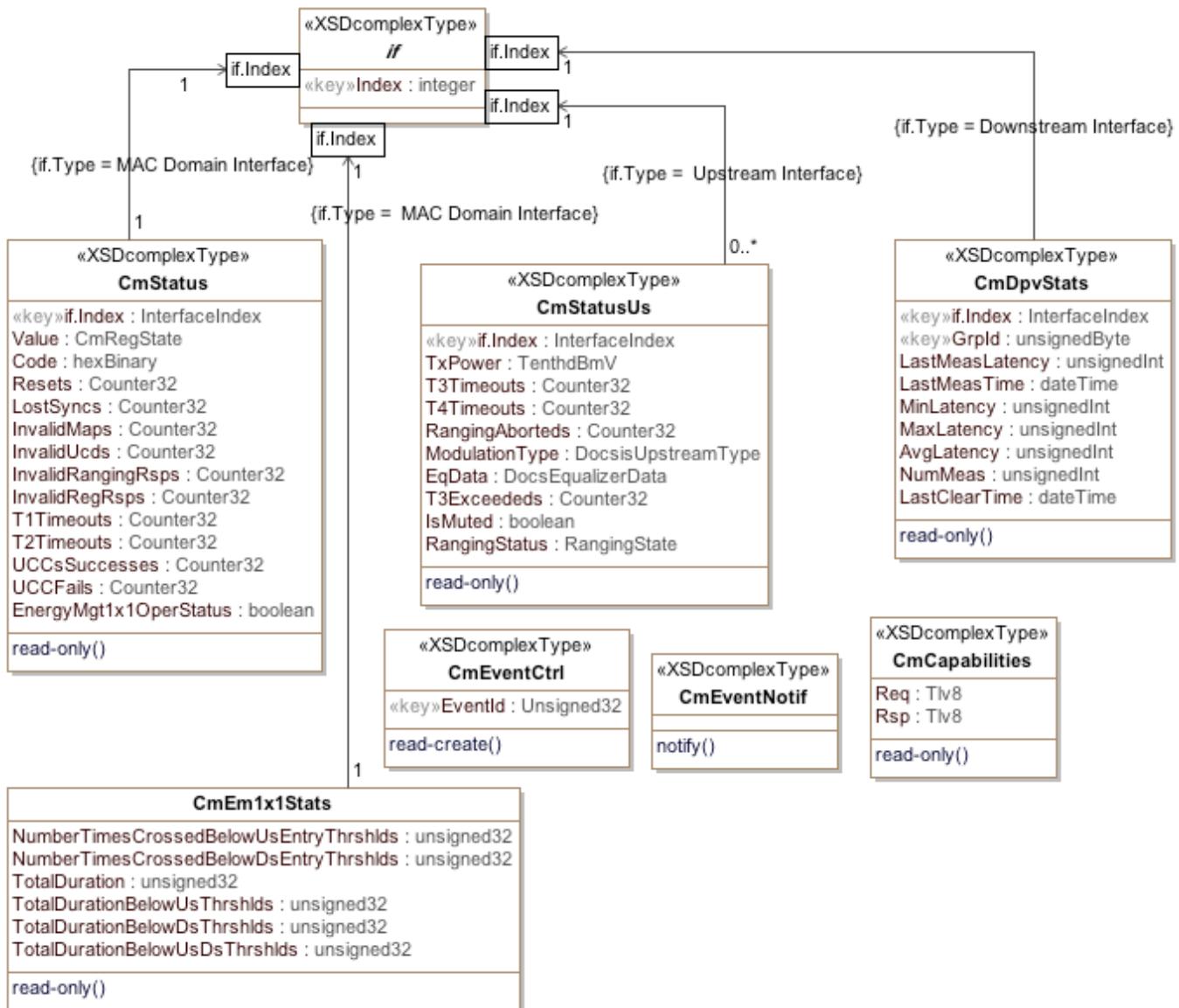


Figure N-1 - CM Operational Status Object Model Diagram<sup>265</sup>

### N.2.2.1 CmStatus Object

This object provides CM connectivity status information of the CM previously available in the SNMP table docsIfCmStatusTable.

References: [RFC 4546].

<sup>265</sup> Figure N-1 replaced per OSSIV3.0-N-07.0445-3 on 5/10/07 by KN and per OSSIV3.0-N-07-0554-4 by ab on 11/13/07. Figure replaced and caption revised per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN. Figure replaced per OSSIV3.0-N-12.1073-3 on 11/1/12 by PO, updated by OSSIV3.0-12.1083-5 on 3/19/13 by PO.

**Table N-4 - CmStatus Object<sup>266</sup>**

<b>Attribute Name</b>	<b>Type</b>	<b>Access</b>	<b>Type Constraints</b>	<b>Units</b>	<b>Default</b>
IfIndex	InterfaceIndex	key	Interface Index of the MAC interface	N/A	N/A
Value	CmRegState	read-only		N/A	N/A
Code	hexBinary	read-only	SIZE( 0   5   6 )	N/A	N/A
Resets	Counter32	read-only		resets	N/A
LostSyncs	Counter32	read-only		messages	N/A
InvalidMaps	Counter32	read-only		maps	N/A
InvalidUcds	Counter32	read-only		messages	N/A
InvalidRangingRsp	Counter32	read-only		messages	N/A
InvalidRegRsp	Counter32	read-only		messages	N/A
T1Timeouts	Counter32	read-only		timeouts	N/A
T2Timeouts	Counter32	read-only		timeouts	N/A
UccSuccesses	Counter32	read-only		attempts	N/A
UccFails	Counter32	read-only		attempts	N/A
EnergyMgt1x1OperStatus	boolean	read-only		N/A	N/A

#### *N.2.2.1.1 IfIndex*

This attribute denotes the MAC Domain interface index of the CM.

#### *N.2.2.1.2 Value*

This attribute denotes the current CM connectivity state. For the case of IP acquisition related states, this attribute reflects states for the current CM provisioning mode, not the other DHCP process associated with dual stack operation.

References: [MULPI] Establishing IP Connectivity section.

#### *N.2.2.1.3 Code*

This attribute denotes the status code for CM as defined in the OSSl Specification. The status code consists of a single character indicating error groups, followed by a two- or three-digit number indicating the status condition, followed by a decimal. An example of a returned value could be 'T101.0'. The zero-length hex string indicates no status code yet registered.

References: Annex D.

#### *N.2.2.1.4 Resets*

This attribute denotes the number of times the CM reset or initialized this interface. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.5 LostSyncs*

This attribute denotes the number of times the CM lost synchronization with the downstream channel. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

<sup>266</sup> Table modified by OSSlV3.0-N-12.1073-3 on 10/31/12 by PO.

#### *N.2.2.1.6 InvalidMaps*

This attribute denotes the number of times the CM received invalid MAP messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.7 InvalidUcds*

This attribute denotes the number of times the CM received invalid UCD messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.8 InvalidRangingRsps*

This attribute denotes the number of times the CM received invalid ranging response messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.9 InvalidRegRsps*

This attribute denotes the number of times the CM received invalid registration response messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

#### *N.2.2.1.10 T1Timeouts*

This attribute denotes the number of times counter T1 expired in the CM. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.11 T2Timeouts*

This attribute denotes the number of times counter T2 expired in the CM. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.12 UccSuccesses*

This attribute denotes the number of successful Upstream Channel Change transactions. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

#### *N.2.2.1.13 UccFails*

This attribute denotes the number of failed Upstream Channel Change transactions. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

References: [RFC 2863].

### N.2.2.1.14 *EnergyMgt1x1OperStatus*<sup>267</sup>

This attribute indicates whether the CM is currently operating in Energy Management 1x1 Mode. If this attribute returns true, the CM is operating in Energy Management 1x1 Mode.

References: [MULPI] Energy Management Mode Indicator section.

### N.2.2.2 *CmStatusUs Object*<sup>268</sup>

This object defines PHY and MAC information about the CM's upstream channels operating in Multiple Transmit Channel (MTC) mode or in a Pre-3.0 DOCSIS transmit channel mode. This object provides per-CM Upstream channel information previously available in the SNMP table docsIfCmStatusTable.

**Table N-5 - CmStatusUs Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of upstream interface	N/A	N/A
TxPower	TenthdBmV	read-only		TenthdBmV	N/A
T3Timeouts	Counter32	read-only		timeouts	N/A
T4Timeouts	Counter32	read-only		timeouts	N/A
RangingAborteds	Counter32	read-only		attempts	N/A
ModulationType	DocsisUpstreamType	read-only		N/A	N/A
EqData	DocsEqualizerData	read-only		N/A	N/A
T3Exceededs	Counter32	read-only		timeouts	N/A
IsMuted	boolean	read-only		N/A	N/A
RangingStatus	RangingState	read-only		N/A	N/A

#### N.2.2.2.1 *IfIndex*

This attribute denotes the interface index of the upstream interface to which this instance applies.

#### N.2.2.2.2 *TxPower*

This attribute demotes the operational CM transmit power for this upstream channel.

#### N.2.2.2.3 *T3Timeouts*

This attribute denotes the number of times counter T3 expired in the CM for this upstream channel. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

#### N.2.2.2.4 *T4Timeouts*

This attribute denotes the number of times counter T4 expired in the CM for this upstream channel. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

#### N.2.2.2.5 *RangingAborteds*

This attribute denotes the number of times the ranging process was aborted by the CMTS. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

<sup>267</sup> Section added per OSSIV3.0-N-12.1073-3 on 11/1/12 by PO.

<sup>268</sup> Section revised per OSSIV3.0-N-07.0410-4, #4 on 5/8/07 by KN.

**N.2.2.2.6 ModulationType**

This attribute denotes the modulation type status currently used by the CM for this upstream channel. Since this object specifically identifies PHY Layer mode, the shared upstream channel type 'tdmaAndAtdma' is not permitted.

References: [RFC 2863].

**N.2.2.2.7 EqData**

This attribute denotes the pre-equalization data for the specified upstream channel on this CM after convolution with data indicated in the RNG-RSP. This data is valid when docsIfUpChannelPreEqEnable is set to 'true'.

References: [RFC 4546].

**N.2.2.2.8 T3Exceededs**

This attribute denotes the number of times for excessive T3 timeouts. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

**N.2.2.2.9 IsMuted**

This attribute denotes whether the upstream channel is muted.

References: [MULPI] Media Access Control Specification section.

**N.2.2.2.10 RangingStatus**

This attribute denotes ranging status of this upstream channel.

References: [MULPI] Media Access Control Specification section.

**N.2.2.3 CmCapabilities Object**

This object defines attributes of the CM capabilities.

**Table N-6 - CmCapabilities Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Req	Tlv8	read-only		N/A	N/A
Rsp	Tlv8	read-only		N/A	N/A

**N.2.2.3.1 Req**

This attribute contains the TLV encoding for TLV-5 sent in a REG-REQ. The first byte of this encoding is expected to be '05'H.

References: [MULPI] Modem Capabilities Encoding section in the Common Radio Frequency Interface Encodings Annex.

**N.2.2.3.2 Rsp**

This attribute contains the TLV encoding for TLV-5 (see the Modem Capabilities Encoding section in Common Radio Frequency Interface Encodings Annex of [MULPI]) received in a REG-RSP. The first byte of this encoding is expected to be '05'H.

References: [MULPI] Modem Capabilities Encoding section in the Common Radio Frequency Interface Encodings Annex.

#### N.2.2.4 *CmDpvStats Object*<sup>269</sup>

This object represents the DOCSIS Path Verify Statistics collected in the cable modem device. The CMTS controls the logging of DPV statistics in the cable modem. Therefore the context and nature of the measurements are governed by the CMTS and not self-descriptive when read from the CM.

**Table N-7 - CmDpvStats Object<sup>270</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface index of downstream interface		N/A
GrpId	unsignedByte	key	1..2	N/A	N/A
LastMeasLatency	unsignedInt	read-only		nanoseconds	N/A
LastMeasTime	dateTime	read-only		NA	N/A
MinLatency	unsignedInt	read-only		nanoseconds	N/A
MaxLatency	unsignedInt	read-only		nanoseconds	N/A
AvgLatency	unsignedInt	read-only		nanoseconds	N/A
NumMeas	unsignedInt	read-only		nanoseconds	N/A
LastClearTime	dateTime	read-only		N/A	N/A

##### N.2.2.4.1 *ifIndex*

This key represents the interface Index of the Downstream Interface where the measurements are taken.

##### N.2.2.4.2 *GrpId*

This key represents the DPV Group ID. The CM reports two instance of DPV statistics per downstream normally referred as Statistical Group 1 and Statistical Group 2.

##### N.2.2.4.3 *LastMeasLatency*

This attribute represents the last latency measurement for this statistical group.

##### N.2.2.4.4 *LastMeasTime*

This attribute represents the last measurement time of the last latency measurement for this statistical group. This attribute reports the EPOC time value when no measurements are being reported or after the statistics were cleared.

##### N.2.2.4.5 *MinLatency*

This attribute represents the minimum latency measurement for this statistical group since the last time statistics were cleared.

##### N.2.2.4.6 *MaxLatency*

This attribute represents the maximum latency measurement for this statistical group since the last time statistics were cleared.

##### N.2.2.4.7 *AvgLatency*

This attribute represents the average latency measurement for this statistical group since the last time statistics were cleared. The averaging mechanism is controlled by the CMTS

References: [MULPI] DPV Math section

##### N.2.2.4.8 *NumMeas*

This attribute represents the number of latency measurements made for this statistical group since the last time statistics were cleared.

<sup>269</sup> Section added per OSSIV3.0-N-07.0554-4 by ab on 11/13/07.

<sup>270</sup> Caption added per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

#### N.2.2.4.9 *LastClearTime*

This attribute represents the last time statistics were cleared for this statistical group, otherwise this attribute reports the EPOC time value.

#### N.2.2.5 *CmEventCtrl Object*<sup>271</sup>

This object represents the control mechanism to enable the dispatching of events based on the event Id. The following rules define the event control behavior:

- The CmEventCtrl object has no instances or contains an instance with Event ID 0.  
All events matching the Local Log settings of docsDevEvReporting are sent to local log ONLY.
- Additionally, if  
The CmEventCtrl object contains configured instances with non-zero Event IDs.  
Events matching the Event Ids configured in the object are sent according to the settings of the docsDevEvReporting object; i.e., Traps, Syslog, etc.

The CM MUST NOT persist instances of CmEventCtrl across reinitializations.

**Table N-8 - CmEventCtrl Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
EventId	unsignedInt	key		N/A	

#### N.2.2.5.1 *EventId*

This key represents the Event ID of the event being enabled for delivery to a dispatch mechanism (e.g., syslog).

References: Annex D.

#### N.2.2.6 *CM Event Notification Object*<sup>272</sup>

This object represents the abstract definition of an event object for the CM. The realization of the event object depend of the management protocol that carries the event. For example, the object event realization as a SNMP notification is defined in Annex Q.6.

#### N.2.2.7 *CmEm1x1Stats Object*<sup>273</sup>

This object defines Energy Management 1x1 mode statistics on the CM to provide insight into configuration of appropriate EM 1x1 Mode Activity Detection thresholds and/or to get feedback on how/if the current thresholds are working well or are causing user experience issues. These statistics are only applicable/valid when the Energy Management 1x1 mode is enabled in the CM.

**Table N-9 - CmEm1x1Stats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
NumberTimesCrossedBelowUsEntryThrshlds	unsignedInt	read-only		N/A	N/A
NumberTimesCrossedBelowDsEntryThrshlds	unsignedInt	read-only		N/A	N/A
TotalDuration	unsignedInt	read-only		seconds	N/A
TotalDurationBelowUsThrshlds	unsignedInt	read-only		seconds	N/A
TotalDurationBelowDsThrshlds	unsignedInt	read-only		seconds	N/A
TotalDurationBelowUsDsThrshlds	unsignedInt	read-only		seconds	N/A

<sup>271</sup> Section added per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN and per OSSIV3.0-N-09.0871-4 on 1/5/10 by JB.

<sup>272</sup> Section added per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

<sup>273</sup> Section added per OSSIV3.0-N-12.1083-5 on 3/19/13 by PO.

**N.2.2.7.1 *NumberTimesCrossedBelowUsEntryThrshlds***

This attribute indicates the number of times since registration the CM crossed below the upstream entry bitrate threshold for a number of consecutive seconds equal to or exceeding the upstream entry time threshold.

**N.2.2.7.2 *NumberTimesCrossedBelowDsEntryThrshlds***

This attribute indicates the number of times since registration the CM crossed below the downstream entry bitrate threshold for a number of consecutive seconds equal to or exceeding the downstream entry time threshold.

**N.2.2.7.3 *TotalDuration***

This attribute indicates the total time duration, in seconds since registration, the CM has been in Energy Management 1x1 mode, as controlled by the DBC-REQ Energy Management 1x1 Mode Indicator TLV. This attribute differs from TotalDurationBelowUsDsThrshlds because it is dependent on effects of the Energy Management Cycle Period, and processing of EM-REQ/EM-RSP messages and DBC messages that specifically indicate entry into or exit from Energy Management 1x1 mode.

**N.2.2.7.4 *TotalDurationBelowUsThrshlds***

This attribute indicates the total time duration, in seconds since registration, the CM satisfied upstream conditions for entry into or remaining in Energy Management 1x1 mode.

**N.2.2.7.5 *TotalDurationBelowDsThrshlds***

This attribute indicates the total time duration, in seconds since registration, the CM satisfied downstream conditions for entry into or remaining in Energy Management 1x1 mode.

**N.2.2.7.6 *TotalDurationBelowUsDsThrshlds***

This attribute indicates the total time duration, in seconds since registration, the CM, with respect to both upstream and downstream entry and exit thresholds, satisfied conditions for entry into and remaining in Energy Management 1x1 mode. This attribute differs from TotalDuration because it is not dependent on effects of the Energy Management Cycle Period or processing of EM-REQ/EM-RSP messages and DBC messages that specifically indicate entry into or exit from Energy Management 1x1 mode.

### N.2.3 CMTS Operational Status Objects<sup>274</sup>

This section defines CMTS configuration and reporting of the operational status of the CMTS and CM as perceived by the CMTS.

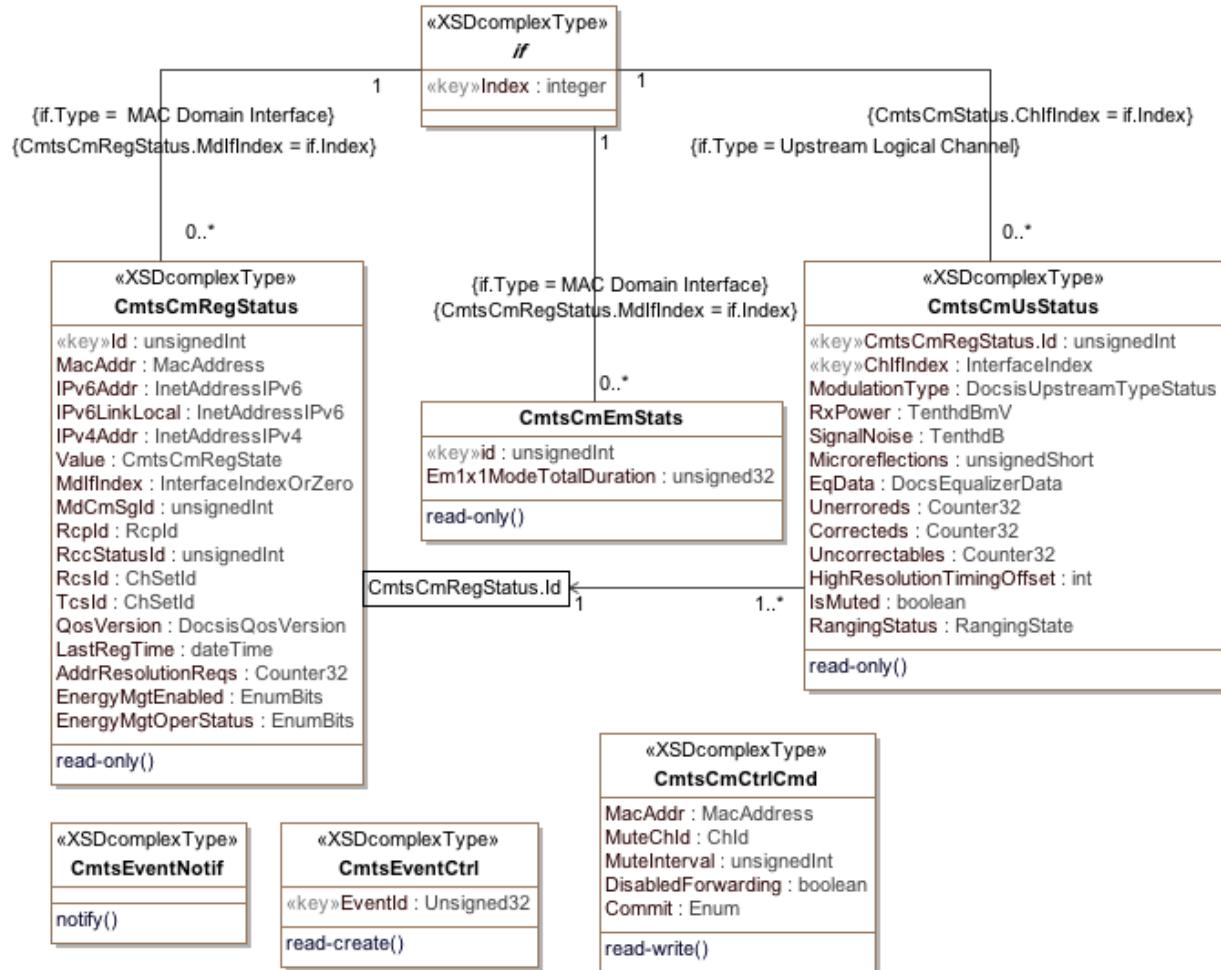


Figure N-2 - CMTS Operational Status Object Model Diagram<sup>275</sup>

<sup>274</sup> Section revised per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

<sup>275</sup> Figure N-2 replaced per OSSIV3.0-N-07.0445-3 on 5/10/07 and replaced again per OSSIV3.0-N-08.0616-2 on 4/10/08 by KN. Figure replaced and caption revised per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN, OSSIV3.0-12.1073-3 on 10/29/12 by PO, replaced per OSSIV3.0-12.1083-5 on 3/19/13 by PO.

### N.2.3.1 *CmtsCmRegStatus Object*<sup>276</sup>

This object defines attributes that represent the CM's registration status as tracked by the CMTS.

**Table N-10 - CmtsCmRegStatus Object<sup>277</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
MacAddr	MacAddress	read-only		N/A	N/A
Ipv6Addr	InetAddressIPv6	read-only		N/A	N/A
Ipv6LinkLocal	InetAddressIPv6	read-only		N/A	N/A
Ipv4Addr	InetAddressIPv4	read-only		N/A	N/A
Value	CmtsCmRegState	read-only		N/A	N/A
MdIfIndex	InterfaceIndexOrZero	read-only		N/A	N/A
MdCmSgId	unsignedInt	read-only		N/A	N/A
RcpId	RcpId	read-only		N/A	N/A
RccStatusId	unsignedInt	read-only		N/A	N/A
RcsId	ChSetId	read-only		N/A	N/A
TcsId	ChSetId	read-only		N/A	N/A
QosVersion	DocsisQosVersion	read-only		N/A	N/A
LastRegTime	dateTime	read-only		N/A	N/A
AddrResolutionReqs	Counter32	read-only		N/A	N/A
EnergyMgtEnabled	EnumBits	read-only	em1x1Mode(0)	N/A	N/A
EnergyMgtOperStatus	EnumBits	read-only	em1x1Mode(0)	N/A	N/A

#### N.2.3.1.1 *Id*

This attribute uniquely identifies a CM. The CMTS MUST assign a single id value for each CM MAC address seen by the CMTS. The CMTS SHOULD ensure that the association between an Id and MAC Address remains constant during CMTS uptime.

#### N.2.3.1.2 *MacAddr*

This attribute demotes the MAC address of the CM. If the CM has multiple MAC addresses, this is the MAC address associated with the MAC Domain interface.

#### N.2.3.1.3 *Ipv6Addr*

This attribute denotes the IPv6 address of the CM. If the CM has no Internet address assigned, or the Internet address is unknown, the value of this attribute is the all zeros address.

#### N.2.3.1.4 *Ipv6LinkLocal*

This attribute denotes the IPv6 local scope address of the CM.

#### N.2.3.1.5 *Ipv4Addr*

This attribute demotes the IPv4 address of the CM. If the CM has no IP address assigned, or the IP address is unknown, this object returns 0.0.0.0.

#### N.2.3.1.6 *Value*

This attribute denotes the current CM connectivity state.

References: [MULPI] Cable Modem Initialization and Reinitialization section.

<sup>276</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 by KN.

<sup>277</sup> Table modified per OSSIV3.0-N-08.0616-2 on 4/10/08 by KN, and OSSIV3.0-N-12.1073-3 on 10/29/12 by PO.

#### N.2.3.1.7 *MdlfIndex*

This attribute denotes the interface Index of the CMTS MAC Domain where the CM is active. If the interface is unknown, the CMTS returns a value of zero.

#### N.2.3.1.8 *MdCmSgId*

This attribute denotes the ID of the MAC Domain CM Service Group Id (MD-CM-SG-ID) in which the CM is registered. If the ID is unknown, the CMTS returns a value of zero.

References: [MULPI] Cable Modem Service Group (CM-SG) section.

#### N.2.3.1.9 *RcpId*

This attribute denotes the RCP-ID associated with the CM. If the RCP-ID is unknown the CMTS returns a five octet long string of zeros.

References: [MULPI] RCP-ID section in the Common Radio Frequency Interface Encodings Annex.

#### N.2.3.1.10 *RccStatusId*

This attribute denotes the RCC Id the CMTS used to configure the CM receive channel set during the registration process. If unknown, the CMTS returns the value zero.

#### N.2.3.1.11 *RcsId*

This attribute denotes the Receive Channel Set (RCS) that the CM is currently using. If the RCS is unknown, the CMTS returns the value zero.

References: [MULPI] Cable Modem Physical Receive Channel Configuration section and the Receive Channels section in the Common Radio Frequency Interface Encodings Annex.

#### N.2.3.1.12 *TcsId*

This attribute denotes Transmit Channel Set (TCS) the CM is currently using. If the TCS is unknown, the CMTS returns the value zero.

References: [MULPI] Changes to the Transmit Channel Set section.

#### N.2.3.1.13 *QosVersion*<sup>278</sup>

This attribute denotes the queuing services the CM registered, either DOCSIS 1.1 QoS or DOCSIS 1.0 CoS mode.

#### N.2.3.1.14 *LastRegTime*

This attribute denotes the last time the CM registered.

#### N.2.3.1.15 *AddrResolutionReqs*

This attribute denotes the number of upstream packets received on the SIDs assigned to a CM that are any of the following:

- Upstream IPv4 ARP Requests
- Upstream IPv6 Neighbor Solicitation Requests
- (For Routing CMTSs) Upstream IPv4 or IPv6 packets to unresolved destinations in locally connected downstream in the HFC.

Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated MAC Domain interface.

References: [SEC] Secure Provisioning section; [RFC 2863].

<sup>278</sup> Section modified per OSSIV3.0-N-08.0613-1 on 4/10/08 by KN.

### N.2.3.1.16 *EnergyMgtEnabled*<sup>279</sup>

This attribute indicates which, if any, of the Energy Management Features are enabled for this CM. If this attribute returns em1x1Mode(0) bit set, the CM is configured with the Energy Management 1x1 Feature enabled. If this attribute returns all bits cleared, the CM will not request to operate in any Energy Management mode of operation.

**Note:** This attribute only indicates if an Energy Management Feature is enabled/disabled via the CM config file and registration request/response exchange and does not indicate whether the CM is actively operating in an Energy Management Mode.

References: [MULPI] Energy Management Features section.

### N.2.3.1.17 *EnergyMgtOperStatus*

This attribute indicates whether the CM is currently operating in an Energy Management Mode. If this attribute returns em1x1Mode(0) bit set, the CM is operating in Energy Management 1x1 Mode. If this attribute returns all bits cleared, the CM is not operating in any Energy Management Mode. This attribute always returns 0x00 (no bits set) in the case when EnergyMgtEnabled is set to 0x00 (no Energy Management Features enabled).

References: [MULPI] Energy Management 1x1 Mode Indicator section.

## N.2.3.2 *CmtsCmUsStatus Object*<sup>280</sup>

This object defines status information of the CM currently in use by Upstream Logical Channels, as reported by the CMTS.

**Table N-11 - CmtsCmUsStatus Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
ChIfIndex	InterfaceIndex	key		N/A	N/A
ModulationType	DocsisUpstreamType	read-only		N/A	N/A
RxPower	TenthdBmV	read-only		TenthdBmV	N/A
SignalNoise	TenthdB	read-only		TenthdB	N/A
Microreflections	unsignedShort	read-only		-dBc	N/A
EqData	DocsEqualizerData	read-only		N/A	N/A
Unerroreds	Counter32	read-only		N/A	N/A
Correcteds	Counter32	read-only		N/A	N/A
Uncorrectables	Counter32	read-only		N/A	N/A
HighResolutionTimingOffset	int	read-only		time tick/(64*256)	N/A
IsMuted	boolean	read-only		N/A	N/A
RangingStatus	RangingState	read-only		N/A	N/A

### N.2.3.2.1 *Id*

This attribute represents the CMTS assigned Id to the CM in the CmtsCmRegStatus object.

### N.2.3.2.2 *ChIfIndex*

This attribute represents an upstream logical interface. The CMTS instantiates each one of the channels in the current Transmit Channel Set of the CM in this object.

### N.2.3.2.3 *ModulationType*

This attribute represents the modulation type currently used by this upstream channel.

<sup>279</sup> Section added per OSSIV3.0-N-12.1073-3 on 10/29/12 by PO.

<sup>280</sup> Section revised per OSSIV3.0-N-07.0410-4 # 5 on 5/8/07 by KN, and per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

#### N.2.3.2.4 *RxPower*

This attribute represents the receive power of this upstream channel.

#### N.2.3.2.5 *SignalNoise*

This attribute represents Signal/Noise ratio as perceived for upstream data from the CM on this upstream channel.

#### N.2.3.2.6 *Microreflections*

This attribute represents microreflections received on this upstream channel.

#### N.2.3.2.7 *EqData*

This attribute represents the equalization data for the CM on this upstream channel.

#### N.2.3.2.8 *Unerroreds*

This attribute represents the codewords received without error from the CM on this upstream channel.

Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

#### N.2.3.2.9 *Correcteds*

This attribute represents the codewords received with correctable errors from the CM on this upstream channel.

Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

#### N.2.3.2.10 *Uncorrectables*

This attribute represents the codewords received with uncorrectable errors from the CM on this upstream channel.

Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated upstream channel.

References: [RFC 2863].

#### N.2.3.2.11 *HighResolutionTimingOffset*

This attribute represents the current measured round trip time on this CM's upstream channel in units of (6.25 microseconds/(64\*256)). This attribute returns zero if the value is unknown.

#### N.2.3.2.12 *IsMuted*

This attribute has a value 'true' to indicate that the CM's upstream channel has been muted via CM-CTRL-REQ/CM-CTRL-RSP message exchange.

References: [MULPI] Media Access Control Specification section.

#### N.2.3.2.13 *RangingStatus*

This attribute denotes ranging status of the CM on this upstream channel as reported by the CMTS.

References: [MULPI] Media Access Control Specification section.

### N.2.3.3 *CMTS CM Control Object*<sup>281</sup>

This section defines the CMTS CM Control Command object.

#### N.2.3.4 *CmtsEventCtrl Object*<sup>282</sup>

This object represents the control mechanism to enable the dispatching of events based on the event Id. The following rules define the event control behavior:

<sup>281</sup> Section added per OSSIV3.0-N-07.0413-3, #1 on 5/11/07 by KN. Level of Heading lowered per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

<sup>282</sup> Section added per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN and per OSSIV3.0-N-09.0871-4 on 1/5/10 by JB.

- The CmtsEventCtrl object has no instances or contains an instance with Event ID 0.  
All events matching the Local Log settings of docsDevEvReporting are sent to local log ONLY.
- Additionally, if  
The CmtsEventCtrl object contains configured instances.  
Events matching the Event Ids configured in the object are sent according to the settings of the docsDevEvReporting object; i.e., Traps, Syslog, etc.

The CMTS MUST persist all instances of CmtsEventCtrl across reinitializations.

**Table N-12 - CmtsEventCtrl Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
EventId	unsignedInt	key		N/A	

#### N.2.3.4.1 EventId

This key represents the Event ID of the event being enabled for delivery to a dispatch mechanism (e.g., syslog).

References: Annex D.

#### N.2.3.5 CMTS Event Notification Object<sup>283</sup>

This object represents the abstract definition of an event object for the CMTS. The realization of the event object depend of the management protocol that carries the event. For example, the object event realization as a SNMP notification is defined in Annex Q.6.

#### N.2.3.6 CmtsCmCtrlCmd Object

The CMTS CM Control Command object allows an operator to trigger the CMTS to send a CM-CTRL-REQ message to the specified CM with specific parameters.

The CMTS is not required to persist the values of the attributes of the CmtsCmCtrlCmd object across reinitializations.

References: [MULPI] Media Access Control Specification section.

**Table N-13 - CmtsCmCtrlCmd Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
MacAddr	MacAddress	read-write		N/A	'000000000000'H
MuteUsChld	Chld	read-write		N/A	0
MuteInterval	unsignedInt	read-write		milliseconds	0
DisableForwarding	boolean	read-write		N/A	false
Commit	Enum	read-write	mute(1) cmReinit(2) disableForwarding(3)	N/A	'mute'

#### N.2.3.6.1 MacAddr

This attribute represents the MAC Address of the CM which the CMTS is instructed to send the CM-CTRL-REQ message.

#### N.2.3.6.2 MuteUsChld

This attribute represents the Upstream Channel ID (UCID) to mute or unmute. A value of zero indicates all upstream channels. This attribute is only applicable when the Commit attribute is set to 'mute'.

<sup>283</sup> Section added per OSSIV3.0-N-08.0640-4 on 4/24/08 by KN.

#### N.2.3.6.3 *MuteInterval*

This attribute represents the length of time that the mute operation is in effect. This attribute is only applicable when the Commit attribute is set to 'mute'. A value of 0 is an indication to unmute the channel referenced by the MuteUsChId attribute while a value of 0xFFFFFFFF is used to mute the channel referenced by the MuteUsChId attribute indefinitely.

#### N.2.3.6.4 *DisableForwarding*

When set to 'true', this attribute disables data forwarding to the CMCI ports when the Commit attribute is set to 'disableForwarding'. When set to 'false', this attribute enables data forwarding to the CMCI ports when the Commit attribute is set to 'disableForwarding'. This attribute is only applicable when the Commit attribute is set to 'disableForwarding'.

#### N.2.3.6.5 *Commit*

This attribute indicates the type of command for the CMTS to trigger in the CM-CTRL-REQ message. This attribute will return the value of the last operation performed or the default if no operation has been performed.

#### N.2.3.7 *CmtsCmEmStats Object*<sup>284</sup>

This object defines Energy Management mode statistics for the CM as reported by the CMTS. For example, such metrics can provide insight into configuration of appropriate EM 1x1 Mode Activity Detection thresholds on the CM and/or to get feedback on how/if the current thresholds are working well or are causing user experience issues.

**Table N-14 - CmtsCmEmStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Id	unsignedInt	key	1..4294967295	N/A	N/A
Em1x1ModeTotalDuration	unsignedInt	read-only		seconds	N/A

##### N.2.3.7.1 *Id*

This key represents the CMTS assigned Id to the CM in the CmtsCmRegStatus object.

##### N.2.3.7.2 *Em1x1ModeTotalDuration*

This attribute indicates the total time duration, in seconds since registration, the CM identified by Id has been in Energy Management 1x1 mode, as controlled by the DBC-REQ Energy Management 1x1 Mode Indicator TLV.

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<sup>284</sup> Section added per OSSIV3.0-N-12.1083-5 on 3/20/13 by PO.

## Annex O Media Access Control (MAC) Requirements (Normative)

### O.1 Overview

This Annex defines management object extensions for Media Access Control (MAC) information, including DOCSIS interface configuration, RF Topology, Channel Bonding, QOS, and related extensions.

#### O.1.1 Cable Modem Service Groups (CM-SGs)

The HFC RF combining and splitting topology between a CMTS and Cable Modems results in distinct sets of CMs called Cable Modem Service Groups (CM-SGs) that are served by distinct combinations (i.e., non-overlapping subsets) of Downstream Channels and Upstream Channels. Because a MAC Domain defines a separate number space for many DOCSIS protocol elements (e.g., DSIDs, SAIDs, etc), an operator should define separate MAC Domains that serve disjoint subsets of CM-SGs rather than a single MAC Domain for all CM-SGs.

#### O.1.2 Downstream Bonding Group (DBG)

A Downstream Bonding Group (DBG) is a set of Downstream Channels (DCs) on which the CMTS distributes packets. The CMTS enforces that all Downstream Channels of a DBG are contained within the same MAC Domain Downstream Service Group (MD-DS-SG). A CMTS permits configuration of a Downstream Channel as a member of multiple DBGs. A CMTS can restrict the assignment of Downstream Channels to DBGs based on vendor product implementation. For example, a CMTS product implementation may restrict the set of Downstream Channels that could be bonded to a given Bonded Channel Set to a subset of the downstream channels in the MAC Domain.

#### O.1.3 Upstream Bonding Group (UBG)

An Upstream Bonding Group (UBG) is a set of Upstream Channels (UCs) on which upstream data forwarding service may be provided to a single CM. All Upstream Channels in an Upstream Bonding Group must be contained within the same MAC Domain Upstream Service Group (MD-US-SG). A CMTS permits configuration of an Upstream Channel as a member of multiple UBGs. A CMTS can restricts the assignment of Upstream Channels to UBGs based on vendor product implementation. For example, a CMTS product implementation could restrict the set of Upstream Channels that could be bonded to a subset of the downstream channels in the MAC Domain.

### O.2 Object Definitions

This section defines the MAC objects including the associated attributes.

The CMTS object model contains several read-create objects that contain references to other read-create objects. For example, ChFnCfg object contains a NodeName attribute that references an instance of the FiberNodeCfg object. The CMTS is not required to implement dangling references, i.e., allow an object to contain a reference to another object instance that does not yet exist. This could require an operator to create and delete object instances in an order to avoid dangling references. For example, a FiberNodeCfg object might need to be instantiated before a ChFnCfg object is instantiated that references it. Likewise, a ChFnCfg object instance that references a NodeName might need to be deleted before the FiberNodeCfg object instance for that NodeName is deleted.

#### O.2.1 Type Definitions<sup>285</sup>

This section defines data types used in the object definitions for the Diagnostic Log object model.

**Table O-1 - Data Type Definitions<sup>286</sup>**

Data Type Name	Base Type	Permitted Values
NodeName	string	SIZE(0..64)
Chld	unsignedByte	0..255
ChSetId	unsignedInt	0..4294967295
ChannelList	hexBinary	SIZE(0..255)

<sup>285</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

<sup>286</sup> Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

Data Type Name	Base Type	Permitted Values
AttributeMask	EnumBits	bonded(0) lowLatency(1) highAvailability(2)
AttrAggrRuleMask	hexBinary	SIZE (4)
RcpId	hexBinary	SIZE (5)
Dsid	unsignedInt	0..1048575
ScdmaSelectionString	hexBinary	SIZE (0   16)
IfDirection	Enum	downstream (1) upstream (2)
BitRate	unsignedInt	0..4294967295
SchedulingType	Enum	undefined (1) bestEffort (2) nonRealTimePollingService (3) realTimePollingService (4) unsolicitedGrantServiceWithAD (5) unsolicitedGrantService (6)

#### O.2.1.1 **NodeName**

This data type is a human readable string that represents the name of a fiber node. Internationalization is supported by conforming to the SNMP textual convention SnmpAdminString. The US-ASCII control characters (0x00 – 0x1F), the DEL character (0x7F), and the double-quote mark (0x22) are prohibited within the syntax of this data type.<sup>287</sup>

References: [RFC 3411].

#### O.2.1.2 **ChId**

This data type is an 8-bit number that represents a provisioned Downstream Channel ID (DCID) or a provisioned Upstream Channel ID (UCID). A Channel Id is unique per direction within a MAC Domain. The value zero is reserved for use when the channel ID is unknown.

References: [MULPI] Upstream Channel Descriptor (UCD) section.

#### O.2.1.3 **ChSetId**

This data type is a CMTS-derived unique number within a MAC Domain used to reference a Channel Set within the CMTS. Values in the range of 1 to 255 define a single-channel Channel Set and correspond to either the Downstream Channel ID (DCID) or an Upstream Channel ID (UCID) of that channel. Values greater than 255 indicate a Channel Set consisting of two or more channels in the same direction within the MAC Domain. The value zero is reserved for use when the Channel Set is unknown.

References: [MULPI] Channel Bonding section.

#### O.2.1.4 **ChannelList**

This data type represents a unique set of channel IDs in either the upstream or the downstream direction. Each octet represents a UCID or DCID depending on the direction of the channels within the list. The CMTS MUST ensure that this combination of channels is unique per direction within the MAC Domain.

A query to retrieve the value of an attribute of this type, returns the set of channels in the channel list in ascending order of Channel Ids.

<sup>287</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

### **O.2.1.5    *AttributeMask***

This data type consists of a sequence of 32-bit positions used to select the bonding group or the channel to which a service flow is assigned. DOCSIS defines three types of Attribute Masks for which this type applies: The Provisioned Attribute Mask that is configured to a Bonding Group or a single-channel, whereas the Required Attribute and the Forbidden Attribute Mask are part of the Service Flow QOS Parameter Set to be matched with the Provisioned Attribute Mask of CMTS-configured Bonding Groups or single-channels. DOCSIS reserves the assignment of the meaning of the first 8 bit positions (left to right) as follows:

Bit 0: 'bonding'

Bit 1: 'lowLatency'

Bit 2: 'highAvailability'

Bit positions 3-15 are reserved.

Bit positions 16-31 are freely assigned by operators to represent their own constraints on the channel(s) selection for a particular service flow.

References: [MULPI] Service Flow Assignment section.

### **O.2.1.6    *AttrAggrRuleMask***

This data type represents a sequence of 32-bit positions that defines logical (e.g., AND, OR) operations to match against the channel list Provisioned Mask and Service Flow Required Mask bit positions when the CMTS is determining the service flow for assignment to a bonding group not configured by the management system.

References: [MULPI] Service Flow Assignment section.

### **O.2.1.7    *RcpId***

This data type defines a 'Receive Channel Profile Identifier' (RCP-ID). An RCP-ID consists of 5-octet length string where the first 3-bytes (from left to right corresponds to the Organizational Unique ID (OUI) followed by a two-byte vendor-maintained identifier to represent multiple versions or models of RCP-IDs.

References: [MULPI] RCP-ID section in the Common Radio Frequency Interface Encodings Annex.

### **O.2.1.8    *Dsid*<sup>288</sup>**

This data type defines the 20-bit Downstream Service Identifier used by the CM for downstream resequencing, filtering, and forwarding. The value zero is reserved for use when the DSID is unknown or does not apply.

References: [MULPI] DSID Definition section.

### **O.2.1.9    *ScdmaSelectionString***

This data type represents the S-CDMA selection string for active codes used with Selectable Active Codes Mode 2.

A 128-bit string indicating which codes are active. The first element in the string corresponds to code 0 (the all-ones code), and the last element in the string corresponds to code 127. A '1' element in the string indicates an active code, and a '0' indicates an unused code. A zero-length string is returned for an unknown or non-applicable value.<sup>289</sup>

References: [PHY] Mini-slot Numbering Parameters in UCD section.

### **O.2.1.10    *IfDirection***

Indicates a direction on an RF MAC interface. The value downstream(1) is from Cable Modem Termination System to Cable Modem. The value upstream(2) is from Cable Modem to Cable Modem Termination System.

Valid enumerations for the data type are:

- downstream(1)
- upstream(2)

<sup>288</sup> Revised per OSSlv3.0-N-07.0551-4 by ab on 11/12/07.

<sup>289</sup> Revised per OSSlv3.0-N-08.0700-4 by JS on 1/12/09.

Reference: [MULPI] Terms and Definitions section.

### O.2.1.11 BitRate

The rate of traffic in units of bits per second. Used to specify traffic rate for QoS.

### O.2.1.12 SchedulingType

The scheduling service provided by a CMTS for an upstream Service Flow. This parameter must be reported as 'undefined' for downstream QoS Parameter Sets.

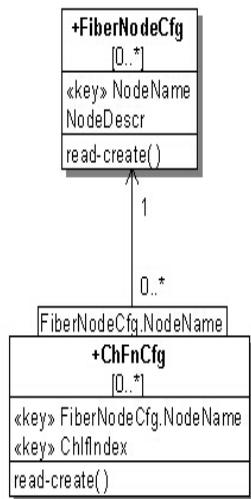
Valid enumerations for the data type are:

- undefined(1)
- bestEffort(2)
- nonRealTimePollingService(3)
- realTimePollingService(4)
- unsolicited GrantServiceWithAD(5)
- unsolicitedGrantService(6)

Reference: [MULPI] Service Flow Scheduling Type section.

## O.2.2 Fiber Node Topology Objects

This section defines the Fiber Node topology related objects.



**Figure O-1 - Fiber Node Topology Object Model Diagram**

### O.2.2.1 FiberNodeCfg Object

This object defines the cable HFC plant Fiber Nodes known at a CMTS.

This object supports the creation and deletion of multiple instances.

The CMTS MUST persist all instances of FiberNodeCfg across reinitializations.

**Table O-2 - FiberNodeCfg Object<sup>290</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
NodeName	NodeName	key	SIZE (1..64)	N/A	
NodeDescr	AdminString	read-create		N/A	"H

#### O.2.2.1.1 *NodeName*

This key represents a human-readable name for a fiber node.

References: [MULPI] RF Topology Configuration section.

#### O.2.2.1.2 *NodeDescription*

This attribute represents a human-readable description of the node.

### O.2.2.2 *ChFnCfg Object*

This object defines the RF topology by defining the connectivity of a CMTS's downstream and upstream channels to the fiber nodes. Each instance of this object describes connectivity of one downstream or upstream channel with a single fiber node.

This object supports the creation and deletion of multiple instances.

The CMTS MUST persist all instances of ChFnCfg across reinitializations.

**Table O-3 - ChFnCfg Object<sup>291</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
NodeName	NodeName	key	SIZE (1..64)	N/A	N/A
ChIfIndex	InterfaceIndex	key		N/A	N/A

#### O.2.2.2.1 *NodeName*

This key represents a human-readable assigned name for the fiber node. The NodeName should exist in the FiberNodeCfg object prior to use in this object.

#### O.2.2.2.2 *ChIfIndex*

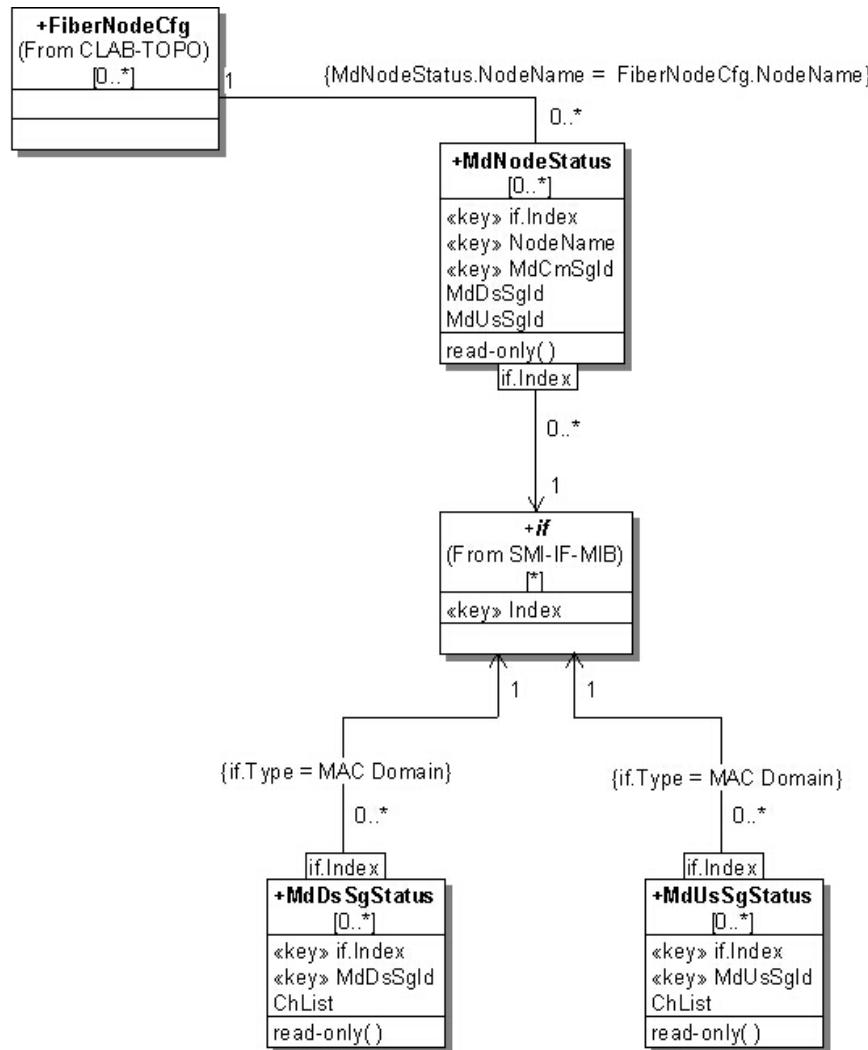
This key represents the interface index of an upstream or downstream channel associated with this fiber node. In the upstream direction, only ifIndices docsCableUpstream channels are reflected.

## O.2.3 CMTS Topology Objects

This section defines the CMTS topology related objects.

<sup>290</sup> Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

<sup>291</sup> Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

**Figure O-2 - CMTS Topology Object Model Diagram**

#### O.2.3.1 **MdNodeStatus Object**

This object reports the MD-DS-SG-ID and MD-US-SG-ID associated with a MD-CM-SG-ID within a MAC Domain and the Fiber Nodes reached by the MD-CM-SG.

**Table O-4 - MdNodeStatus Object<sup>292</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
NodeName	NodeName	key	SIZE (1..64)	N/A	N/A
MdCmSgId	unsignedInt	key	1..4294967295	N/A	N/A
MdDsSgId	unsignedByte	read-only	1..255	N/A	N/A
MdUsSgId	unsignedByte	read-only	1..255	N/A	N/A

<sup>292</sup> Table revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

#### 0.2.3.1.1 *IfIndex*

This key represents the interface index of the MAC Domain associated with the fiber node to which this instance applies.

#### 0.2.3.1.2 *NodeName*

This key represents the name of a fiber node associated with a MD-CM-SG of a MAC Domain.

#### 0.2.3.1.3 *MdCmSgId*

This attribute is a key and indicates the MD-CM-SG-ID of this instance. A particular MdCmSgId in a MAC Domain is associated with one or more Fiber Nodes.

#### 0.2.3.1.4 *MdDsSgId*

This attribute corresponds to the MD-DS-SG-ID of the MD-CM-SG of this object instance. The MdDsSgId values are unique within a MAC Domain.

#### 0.2.3.1.5 *MdUsSgId*

This attribute corresponds to the MD-US-SG-ID of the MD-CM-SG of this object instance. The MdUsSgId values are unique within a MAC Domain.

### 0.2.3.2 *MdDsSgStatus Object*

This object returns the list of downstream channel set associated with a MAC Domain MD-DS-SG-ID.

**Table O-5 - *MdDsSgStatus Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
MdDsSgId	unsignedByte	key	1..255	N/A	N/A
ChSetId	ChSetId	read-only		N/A	N/A

#### 0.2.3.2.1 *IfIndex*

This key represents the interface index of the MAC Domain to which the MD-DS-SG-ID applies.

#### 0.2.3.2.2 *MdDsSgId*

This key represents a MD-DS-SG-ID in a Mac Domain.

#### 0.2.3.2.3 *ChSetId*

This attribute represents a reference to the list of downstream channels of the MD-DS-SG-ID.

### 0.2.3.3 *MdUsSgStatus Object*

This object returns the list of upstream channels associated with a MAC Domain MD-US-SG-ID.

**Table O-6 - *MdUsSgStatus Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
MdUsSgId	unsignedByte	key	1..255	N/A	N/A
ChSetId	ChSetId	read-only		N/A	N/A

#### 0.2.3.3.1 *IfIndex*

This key represents the interface index of the MAC Domain to which the MD-DS-SG-ID applies.

#### 0.2.3.3.2 *MdUsSgId*

This key represents a MD-US-SG-ID in a Mac Domain.

### 0.2.3.3.3 ChSetId

This attribute represents a reference to the list of upstream channels of the MD-US-SG-ID.

## 0.2.4 CMTS Bonding Objects

This section defines the CMTS topology related objects.

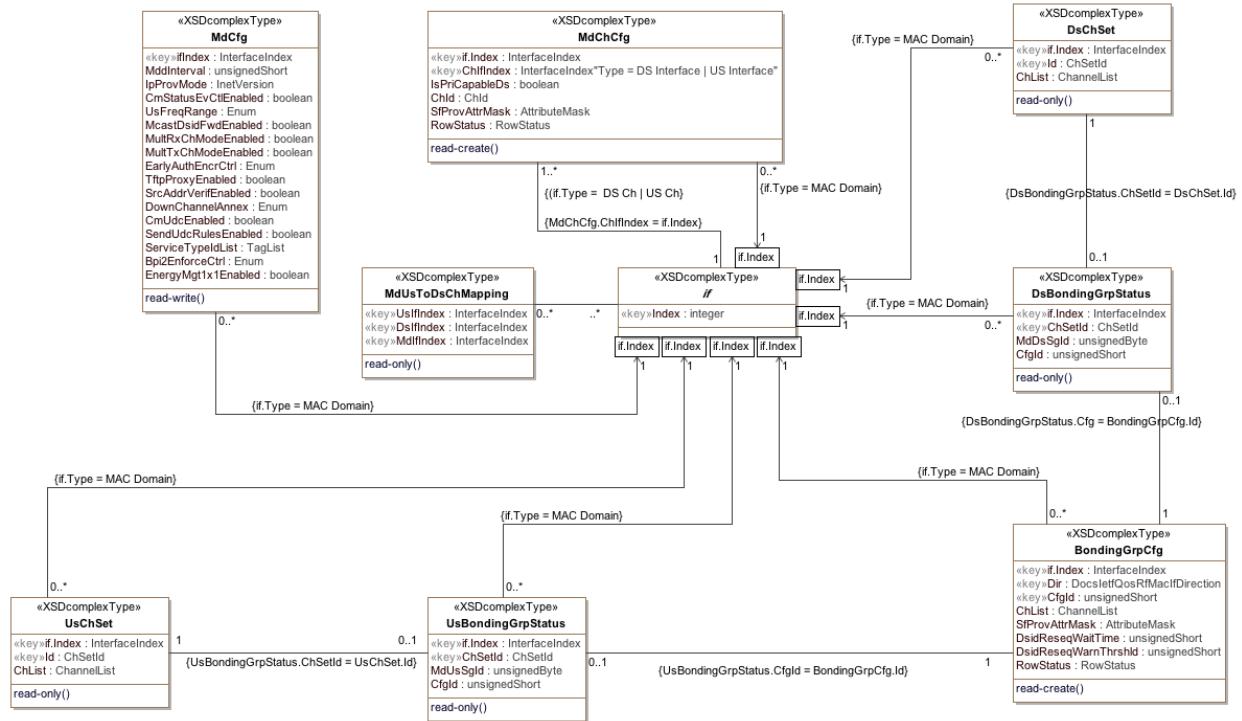


Figure O-3 - CMTS Bonding Object Model Diagram<sup>293</sup>

### 0.2.4.1 MdChCfg Object

This object configures the association of downstream and upstream channels to a particular MAC Domain (MD) on a CMTS. The creation of channels and MAC domain object interface instances is vendor-specific. In particular, the assignment of the channel interface index is normally vendor-specific. Therefore, this object is intended only for associating channels to a MAC Domain and assumes that those channels were previously configured.

The CMTS MAY have restrictions on which channels can be configured in the same MAC Domain. For example, it could require the upstream channels to be from the same line card.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the ChId attribute to be set.

The CMTS MUST persist all instances of MdChCfg across reinitializations.

<sup>293</sup> Figure O-3 replaced per OSSIV3.0-N-07.0445-3, #3 on 5/10/07 by KN, and again per OSSIV3.0-N-07.0481-2 by ab on 7/17/07, and again per OSSIV3.0-N-07.0522-7 by ab on 11/6/07. Replaced figure per OSSIV3.0-N-10.0906-2 on 5/20/10 by JB, replaced Figure per OSSIV3.0-N-12.1073-3 by PO 10/29/12.

**Table O-7 - MdChCfg Object<sup>294</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
ChlIfIndex	InterfaceIndex	key	InterfaceIndex of downstream or upstream channel	N/A	N/A
IsPriCapableDs	boolean	read-create		N/A	
Chld	Chld	read-create	1..255	N/A	N/A
SfProvAttrMask	AttributeMask	read-create		N/A	'00000000'H

**O.2.4.1.1 IfIndex<sup>295</sup>**

This key represents the interface index of the MAC Domain to which this instance applies. The CMTS MAY restrict the value chosen for the IfIndex attribute of the MdChCfg object.

**O.2.4.1.2 ChlIfIndex**

This key represents the interface index of an existing logical upstream (ifType docsCableUpstreamChannel(205)) or downstream (ifTypes docsCableDownstream(128) and docsCableMCmtsDownstream(229)) channel that is configured to be part of the MAC Domain.

The CMTS could require that all upstream logical channels under the same physical upstream interface be assigned to one MAC Domain.

**O.2.4.1.3 IsPriCapableDs<sup>296</sup>**

If set to 'true', this attribute configures the downstream channel as Primary-Capable. The default value for a downstream channel is 'true'. This attribute is not relevant for upstream interfaces, therefore it reports the value 'false' for such interfaces. A CMTS MAY restrict the permitted value of this attribute based upon physical channel capabilities.

**O.2.4.1.4 Chld**

This attribute contains the 8-bit Downstream Channel ID (DCID) or Upstream Channel ID (UCID) configured for the channel in the MAC Domain.

**O.2.4.1.5 SfProvAttrMask**

This attribute contains Provisioned Attribute Mask of non-bonded service flow assignment to this channel.

**O.2.4.2 MdCfg Object<sup>297</sup>**

This object contains MAC domain level control and configuration attributes.

The CMTS MUST persist all instances of MdCfg across reinitializations.

**Table O-8 - MdCfg Object<sup>298</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
MddInterval	unsignedShort	read-write	1..2000	milliseconds	2000

<sup>294</sup> Table edited per OSSIV3.0-N-07.0384-1 by ab on 5/3/07.

<sup>295</sup> Section revised per OSSIV3.0-N-08.0613-1 on 4/10/08 by KN.

<sup>296</sup> Section revised per OSSIV3.0-N-07.0384-1 by ab on 5/3/07.

<sup>297</sup> Revised per OSSIV3.0-N-07.0392-1 by ab on 5/3/07, OSSIV3.0-N-07.0441-4 on 9/9/07 by KN, and OSSIV3.0-N-07.0481-2 by ab on 7/17/07.

<sup>298</sup> Table revised per OSSIV3.0-N-07.0446-4, #4 on 5/10/07 by KN, and per OSSIV3.0-N-07.0522-7 by ab on 11/6/07 and per OSSIV3.0-N-09.0872-4 on 1/5/10, per OSSIV3.0-N-10.0906-2 on 5/20/10 by JB, and OSSIV3.0-N-12.1073-3 on 10/29/12 by PO.

Attribute Name	Type	Access	Type Constraints	Units	Default
IpProvMode	Enum	read-write	ipv4Only(0) ipv6Only(1) alternate(2) dualStack(3)	N/A	ipv6Only
CmStatusEvCtlEnabled	boolean	read-write		N/A	true
UsFreqRange	Enum	read-write	standard(0) extended(1)	N/A	standard
McastDsidFwdEnabled	boolean	read-write		N/A	true
MultRxChModeEnabled	boolean	read-write		N/A	true
MultTxChModeEnabled	boolean	read-write		N/A	true
EarlyAuthEncryptCtrl	Enum	read-write	disableEae(1) enableEaeRangingBasedEnforcement(2) enableEaeCapabilityBasedEnforcement(3) enableEaeTotalEnforcement(4)	N/A	enableEaeRangingBasedEnforcement
TftpProxyEnabled	boolean	read-write		N/A	true
SrcAddrVerifEnabled	boolean	read-write		N/A	true
DownChannelAnnex	Enum	read-write	unknown(1) other(2) annexA(3) annexB(4) annexC(5)	N/A	unknown
CmUdcEnabled	boolean	read-write		N/A	false
SendUdcRulesEnabled	boolean	read-write		N/A	false
ServiceTypeList	TagList	read-write	SIZE (0..256)	N/A	"H
Bpi2EnforceCtrl	Enum	read-write	disable(0) qosCfgFileWithBpi2AndCapabPrivSupportEnabled(1) qosCfgFileWithBpi2Enabled(2) qosCfgFile(3) total(4)	N/A	qosCfgFileWithBpi2Enabled
EnergyMgt1x1Enabled	boolean	read-write		N/A	false

#### 0.2.4.2.1 *ifIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### 0.2.4.2.2 *MddInterval*

This attribute configures the interval for the insertion of MDD messages in each downstream channel of a MAC Domain.

References: [MULPI] Parameters and Constants Annex.

#### 0.2.4.2.3 *IpProvMode*

This attribute configures the IP provisioning mode for a MAC Domain.

When this attribute is set to 'ipv4Only' the CM will acquire a single IPv4 address for the CM management stack.

When this attribute is set to 'ipv6Only' the CM will acquire a single IPv6 address for the CM management stack.

When this attribute is set to 'alternate' the CM will acquire a single IPv6 address for the CM management stack and, if failures occur, the CM will fall back to provisioning and operation with an IPv4 address.

When this attribute is set to 'dualStack' the CM will acquire both an IPv6 and IPv4 address for provisioning and operation.

References: [MULPI] IP Initialization Parameters TLV section.

#### *O.2.4.2.4 CmStatusEvCtlEnabled*

If set to 'true', this attribute enables the signaling of the CM-Status Event reporting mechanism.

References: [MULPI] CM-STATUS Event Control section.

#### *O.2.4.2.5 UsFreqRange*

This attribute indicates in MDD messages the upstream frequency upper band edge of an upstream Channel.

A value 'standard' means Standard Frequency Range and a value 'extended' means Extended Frequency Range.

References: [MULPI] Upstream Frequency Upper Band Edge TLV section.

#### *O.2.4.2.6 McastDsidFwdEnabled*

If set to 'true', this attribute enables the CMTS to use IP Multicast DSID Forwarding (MDF) for the MAC domain.

References: [MULPI] Multicast DSID-based Forwarding (MDF) Modes section in the Compatibility with Previous Versions of DOCSIS Annex.

#### *O.2.4.2.7 MultRxChModeEnabled<sup>299</sup>*

If set to 'true', this attribute enables Downstream Channel Bonding for the MAC Domain.

References: [MULPI] Downstream Channel Bonding section.

#### *O.2.4.2.8 MultTxChModeEnabled*

If set to 'true', this attribute enables Multiple Transmit Channel (MTC) Mode for the MAC Domain.

References: [MULPI] Upstream Channel Bonding section.

#### *O.2.4.2.9 EarlyAuthEncryptCtrl*

This attribute enables or disables early authentication and encryption (EAE) signaling for the MAC Domain. It also defines the type of EAE enforcement in the case that EAE is enabled.

If set to 'disableEAE', EAE is disabled for the MAC Domain.

If set to 'enableEaeRangingBasedEnforcement', 'enableEaeCapabilityBasedEnforcement' or 'enableEaeTotalEnforcement', EAE is enabled for the MAC Domain.

The following EAE enforcement methods are defined in the case where EAE signaling is enabled:

- The option 'enableEaeRangingBasedEnforcement' indicates EAE is enforced on CMs that perform ranging with a B-INIT-RNG-REQ message.
- The option 'enableEaeCapabilityBasedEnforcement' indicates EAE is enforced on CMs that perform ranging with a B-INIT-RNG-REQ message in which the EAE capability flag is set.

The option 'enableEaeTotalEnforcement' indicates EAE is enforced on all CMs regardless of their EAE capabilities.

References: [SEC] Early Authentication and Encryption section.

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<sup>299</sup> Revised per OSSIV3.0-N-07.0392-1 by ab on 5/3/07.

#### 0.2.4.2.10 *TftpProxyEnabled*

If set to 'true', this attribute enables TFTP Proxy functionality for the MAC Domain.

References: [SEC] TFTP Configuration File Security section.

#### 0.2.4.2.11 *SrcAddrVerifiEnabled*<sup>300</sup>

If set to 'true', this attribute enables Source Address Verification (SAV) functionality for the MAC Domain.

References: [SEC] Source Address Verification section.

#### 0.2.4.2.12 *DownChannelAnnex*<sup>301</sup>

This attribute defines the ITU-J-83 Annex being used for this MAC Domain. The value of this attribute indicates the conformance of the implementation to important regional cable standards. Valid enumerations for the attribute are:

- 'unknown'
- 'other'
- 'annexA' : Annex A from ITU-J83 is used
- 'annexB' : Annex B from ITU-J83 is used
- 'annexC' : Annex C from ITU-J83 is used

Values 6-255 are reserved.

#### 0.2.4.2.13 *CmUdcEnabled*

If set to 'true', this attribute instructs the CMTS MAC Domain to enable Upstream Drop Classifiers (UDC) for the CMs attempting registration in this MAC Domain.

References: [MULPI], Upstream Drop Classifiers section

#### 0.2.4.2.14 *SendUdcRulesEnabled*

If set to 'true' and when the CM signals to the CMTS 'Upstream Drop Classifier Group ID' encodings, this attribute instructs the CMTS MAC Domain to send the Subscriber Management Filters rules associated with the 'Upstream Drop Classifier Group ID'encodings to the CM in the form of UDCs when the following conditions occurs:

- The attribute CmUdcEnabled value for this MAC Domain is set to 'true', and
- The CM has the UDC capability advertised as supported.

If there is no a single Subscriber Management Filter configured in the CMTS for the CM's signaled UDC Group ID, the CMTS does not send UDC encodings to the CM.

It is vendor specific whether the CMTS maintains enforcement of the CM signaled or default Subscriber Management Filter groups in the upstream direction.

References: [MULPI], Upstream Drop Classifiers section

#### 0.2.4.2.15 *ServiceTypeidList*<sup>302</sup>

This attribute indicates the list of Service Type IDs associated with the MAC Domain.

During the CM registration process the CMTS will attempt to redirect the CM to a MAC Domain where the CM' Service Type TLV is contained in this attribute.

References: [MULPI], Service Type Identifier section in the Common Radio Frequency Interface Encodings Annex.

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<sup>300</sup> Section revised per OSSIV3.0-N-07.0441-4, #12 on 5/9/07 by KN.

<sup>301</sup> Section added per OSSIV3.0-N-07.0446-4, #5 on 5/10/07 by KN.

<sup>302</sup> Section added per OSSIV3.0-N-07.0522-7 by ab on 11/6/07.

#### 0.2.4.2.16 *Bpi2EnforceCtrl*<sup>303</sup>

This attribute indicates the level of BPI+ enforcement policies with the MAC Domain.

The following BPI+ enforcement policies are defined in the case where BPI+ is enabled:

- The option 'disable' indicates that CMTS does not enforce BPI+.
- The option 'qosCfgFileWithBpi2AndCapabPrivSupportEnabled' indicates the CMTS enforces BPI+ on CMs that register with a DOCSIS 1.1 style configuration file with parameters indicating BPI+ is enabled (missing TLV 29 or containing TLV 29 set to enable) and with a Modem Capabilities Privacy Support TLV (5.6) set to BPI+ support.
- The option 'qosCfgFileWithBpi2Enabled' indicates the CMTS enforces BPI+ on CMs that register with a DOCSIS 1.1 style configuration file with parameters indicating BPI+ is enabled (missing TLV 29 or containing TLV 29 set to enable).
- The option 'qosCfgFile' indicates the CMTS enforces BPI+ on CMs that register with a DOCSIS 1.1 style configuration file.
- The option 'total' indicates the CMTS enforces BPI+ on all CMs.

References: [SEC] BPI+ Enforce Section.

#### 0.2.4.2.17 *EnergyMgt1x1Enabled*<sup>304</sup>

This attribute indicates whether the CMTS is configured for 1x1 Energy Management Mode of operation on a per MAC Domain basis.

If this attribute is set to 'true', the CMTS is configured for 1x1 Energy Management Mode of operation on this MAC Domain. If this attribute is set to 'false', the Energy Management 1x1 Mode of operation is disabled in the CMTS on this MAC Domain.

References: [MULPI], Energy Management Capabilities section.

#### 0.2.4.3 *MdUsToDsChMapping Object*<sup>305</sup>

This object returns the set of downstream channels that carry UCDs and MAPs for a particular upstream channel in a MAC Domain.

**Table O-9 - MdUsToDsChMapping Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
UsIfIndex	InterfaceIndex	key	Interface Index of a logical upstream channel	N/A	N/A
DsIfIndex	InterfaceIndex	key		N/A	N/A
MdIfIndex	InterfaceIndex	read-only		N/A	N/A

##### 0.2.4.3.1 *UsIfIndex*

This key represents the interface index of the logical upstream channel (ifType docsCableUpstreamChannel(205)) to which this instance applies.

##### 0.2.4.3.2 *DsIfIndex*

This key represents the interface index of a downstream channel (ifTypes docsCableDownstream(128) and docsCableMCmtsDownstream(229)) carrying in UCD and MAP messages associated with the upstream channel defined by this instance.

<sup>303</sup> Section added per OSSIV3.0-N-09.0872-4 on 1/5/10 and per OSSIV3.0-N-10.0906-2 on 5/20/10 by JB.

<sup>304</sup> Section added per OSSIV3.0-N-12.1073-3 on 10/29/12 by PO.

<sup>305</sup> Section revised per OSSIV3.0-N-07.0441-4, #17 on 5/9/07 by KN.

#### 0.2.4.3.3 *MdlfIndex*

This attribute represents the MAC domain of the upstream and downstream channels of this instance.

#### 0.2.4.4 *DsChSet Object*

This object defines a set of downstream channels. These channel sets may be associated with channel bonding groups, MD-DS-SGs, MD-CM-SGs, or any other channel set that the CMTS may derive from other CMTS processes.

References: [MULPI] Partial Service Encoding section and Cable Modem Attribute Masks section in the Common Radio Frequency Interface Encodings Annex.

**Table O-10 - DsChSet Object<sup>306</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of the MAC Domain interface	N/A	N/A
Id	ChSetId	key		N/A	N/A
ChList	ChannelList	read-only	SIZE (0 2..255)	N/A	N/A

#### 0.2.4.4.1 *IfIndex*

This key represents the MAC Domain interface index where the downstream channel set is defined.

#### 0.2.4.4.2 *Id*

This key defines a reference identifier for the downstream channel set within the MAC Domain.

#### 0.2.4.4.3 *ChList*

This attribute defines the ordered list of channels that comprise the upstream channel set.

#### 0.2.4.5 *UsChSet Object*

This object defines a set of upstream channels. These channel sets may be associated with channel bonding groups, MD-US-SGs, MD-CM-SGs, or any other channel set that the CMTS may derive from other CMTS processes.

References: [MULPI] Partial Service Encoding section and Cable Modem Attribute Masks section in the Common Radio Frequency Interface Encodings Annex.

**Table O-11 - UsChSet Object<sup>307</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of the MAC Domain interface	N/A	N/A
Id	ChSetId	key		N/A	N/A
ChList	ChannelList	read-only	SIZE (0 2..255)	N/A	N/A

#### 0.2.4.5.1 *IfIndex*

This key represents the MAC Domain interface index where the upstream channel set is defined.

#### 0.2.4.5.2 *Id*

This key defines a reference identifier for the upstream channel set within the MAC Domain.

#### 0.2.4.5.3 *ChList*

This attribute defines the ordered list of channels that comprise the upstream channel set.

<sup>306</sup> Table revised per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN.

<sup>307</sup> Table revised per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN.

### 0.2.4.6 *BondingGrpCfg Object*<sup>308</sup>

This object defines statically configured Downstream Bonding Groups and Upstream Bonding Groups on the CMTS.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the ChList attribute to be set.

The CMTS MUST persist all instances of BondingGrpCfg across reinitializations.

**Table O-12 - BondingGrpCfg Object<sup>309</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of Mac Domain interface	N/A	N/A
Dir	IfDirection	key		N/A	N/A
Id	unsignedShort	key	1..65535	N/A	N/A
ChList	ChannelList	read-create	SIZE (2..255)	N/A	N/A
SfProvAttrMask	AttributeMask	read-create		N/A	'80000000'H
DsidReseqWaitTime	unsignedByte	read-create	0   1..180   255	hundredMicroseconds	255
DsidReseqWarnThrshld	unsignedByte	read-create	0..179   255	hundredMicroseconds	255

#### 0.2.4.6.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### 0.2.4.6.2 *Dir*

This key represents whether this bonding group is an Upstream Bonding Group or a Downstream Bonding Group.

#### 0.2.4.6.3 *CfgId*

This key represents the configured bonding group identifier in the indicated direction for the MAC Domain. This attribute is used for the sole purpose of tracking bonding groups defined by management systems.

#### 0.2.4.6.4 *ChList*

This attribute contains the list of channels of the bonding group.

#### 0.2.4.6.5 *SfProvAttrMask*

This attribute represents the Provisioned Attribute Mask encoding for the bonding group.

References: [MULPI] Service Flow Assignment section.

#### 0.2.4.6.6 *DsidReseqWaitTime*

For a Downstream Bonding Group, this attribute provides the DSID Resequencing Wait Time that is to be used for all DSIDs associated with this Downstream Bonding Group. The value of 255 indicates that the DSID Resequencing Wait Time is determined by the CMTS. The value zero is not supported for downstream bonding groups.

For an Upstream Bonding Group, this attribute has no meaning and returns the value 0.

#### 0.2.4.6.7 *DsidReseqWarnThrshld*<sup>310</sup>

For a Downstream Bonding Group, this attribute provides the DSID Resequencing Warning Threshold that is to be used for all DSIDs associated with this Downstream Bonding Group. The value of 255 indicates that the DSID Resequencing Warning Threshold is determined by the CMTS. The value of 0 indicates that the threshold warnings

<sup>308</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

<sup>309</sup> Table revised per OSSIV3.0-N-07.0589-3 on 1/30/08 by KN.

<sup>310</sup> Section modified per OSSIV3.0-N-07.0589-3 on 1/30/08 by KN.

are disabled. When the value of DsidReseqWaitTime is not equal to 0 or 255, the CMTS MUST ensure that the value of this object is either 255 or less than the value of DsidReseqWaitTime.

For an Upstream Bonding Group, this attribute has no meaning and returns the value 0.

#### **O.2.4.7 *DsBondingGrpStatus Object***

This object returns administratively-configured and CMTS defined downstream bonding groups.

**Table O-13 - *DsBondingGrpStatus Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
ChSetId	ChSetId	key		N/A	N/A
MdDsSgId	unsignedByte	read-only		N/A	N/A
CfgId	unsignedShort	read-only		N/A	N/A

##### **O.2.4.7.1 *IfIndex***

This key represents the interface index of the MAC Domain of the bonding group of this instance.

##### **O.2.4.7.2 *ChSetId***

This key represents the identifier for the Downstream Bonding Group or the single-downstream channel of this instance.

##### **O.2.4.7.3 *MdDsSgId***

This attribute corresponds to the MD-DS-SG-ID that includes all the downstream channels of the Downstream Bonding Group. The value zero indicates that the bonding group does not contain channels from a single MD-DS-SG and therefore the bonding group is not valid and usable.

##### **O.2.4.7.4 *CfgId*<sup>311</sup>**

This attribute provides the BondingGrpCfgId for the downstream bonding group if it was configured. Otherwise, the zero value indicates that the CMTS will define the bonding group.

#### **O.2.4.8 *UsBondingGrpStatus Object***

This object returns administratively-configured and CMTS-defined upstream bonding groups.

**Table O-14 - *UsBondingGrpStatus Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
ChSetId	ChSetId	key		N/A	N/A
MdUsSgId	unsignedByte	read-only		N/A	N/A
CfgId	unsignedShort	read-only		N/A	N/A

##### **O.2.4.8.1 *IfIndex***

This key represents the interface index of the MAC Domain of the bonding group of this instance.

##### **O.2.4.8.2 *ChSetId***

This key represents the identifier for the Upstream Bonding Group or the single-upstream channel of this instance.

<sup>311</sup> Section revised per OSSIV3.0-N-07.0384-1 by ab on 5/3/07.

#### 0.2.4.8.3 *MdUsSglId*

This attribute corresponds to the MD-US-SG-ID that includes all the upstream channels of the Upstream Bonding Group. The value zero indicates that the bonding group does not contain channels from a single MD-US-SG and therefore the bonding group is not valid and usable.

#### 0.2.4.8.4 *CfgId*<sup>312</sup>

This attribute provides the BondingGrpCfgId for the upstream bonding group if it was configured. Otherwise, the zero value indicates that the CMTS defines the bonding group.

### 0.2.5 RCC Configuration Objects<sup>313</sup>

This section defines the CMTS Receive Channel Configuration (RCC) Configuration objects.

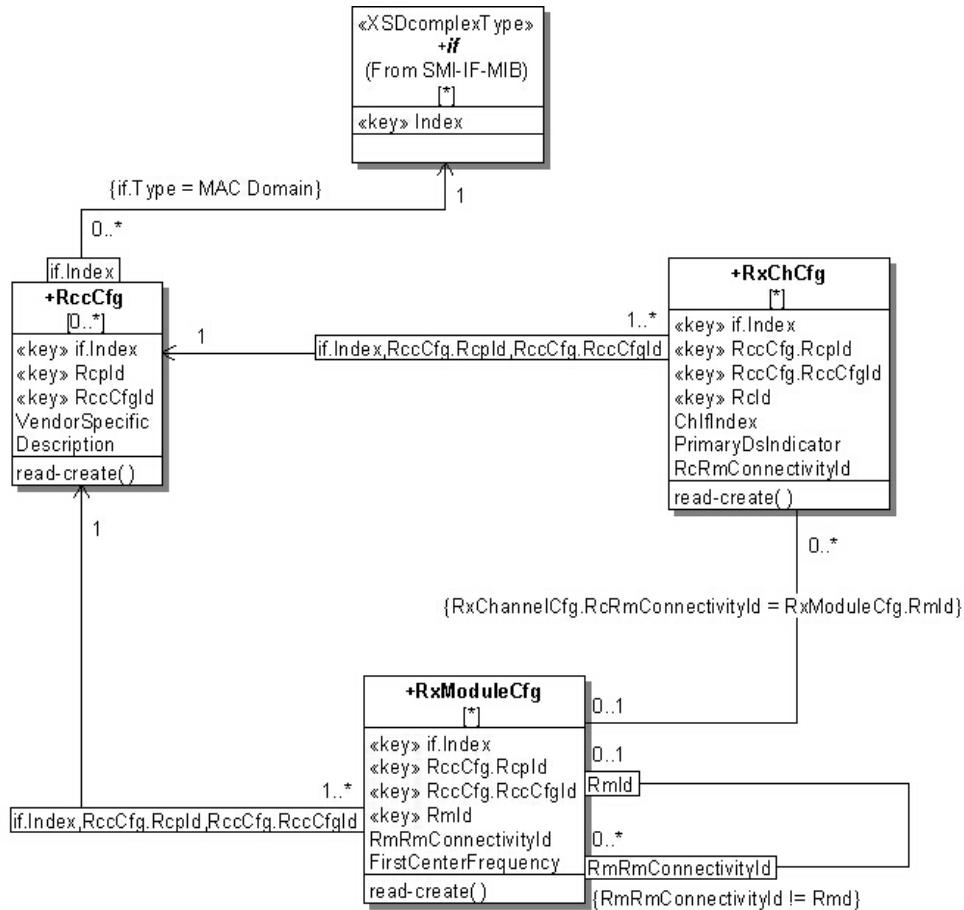


Figure O-4 - RCC Configuration Object Model Diagram

#### 0.2.5.1 *RccCfg Object*

This object identifies the scope of the Receive Channel Configuration (RCC) and provides a top level container for the Receive Module and Receive Channel objects. The CMTS selects an instance of this object to assign to a CM when it registers.

This object supports the creation and deletion of multiple instances.

<sup>312</sup> Section revised per OSSIV3.0-N-07.0384-1 by ab on 5/3/07.

<sup>313</sup> previous section (MdCmSgLoadBalStats Object) deleted per OSSIV3.0-N-07.0481-2 by ab on 7/17/07.

The CMTS MUST persist all instances of RccCfg across reinitializations.

**Table O-15 - RccCfg Object<sup>314</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RcpId	RcpId	key		N/A	N/A
RccCfgId	unsignedInt	key	1..4294967295	N/A	N/A
VendorSpecific	hexBinary	read-create	0..252	N/A	"H
Description	AdminString	read-create	0..15	N/A	""

#### O.2.5.1.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.5.1.2 *RcpId<sup>315</sup>*

This key represents the 'Receive Channel Profile Identifier' (RCP-ID) configured for the MAC Domain indicated by this instance.

References: [MULPI] Standard Receive Channel Profile Encodings Annex.

#### O.2.5.1.3 *RccCfgId*

This key denotes an RCC combination assignment for a particular RcpId and is unique per combination of MAC Domain and RcpId.

#### O.2.5.1.4 *VendorSpecific*

This attribute contains vendor-specific information of the CM Receive Channel configuration.

References: [MULPI] Receive Channel Profile/Configuration Vendor Specific Parameters section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.5.1.5 *Description*

This attribute contains a human-readable description of the CM RCP Configuration.

### O.2.5.2 *RxModuleCfg Object*

The Receive Module Configuration object permits an operator to configure how CMs with certain Receive Channel Profiles (RCPs) will configure the Receive Modules within their profile upon CM registration. When a CM registers with an RCP for which all Receive Module Indices (RmIds) are configured in this object and all Receive Channels are configured within the Receive Channel (RxCh) object, the CMTS SHOULD use the configuration within these objects to set the Receive Channel Configuration assigned to the CM in a REG-RSP message. A CMTS MAY require configuration of all pertinent Receive Module and Receive Channel instances in order to register a CM that reports a Receive Channel Profile. If the CM reports multiple RCPs, and Receive Module and Receive Channel objects have instances for more than one RCP reported by the CM, the particular RCP selected by the CMTS is not specified. A CMTS is not restricted to assigning Receive Modules based only on the contents of this object.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the reference of a valid RccCfg instance.

The CMTS MUST persist all instances of RxModuleCfg across reinitializations.

<sup>314</sup> Table modified per OSSIV3.0-N-07.0605-1 on 1/30/08 by KN.

<sup>315</sup> Section revised per OSSIV3.0-N-07.0412-2 on 5/8/07 by KN.

**Table O-16 - RxModuleCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RcpId	RcpId	key		N/A	N/A
RccCfgId	unsignedByte	key	1..255	N/A	N/A
RmId	unsignedByte	key	1..255	N/A	N/A
RmRmConnectivityId	unsignedByte	read-create		N/A	0
FirstCenterFrequency	unsignedInt	read-create		Hz	0

#### 0.2.5.2.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### 0.2.5.2.2 *RcpId*

This key represents the RCP-ID to which this instance applies.

#### 0.2.5.2.3 *RccCfgId*

This key represents a configuration identifier of the RCC combination assignment for a particular RcpId.

#### 0.2.5.2.4 *RmId*

This key represents an identifier of a Receive Module instance within the Receive Channel Profile.

References: [MULPI] Receive Module Index in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.5.2.5 *RmRmConnectivityId*

This attribute represents the higher level (i.e., closer to RF) Receive Module to which this Receive Module connects. If this object contains a zero value (and thus no Receive Module Connectivity), the Receive Module Connectivity TLV is omitted from the RCC.

Within a single instance of the RxModule object, the RmRmConnectivityId attribute cannot contain the same value as the RmId attribute. The RmRmConnectivityId attribute points to a separate RxModule object instance with the same value of RccCfgId.

References: [MULPI] Receive Module Connectivity section in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.5.2.6 *FirstCenterFrequency*

This attribute represents the center frequency, in Hz, and a multiple of 62500, that indicates the low frequency channel of the Receive Module, or 0 if not applicable to the Receive Module.

References: [MULPI] Receive Module First Channel Center Frequency Assignment section in the Common Radio Frequency Interface Encodings Annex.

### 0.2.5.3 *RxChCfg Object*

The Receive Channel Configuration object permits an operator to configure how CMs registered with certain Receive Channel Profiles will configure the Receive Channels within their profile. When a CM registers with an RCP for which all Receive Channel Indices (RcIds) are configured in the Receive Module object and all Receive Channels are configured within this object, the CMTS SHOULD use the configuration within these objects to set the Receive Channel Configuration returned to the CM in a REG-RSP message. A CMTS MAY require configuration of all pertinent Receive Module and Receive Channel instances in order to register a CM that reports a Receive Channel Profile (RCP), including any standard Receive Channel Profiles. If the CM reports multiple RCPs, and Receive Module and Receive Channel objects have instances for more than one RCP, the particular RCP selected by the CMTS is not specified. A CMTS is not restricted to assigning Receive Modules based only on the contents of this object.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the reference of a valid RccCfg instance and the ChIfIndex attribute to be set.

The CMTS MUST persist all instances of RxChCfg across reinitializations.

**Table O-17 - RxChCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RcpId	RcpId	key		N/A	N/A
RccCfgId	unsignedByte	key	1..255	N/A	N/A
RcId	unsignedByte	key	1..255	N/A	N/A
ChIfIndex	InterfaceIndex	read-create		N/A	N/A
PrimaryDsIndicator	boolean	read-create		N/A	false
RcRmConnectivityId	unsignedByte	read-create		N/A	0

#### O.2.5.3.1 *ifIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.5.3.2 *RcpId*

This key represents the RCP-ID to which this instance applies.

#### O.2.5.3.3 *RccCfgId*

This key represents a configuration identifier of the RCC combination assignment for a particular RcpId.

#### O.2.5.3.4 *RcId*

This key represents an identifier for the parameters of the Receive Channel instance within the Receive Channel Profile.

References: [MULPI] Receive Channel Index section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.5.3.5 *ChIfIndex*

This attribute contains the interface index of a Downstream Channel that this Receive Channel Instance defines.

#### O.2.5.3.6 *PrimaryDsIndicator*

If set to 'true', this attribute indicates the Receive Channel is to be the primary-capable downstream channel for the CM receiving this RCC. Otherwise, the downstream channel is to be a non-primary-capable channel.

References: [MULPI] Receive Channel Primary Downstream Channel Indicator section in the Common Radio Frequency Interface Encodings Annex.

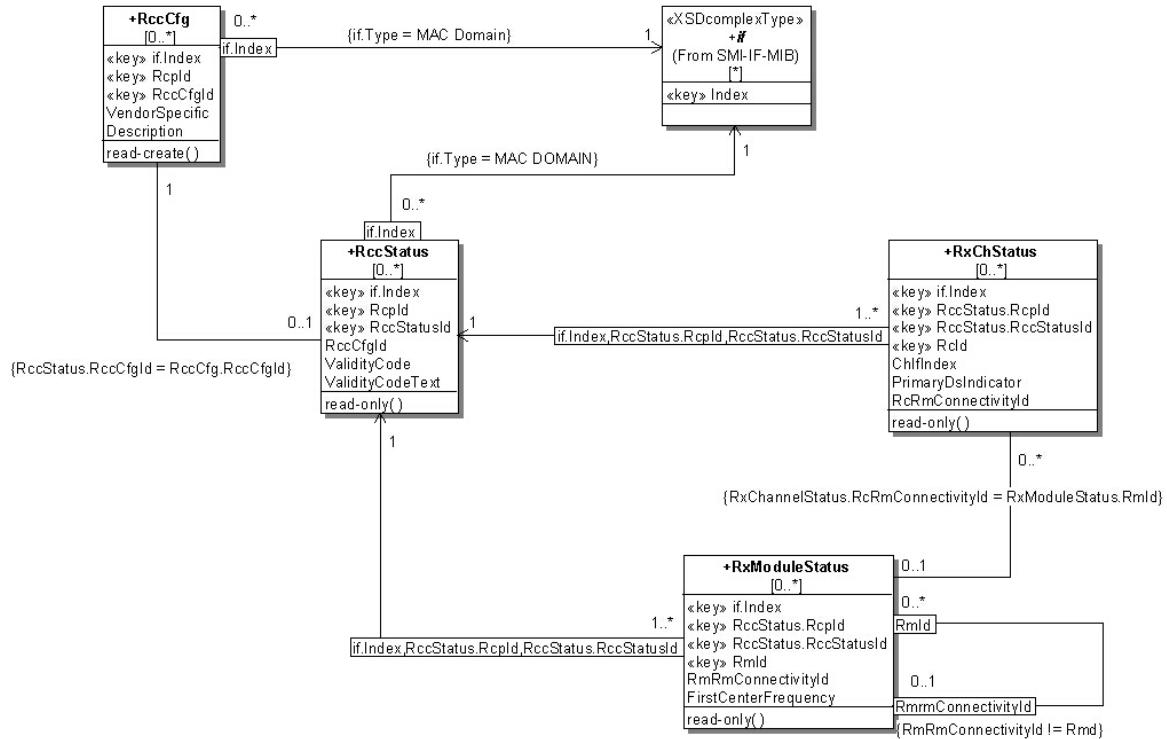
#### O.2.5.3.7 *RcRmConnectivityId*

This attribute indicates the Receive Module (via the RmId from the RxModule object) to which this Receive Channel connects. If this object contains a zero value (and thus no Receive Channel Connectivity), the Receive Channel Connectivity TLV is omitted from the RCC.

References: [MULPI] Receive Channel Connectivity section in the Common Radio Frequency Interface Encodings Annex.

## O.2.6 RCC Status Objects

This section defines the CMTS Receive Channel Configuration (RCC) Status objects.



**Figure O-5 - RCC Status Object Model Diagram**

### O.2.6.1 RccStatus Object

The RCC Status object provides a read-only view of the statically-configured (from the RccCfg object) and dynamically-created RCCs.

The CMTS creates an RCC Status instance for each unique MAC Domain Cable Modem Service Group (MD-CM-SG) to which it signals an RCC to the CM.

**Table O-18 - RccStatus Object<sup>316</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RpId	RpId	key		N/A	N/A
RccStatusId	unsignedInt	key	1..4294967295	N/A	N/A
RccCfgId	unsignedByte	read-only		N/A	N/A

<sup>316</sup> Table modified per OSSIV3.0-N-07.0605-1 on 1/30/08 by KN.

Attribute Name	Type	Access	Type Constraints	Units	Default
ValidityCode	Enum	read-only	other(1) valid(2) invalid(3) wrongPrimaryDs(4) missingPrimaryDs(5) multiplePrimaryDs(6) duplicateDs(7) wrongFrequencyRange(8) wrongConnectivity(9)	N/A	N/A
ValidityCodeText	AdminString	read-only		N/A	N/A

#### O.2.6.1.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.6.1.2 *RcpId*

This key represents the RCP-ID to which this instance applies.

#### O.2.6.1.3 *RccStatusId*

This key represents an RCC combination for a particular RcpId either from an RCC configuration object or a CMTS-determined RCC and is unique per combination of MAC Domain IfIndex and RcpId.

#### O.2.6.1.4 *RccCfgId*

This attribute identifies an RCC-Configured combination from which this instance was defined. If nonzero, it corresponds to the RccCfg instance from which the RCC was created. Zero means that the RCC was dynamically created by the CMTS.

#### O.2.6.1.5 *ValidityCode*

This attribute indicates whether the RCC instance of this object is valid or not. An RCC Status instance from a configured or a dynamic RCC could become invalid, for example, due changes in the topology.

#### O.2.6.1.6 *ValidityCodeText*

This attribute contains the CMTS vendor-specific log information from the Receive Channel Configuration Status encoding.

### O.2.6.2 *RxModuleStatus Object*<sup>317</sup>

The Receive Module Status object provides a read-only view of the statically configured and dynamically created Receive Modules within an RCC. When this object is defined on the CM, the value of RccStatusId is always 1.

**Table O-19 - RxModuleStatus Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RcpId	RcpId	key		N/A	N/A
RccStatusId	unsignedByte	key	1..255	N/A	N/A
RmId	unsignedByte	key	1..255	N/A	N/A
RmRmConnectivityId	unsignedByte	read-only		N/A	N/A
FirstCenterFrequency	unsignedInt	read-only		Hz	N/A

<sup>317</sup> Section modified per OSSIV3.0-N-07.0422-5 #6 on 5/11/07 by KN.

#### O.2.6.2.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.6.2.2 *RcpId*

This key represents the RCP-ID to which this instance applies.

#### O.2.6.2.3 *RccStatusId*<sup>318</sup>

This key represents an RCC combination for a particular RcpId either from an RCC configuration object or a CMTS determined RCC and is unique per combination of MAC Domain interface index and RcpId. Note that when this attribute is instantiated at the CM, its value will always be 1.

#### O.2.6.2.4 *RmId*

This key represents an identifier of a Receive Module instance within the Receive Channel Profile.

References: [MULPI] Receive Module Index section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.6.2.5 *RmRmConnectivityId*

This attribute represents the Receive Module to which this Receive Module connects. Requirements for module connectivity are detailed in the RmRmConnectivityId of the RccCfg object.

#### O.2.6.2.6 *FirstCenterFrequency*

This attribute represents the low frequency channel of the Receive Module, or 0 if not applicable to the Receive Module.

#### O.2.6.3 *RxChStatus Object*<sup>319</sup>

The Receive Channel Status object reports the status of the statically-configured and dynamically-created Receive Channels within an RCC. When this object is defined on the CM, the value of RccStatusId is always 1.

**Table O-20 - RxChStatus Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
RcpId	RcpId	key		N/A	N/A
RccStatusId	unsignedByte	key	1..255	N/A	N/A
RcId	unsignedByte	key	1..255	N/A	N/A
ChIfIndex	InterfaceIndex	read-only	InterfaceIndex of Downstream Channel assigned to the Receive Channel	N/A	N/A
PrimaryDsIndicator	boolean	read-only		N/A	N/A
RcRmConnectivityId	unsignedByte	read-only		N/A	N/A

#### O.2.6.3.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.6.3.2 *RcpId*

This key represents the RCP-ID to which this instance applies.

#### O.2.6.3.3 *RccStatusId*<sup>320</sup>

This key represents an RCC combination for a particular RcpId either from an RCC configuration object or a CMTS determined RCC. It is unique per combination of MAC Domain interface index and RcpId. Note that when this attribute is instantiated at the CM, its value will always be 1.

<sup>318</sup> Section revised per OSSIV3.0-N-07.0422-5, #1 on 5/10/07 by KN.

<sup>319</sup> Section revised per OSSIV3.0-N-07.0422-5, #5 on 5/11/07 by KN.

<sup>320</sup> Section revised per OSSIV3.0-N-007.0422-5, #2 on 5/10/07 by KN.

#### 0.2.6.3.4 *RcId*

This key represents an identifier for the parameters of the Receive Channel instance within the Receive Channel Profile.

#### 0.2.6.3.5 *ChIfIndex*

This attribute contains the interface index of the Downstream Channel that this Receive Channel Instance defines.

#### 0.2.6.3.6 *PrimaryDsIndicator*

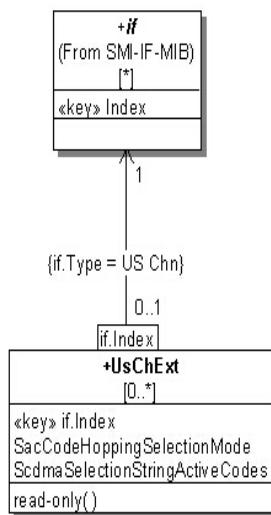
If set to 'true', this attribute indicates the Receive Channel is to be the primary-capable downstream channel for the CM receiving this RCC. Otherwise, the downstream channel is to be a non-primary-capable channel.

#### 0.2.6.3.7 *RcRmConnectivityId*

This attribute identifies the Receive Module to which this Receive Channel connects. A value of zero indicates that the Receive Channel Connectivity TLV is omitted from the RCC.

### 0.2.7 Upstream Channel Extensions Objects

This section defines extensions for the upstream channel for DOCSIS 3.0.



**Figure O-6 - Upstream Channel Extension Object Model Diagram**

#### 0.2.7.1 *UsChExt Object*

This object defines management extensions for upstream channels, in particular SCDMA parameters.

**Table O-21 - UsChExt Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
SacCodeHoppingSelectionMode	Enum	read-only	none(0) sac1NoCodeHopping(1) sac1CodeHoppingMode1(2) sac2CodeHoppingMode2(3) sac2NoCodeHopping(4)	N/A	N/A
ScdmaSelectionStringActiveCodes	ScdmaSelectionString	read-only		N/A	N/A

#### O.2.7.1.1 *IfIndex*

This key represents the interface index of the logical upstream channel to which this instance applies.

#### O.2.7.1.2 *SacCodeHoppingSelectionMode*

This attribute indicates the selection mode for active codes and code hopping.

- 'none'  
Non-SCDMA channel
- 'sac1NoCodeHopping'  
Selectable active codes mode 1 and code hopping disabled
- 'sac1CodeHoppingMode1'  
Selectable active codes mode 1 and code hopping mode 1
- 'sac2CodeHoppingMode2'  
Selectable active codes mode 2 and code hopping mode 2
- 'sac2NoCodeHopping'  
Selectable active codes mode 2 and code hopping disabled

References: [PHY] Mini-slot Numbering Parameters in UCD section.

#### O.2.7.1.3 *ScdmaSelectionStringActiveCodes*

This attribute represents the active codes of the upstream channel and it is applicable only when SacCodeHoppingSelectionMode is 'sac2CodeHoppingMode2'.

References: [PHY] Mini-slot Numbering Parameters in UCD section.

## O.2.8 DOCSIS QOS Objects<sup>321</sup>

This section defines the reporting of the DOCSIS QOS configuration.

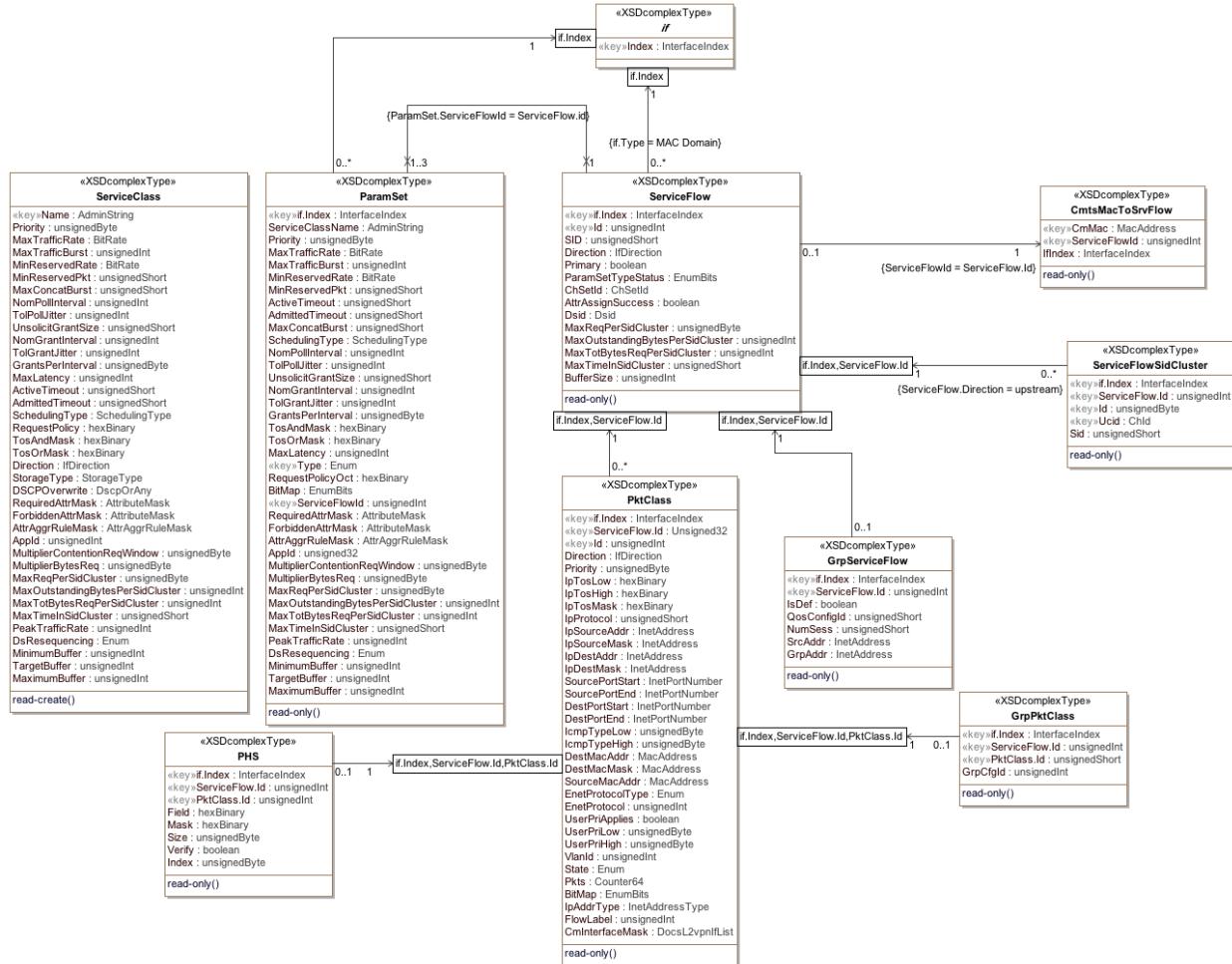


Figure O-7 - Qos Configuration Object Model Diagram<sup>322</sup>

### O.2.8.1 PktClass

This object describes the packet classification configured on the CM or CMTS. The model is that a packet either received as input from an interface or transmitted for output on an interface may be compared against an ordered list of rules pertaining to the packet contents. Each rule is an instance of this object. A matching rule provides a Service Flow ID to which the packet is classified. All rules need to match for a packet to match a classifier. The attributes in this row correspond to a set of Classifier Encoding parameters in a DOCSIS MAC management message. The BitMap attribute indicates which particular parameters were present in the classifier as signaled in the DOCSIS message. If the referenced parameter was not present in the signaled Classifier, the corresponding attribute in this instance reports a value as specified by that attribute description.

<sup>321</sup> Section replaced per OSSIV3.0-N-07.0480-3 by ab on 7/13/07.

<sup>322</sup> Figure O-7 replaced per OSSIV3.0-N-07.0445-3 on 5/10/07 by KN, replaced per OSSIV3.0-N-09.0776-4 on 9/16/09 and again on 5/20/10 per OSSIV3.0-N-10.0924-1 by JB. Figure replaced per OSSIV3.0-N-10.0962-5 on 1/21/11, per OSSIV3.0-N-11.0996-1 on 6/2/11 and per OSSIV3.0-N-11.1025 on 2/29/12 by JB; per OSSIV3.1-N-14.1151-2 on 7/14/14 by PO.

References: [MULPI] Service Flows and Classifiers section.

**Table O-22 - PktClass Object<sup>323</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	Key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	Unsigned32	key	1..4294967295	N/A	N/A
Id	unsignedInt	key	1..65535	N/A	N/A
Direction	IfDirection	read-only		N/A	N/A
Priority	unsignedByte	read-only		N/A	N/A
IpTosLow	hexBinary	read-only		N/A	N/A
IpTosHigh	hexBinary	read-only		N/A	N/A
IpTosMask	hexBinary	read-only		N/A	N/A
IpProtocol	unsignedShort	read-only		N/A	N/A
IpSourceAddr	InetAddress	read-only		N/A	N/A
IpSourceMask	InetAddress	read-only		N/A	N/A
IpDestAddr	InetAddress	read-only		N/A	N/A
IpDestMask	InetAddress	read-only		N/A	N/A
SourcePortStart	InetPortNumber	read-only		N/A	N/A
SourcePortEnd	InetPortNumber	read-only		N/A	N/A
DestPortStart	InetPortNumber	read-only		N/A	N/A
DestPortEnd	InetPortNumber	read-only		N/A	N/A
IcmpTypeLow	unsignedByte	read-only		N/A	N/A
IcmpTypeHigh	unsignedByte	read-only		N/A	N/A
DestMacAddr	MacAddress	read-only		N/A	N/A
DestMacMask	MacAddress	read-only		N/A	N/A
SourceMacAddr	MacAddress	read-only		N/A	N/A
EnetProtocolType	Enum	read-only		N/A	N/A
EnetProtocol	Integer32	read-only	0..65535	N/A	N/A
UserPriLow	unsignedByte	read-only		N/A	N/A
UserPriHigh	unsignedByte	read-only		N/A	N/A
VlanId	unsignedInt	read-only		N/A	N/A
State	Enum	read-only	active(1) inactive(2)	N/A	N/A
Pkts	Counter64	read-only		packets	
BitMap	EnumBits	read-only		N/A	N/A
IpAddrType	InetAddressType	read-only		N/A	N/A
FlowLabel	unsignedInt	read-only	0..1048575	N/A	N/A
CmlInterfaceMask	DocsL2vpnIfList	read-only		N/A	N/A

#### O.2.8.1.1 ifIndex

This key represents the interface index of the MAC Domain of the Service Flow.

#### O.2.8.1.2 ServiceFlowId

This key represents an identifier assigned to a Service Flow by CMTS within a MAC Domain. The value 0 is used only for the purpose of reporting instances pertaining UDCs and not used for association of QOS classifiers to service flows.

<sup>323</sup> Revised per OSSIV3.0-11.1025 on 2/29/12 by JB.

#### O.2.8.1.3 *Id*

This key indicates the assigned identifier to the packet classifier instance by the CMTS, which is unique per Service Flow. For UDCs this corresponds to the Service Flow Reference of the classifier.

References: [MULPI] Classifier Identifier section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.4 *Direction*

This attribute indicates the direction to which the classifier is applied.

#### O.2.8.1.5 *Priority*

This attribute specifies the order of evaluation of the classifiers. The higher the value, the higher the priority. The value of 0 is used as default in provisioned Service Flows Classifiers. The default value of 64 is used for dynamic Service Flow Classifiers. If the referenced parameter is not present in a classifier, this attribute reports the default value as defined above.

References: [MULPI] Rule Priority section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.6 *IpTosLow*

This attribute indicates the low value of a range of TOS byte values. If the referenced parameter is not present in a classifier, this attribute reports the value of 0. The IP TOS octet as originally defined in [RFC 791] has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). This object is defined as an 8-bit octet as defined by the DOCSIS Specification for packet classification.

References: [MULPI] IPv4 Type of Service Range and Mask and IPv6 Traffic Class Range and Mask sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.7 *IpTosHigh*

This attribute indicates the 8-bit high value of a range of TOS byte values. If the referenced parameter is not present in a classifier, this attribute reports the value of 0. The IP TOS octet as originally defined in [RFC 791] has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). This object is defined as an 8-bit octet as defined by the DOCSIS Specification for packet classification.

References: [MULPI] IPv4 Type of Service Range and Mask and IPv6 Traffic Class Range and Mask sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.8 *IpTosMask*

This attribute indicates the mask value is bitwise ANDed with TOS byte in an IP packet, and this value is used for range checking of TosLow and TosHigh. If the referenced parameter is not present in a classifier, this attribute reports the value of 0. The IP TOS octet as originally defined in [RFC 791] has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). This object is defined as an 8-bit octet per the DOCSIS Specification for packet classification.

References: [MULPI] IPv4 Type of Service Range and Mask and IPv6 Traffic Class Range and Mask sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.9 *IpProtocol*

This attribute indicates the value of the IP Protocol field required for IP packets to match this rule. The value 256 matches traffic with any IP Protocol value. The value 257 by convention matches both TCP and UDP. If the referenced parameter is not present in a classifier, this attribute reports the value of 258.

References: [MULPI] IP Protocol and IPv6 Next Header Type sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.10 *IpSourceAddr*

This attribute specifies the value of the IP Source Address required for packets to match this rule. An IP packet matches the rule when the packet IP Source Address bitwise ANDed with the IpSourceMask value equals the

*IpSourceAddr* value. The address type of this object is specified by *IpAddrType*. If the referenced parameter is not present in a classifier, this object reports the value of '00000000'H.

References: [MULPI] IPv4 Source Address and IPv6 Source Address sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.11 *IpSourceMask*

This attribute specifies which bits of a packet's IP Source Address are compared to match this rule. An IP packet matches the rule when the packet source address bitwise ANDed with the *IpSourceMask* value equals the *IpSourceAddr* value. The address type of this attribute is specified by *IpAddrType*. If the referenced parameter is not present in a classifier, this attribute reports the value of 'FFFFFFFFH'.

References: [MULPI] IPv4 Source Mask and IPv6 Source Prefix Length (bits) sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.12 *IpDestAddr*

This attribute specifies the value of the IP Destination Address required for packets to match this rule. An IP packet matches the rule when the packet IP Destination Address bitwise ANDed with the *IpDestMask* value equals the *IpDestAddr* value. The address type of this attribute is specified by *IpAddrType*. If the referenced parameter is not present in a classifier, this attribute reports the value of '00000000H'.

References: [MULPI] IPv4 Destination Address and IPv6 Destination Address sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.13 *IpDestMask*

This attribute specifies which bits of a packet's IP Destination Address are compared to match this rule. An IP packet matches the rule when the packet destination address bitwise ANDed with the *IpDestMask* value equals the *IpDestAddr* value. The address type of this attribute is specified by *IpAddrType*. If the referenced parameter is not present in a classifier, this attribute reports the value of 'FFFFFFFFH'.

References: [MULPI] IPv4 Destination Mask and IPv6 Destination Prefix Length (bits) sections in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.14 *SourcePortStart*

This attribute specifies the low-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets. If the referenced parameter is not present in a classifier, this attribute reports the value of 0.

References: [MULPI] TCP/UDP Source Port Start section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.15 *SourcePortEnd*

This attribute specifies the high-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets. If the referenced parameter is not present in a classifier, this attribute reports the value of 65535.

References: [MULPI] TCP/UDP Source Port End section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.16 *DestPortStart*

This attribute specifies the low-end inclusive range of TCP/UDP destination port numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 0.

References: [MULPI] TCP/UDP Destination Port Start section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.17 *DestPortEnd*

This attribute specifies the high-end inclusive range of TCP/UDP destination port numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 65535.

References: [MULPI] TCP/UDP Destination Port End section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.18 *IcmpTypeLow*<sup>324</sup>

This attribute specifies the low-end inclusive range of the ICMP type numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 0.

References: [MULPI] TypeLow encodings section of the Common Radio Frequency Interface Annex.

#### O.2.8.1.19 *IcmpTypeHigh*

This attribute specifies the high-end inclusive range of the ICMP type numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 255.

References: [MULPI] TypeHigh encodings section of the Common Radio Frequency Interface Annex.

#### O.2.8.1.20 *DestMacAddr*

An Ethernet packet matches an entry when its destination MAC address bitwise ANDed with DestMacMask equals the value of DestMacAddr. If the referenced parameter is not present in a classifier, this attribute reports the value of '000000000000'H.

References: [MULPI] Destination MAC Address section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.21 *DestMacMask*

An Ethernet packet matches an entry when its destination MAC address bitwise ANDed with DestMacMask equals the value of DestMacAddr. If the referenced parameter is not present in a classifier, this attribute reports the value of '000000000000'H.

References: [MULPI] Destination MAC Address section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.22 *SourceMacAddr*

An Ethernet packet matches this entry when its source MAC address equals the value of this attribute. If the referenced parameter is not present in a classifier, this attribute reports the value of 'FFFFFFFFFFFF'.

References: [MULPI] Source MAC Address section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.23 *EnetProtocolType*

This attribute indicates the format of the layer 3 protocol ID in the Ethernet packet. A value of 'none' means that the rule does not use the layer 3 protocol type as a matching criteria. A value of 'ethertype' means that the rule applies only to frames that contain an EtherType value. EtherType values are contained in packets using the Dec-Intel-Xerox (DIX) encapsulation or the RFC1042 Sub-Network Access Protocol (SNAP) encapsulation formats. A value of 'dsap' means that the rule applies only to frames using the IEEE802.3 encapsulation format with a Destination Service Access Point (DSAP) other than 0xAA (which is reserved for SNAP). A value of 'mac' means that the rule applies only to MAC management messages for MAC management messages. A value of 'all' means that the rule matches all Ethernet packets. If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1P/Q header. If the referenced parameter is not present in a classifier, this attribute reports the value of 0.

References: [MULPI] Ethertype/DSAP/MacType section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.1.24 *EnetProtocol*

If EnetProtocolType is 'none', this attribute is ignored when considering whether a packet matches the current rule. If EnetProtocolType is 'ethertype', this attribute gives the 16-bit value of the EtherType that the packet must match in order to match the rule. If EnetProtocolType is 'dsap', the lower 8 bits of this attribute's value must match the DSAP byte of the packet in order to match the rule. If EnetProtocolType is 'mac', the lower 8 bits of this attribute's

<sup>324</sup> Revised per OSSIV3.0-N-12.1064-3 on 7/24/12 by JS.

value represent a lower bound (inclusive) of MAC management message type codes matched, and the upper 8 bits represent the upper bound (inclusive) of matched MAC message type codes. Certain message type codes are excluded from matching, as specified in the reference. If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1P/Q header. If the referenced parameter is not present in the classifier, the value of this attribute is reported as 0.

References: [MULPI] Ethertype/DSAP/MacType section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.1.25 UserPriLow*

This attribute applies only to Ethernet frames using the 802.1P/Q tag header (indicated with EtherType 0x8100). Such frames include a 16-bit Tag that contains a 3-bit Priority field and a 12-bit VLAN number. Tagged Ethernet packets must have a 3-bit Priority field within the range of PriLow to PriHigh in order to match this rule. If the referenced parameter is not present in the classifier, the value of this attribute is reported as 0.

References: [MULPI] IEEE 802.1P User\_Priority section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.1.26 UserPriHigh*

This attribute applies only to Ethernet frames using the 802.1P/Qtag header (indicated with EtherType 0x8100). Such frames include a 16-bit Tag that contains a 3-bit Priority field and a 12-bit VLAN number. Tagged Ethernet packets must have a 3-bit Priority field within the range of PriLow to PriHigh in order to match this rule. If the referenced parameter is not present in the classifier, the value of this attribute is reported as 7.

References: [MULPI] IEEE 802.1P User\_Priority section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.1.27 VlanId*

This attribute applies only to Ethernet frames using the 802.1P/Q tag header. Tagged packets must have a VLAN Identifier that matches the value in order to match the rule. If the referenced parameter is not present in the classifier, the value of this attribute is reported as 0.

References: [MULPI] IEEE 802.1Q VLAN\_ID section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.1.28 State*

This attribute indicates whether or not the classifier is enabled to classify packets to a Service Flow. If the referenced parameter is not present in the classifier, the value of this attribute is reported as 'true'.

References: [MULPI] Classifier Activation State section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.1.29 Pkts*

This attribute counts the number of packets that have been classified using this entry. This includes all packets delivered to a Service Flow maximum rate policing function, whether or not that function drops the packets. This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this attribute.

#### *O.2.8.1.30 BitMap*

This attribute indicates which parameter encodings were actually present in the DOCSIS packet classifier encoding signaled in the DOCSIS message that created or modified the classifier. Note that Dynamic Service Change messages have replace semantics, so that all non-default parameters must be present whether the classifier is being created or changed. A bit of this attribute is set to 1 if the parameter indicated by the comment was present in the classifier encoding, and to 0 otherwise. Note that BITS are encoded most significant bit first, so that if, for example, bits 6 and 7 are set, this attribute is encoded as the octet string '030000'H.

#### *O.2.8.1.31 IpAddrType*

This attribute indicates the type of the Internet address for IpSourceAddr, IpSourceMask, IpDestAddr, and IpDestMask. If the referenced parameter is not present in a classifier, this object reports the value of 'ipv4'.

### 0.2.8.1.32 *FlowLabel*

This attribute represents the Flow Label field in the IPv6 header to be matched by the classifier. The value zero indicates that the Flow Label is not specified as part of the classifier and is not matched against the packets.

References: [MULPI] IPv6 Flow Label section in the Common Radio Frequency Interface Encodings Annex.

### 0.2.8.1.33 *CmInterfaceMask*

This attribute represents a bit-mask of the CM in-bound interfaces to which this classifier applies. This attribute only applies to QOS upstream Classifiers and upstream Drop Classifiers. For QOS downstream classifiers this object reports the zero-length string.

References: [MULPI] CM Interface Mask (CMIM) Encoding section in the Common Radio Frequency Interface Encodings Annex.

## 0.2.8.2 *ParamSet Object*

This object describes the set of QOS parameters defined in a managed device. DOCSIS 1.0 COS service profiles are not represented in this object. Each row corresponds to a DOCSIS QOS Parameter Set as signaled via DOCSIS MAC management messages. Each attribute of an instance of this object corresponds to one or part of oneService Flow Encoding. The BitMap attribute indicates which particular parameters were signaled in the original registration or dynamic service request message that created the QOS Parameter Set. In many cases, even if a QOS Parameter Set parameter was not signaled, the DOCSIS specification calls for a default value to be used. That default value is reported as the value of the corresponding attribute in this object instance. Many attributes are not applicable, depending on the Service Flow direction, upstream scheduling type or Service Flow bonding configuration. The attribute value reported in this case is specified by those attributes descriptions.

References: [MULPI] Service Flow Encodings section in the Common Radio Frequency Interface Encodings Annex.

**Table O-23 - ParamSet Object<sup>325</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default (See attribute Description)
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceClassName	AdminString	read-only	SIZE (0..15)	N/A	N/A
Priority	unsignedByte	read-only	0..7	N/A	N/A
MaxTrafficRate	BitRate	read-only		bps	N/A
MaxTrafficBurst	unsignedInt	read-only		bytes	N/A
MinReservedRate	BitRate	read-only		bps	N/A
MinReservedPkt	unsignedShort	read-only		bytes	N/A
ActiveTimeout	unsignedShort	read-only		seconds	N/A
AdmittedTimeout	unsignedShort	read-only		seconds	N/A
MaxConcatBurst	unsignedShort	read-only		bytes	N/A
SchedulingType	SchedulingType	read-only		N/A	N/A
NomPollInterval	unsignedInt	read-only		microseconds	N/A
TolPollJitter	unsignedInt	read-only		microseconds	N/A
UnsolicitGrantSize	unsignedShort	read-only		bytes	N/A
NomGrantInterval	unsignedInt	read-only		microseconds	N/A
TolGrantJitter	unsignedInt	read-only		microseconds	N/A
GrantsPerInterval	unsignedByte	read-only	0..127	dataGrants	N/A
TosAndMask	hexBinary	read-only	SIZE (1)	N/A	N/A

<sup>325</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09. Revised per OSSIV3.0-N-10.0962-5 on 1/21/11 by JB.

Attribute Name	Type	Access	Type Constraints	Units	Default (See attribute Description)
TosOrMask	hexBinary	read-only	SIZE (1)	N/A	N/A
MaxLatency	unsignedInt	read-only		microseconds	N/A
Type	Enum	key	active (1) admitted (2) provisioned (3)	N/A	N/A
RequestPolicyOct	hexBinary	read-only	SIZE (4)	N/A	N/A
BitMap	EnumBits	read-only	trafficPriority(0) maxTrafficRate(1) maxTrafficBurst(2) minReservedRate(3) minReservedPkt(4) activeTimeout(5) admittedTimeout(6) maxConcatBurst(7) schedulingType(8) requestPolicy(9) nomPollInterval(10) tolPollJitter(11) unsolicitGrantSize(12) nomGrantInterval(13) tolGrantJitter(14) grantsPerInterval(15) tosOverwrite(16) maxLatency(17) requiredAttrMask(18) forbiddenAttrMask(19) attrAggrMask(20) applicationId(21) multipCntnReqWindow(22) multipBytesReq(23) maxReqPerSidCluster(24) maxOutstandingBytesPerSidCluster(25) maxTotalBytesReqPerSidCluster(26) maximumTimeInSidCluster(27) peakTrafficRate(28) dsResequencing(29)		N/A
ServiceFlowId	unsignedInt	key	1.. 4294967295		N/A
RequiredAttrMask	AttributeMask	read-only			N/A
ForbiddenAttrMask	AttributeMask	read-only			N/A
AttrAggrRuleMask	AttrAggrRuleMask	read-only	SIZE (0   4)		N/A
Appld	unsignedInt	read-only			N/A
MultiplierContentionReqWindow	unsignedByte	read-only	0   4..12	eighths	N/A
MultiplierBytesReq	unsignedByte	read-only	1   2   4   8   16	requests	N/A
MaxReqPerSidCluster	unsignedByte	read-only		bytes	N/A
MaxOutstandingBytesPerSidCluster	unsignedInt	read-only		bytes	N/A

Attribute Name	Type	Access	Type Constraints	Units	Default (See attribute Description)
MaxTotBytesReqPerSidCluster	unsignedInt	read-only		bytes	N/A
MaxTimeInSidCluster	unsignedShort	read-only		milliseconds	N/A
PeakTrafficRate	unsignedInt	read-only		bps	N/A
DsResequencing	Enum	read-only	resequencingDsidIfBonded(0) noResequencingDsid(1) notApplicable(2)	NA	N/A
MinimumBuffer	unsignedInt	read-only		bytes	N/A
TargetBuffer	unsignedInt	read-only		bytes	N/A
MaximumBuffer	unsignedInt	read-only		bytes	N/A

#### O.2.8.2.1 *ifIndex*

This key represents the interface index of the MAC Domain of the Service Flow.

#### O.2.8.2.2 *ServiceClassName*

This attribute represents the Service Class Name from which the parameter set values were derived. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns the zero-length string.

References: [MULPI] Service Class Name section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.3 *Priority*

This attribute represents the relative priority of a Service Flow. Higher numbers indicate higher priority. This priority should only be used to differentiate Service Flow from identical parameter sets. This attribute returns 0 if the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set or if the parameter is not applicable.

References: [MULPI] Traffic Priority section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.4 *MaxTrafficRate*

This attribute represents the maximum sustained traffic rate allowed for this Service Flow in bits/sec. It counts all MAC frame data PDUs from the bytes following the MAC header HCS to the end of the CRC. The number of bytes forwarded is limited during any time interval. The value 0 means no maximum traffic rate is enforced. This attribute applies to both upstream and downstream Service Flows. This attribute returns 0 if the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, or if the parameter is not applicable.

References: [MULPI] Maximum Sustained Traffic Rate section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.5 *MaxTrafficBurst*

This attribute specifies the token bucket size in bytes for this parameter set. The value is calculated from the byte following the MAC header HCS to the end of the CRC. This object is applied in conjunction with MaxTrafficRate to calculate maximum sustained traffic rate. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 3044 for scheduling types 'bestEffort', 'nonRealTimePollingService' and 'realTimePollingService'. If this parameter is not applicable, it is reported as 0.

References: [MULPI] Maximum Traffic Burst section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.6 *MinReservedRate*

This attribute specifies the guaranteed minimum rate in bits/sec for this parameter set. The value is calculated from the byte following the MAC header HCS to the end of the CRC. The value of 0 indicates that no bandwidth is

reserved. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0. If the parameter is not applicable, it is reported as 0.

References: [MULPI] Minimum Reserved Traffic Rate section of the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.7 MinReservedPkt*

This attribute specifies an assumed minimum packet size in bytes for which the MinReservedRate will be provided. The value is calculated from the byte following the MAC header HCS to the end of the CRC. If the referenced parameter is omitted from a DOCSIS QOS parameter set, the used and reported value is CMTS implementation and the CM reports a value of 0. If the referenced parameter is not applicable to the direction or scheduling type of the Service Flow, both CMTS and CM report the value 0.

References: [MULPI] Assumed Minimum Reserved Rate Packet Size, in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.8 ActiveTimeout*

This attribute specifies the maximum duration in seconds that resources remain unused on an active service flow before the CMTS signals that both the active and admitted parameter sets are null. The value 0 signifies an infinite amount of time. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0.

References: [MULPI] Timeout for Active QoS Parameters section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.9 AdmittedTimeout*

This attribute specifies the maximum duration in seconds that resources remain in admitted state before resources must be released. The value of 0 signifies an infinite amount of time. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 200.

References: [MULPI] Timeout for Admitted QoS Parameters section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.10 MaxConcatBurst*

This attribute specifies the maximum concatenated burst in bytes that an upstream Service Flow is allowed. The value is calculated from the FC byte of the Concatenation MAC Header to the last CRC byte of the last concatenated MAC frame, inclusive. The value of 0 specifies no maximum burst. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns the value of 1522 for scheduling types 'bestEffort', 'nonRealTimePollingService', and 'realTimePollingService'. If the parameter is not applicable, it is reported as 0.

References: [MULPI] Maximum Concatenated Burst section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.11 SchedulingType*

This attribute specifies the upstream scheduling service used for upstream Service Flow. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set of an upstream Service Flow, this attribute returns the value of 'bestEffort'. For QOS parameter sets of downstream Service Flows, this attribute's value is reported as 'undefined'.

References: [MULPI] Service Flow Scheduling Type section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.12 NomPollInterval*

This attribute specifies the nominal interval in microseconds between successive unicast request opportunities on an upstream Service Flow. This attribute applies only to upstream Service Flows with SchedulingType of value 'nonRealTimePollingService', 'realTimePollingService', and 'unsolicitedGrantServiceWithAD'. The parameter is mandatory for 'realTimePollingService'. If the parameter is omitted with 'nonRealTimePollingService', the CMTS uses an implementation-dependent value. If the parameter is omitted with 'unsolicitedGrantServiceWithAD(5)' the

CMTS uses the value of the Nominal Grant Interval parameter. In all cases, the CMTS reports the value it is using when the parameter is applicable. The CM reports the signaled parameter value if it was signaled. Otherwise, it returns 0. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Polling Interval section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.13 TolPollJitter*

This attribute specifies the maximum amount of time in microseconds that the unicast request interval may be delayed from the nominal periodic schedule on an upstream Service Flow. This parameter is applicable only to upstream Service Flows with a SchedulingType of 'realTimePollingService' or 'unsolicitedGrantServiceWithAD'. If the referenced parameter is applicable but not present in the corresponding DOCSIS QOS Parameter Set, the CMTS uses an implementation-dependent value and reports the value it is using. The CM reports a value of 0 in this case. If the parameter is not applicable to the direction or upstream scheduling type of the Service Flow, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Tolerated Poll Jitter section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.14 UnsolicitGrantSize*

This attribute specifies the unsolicited grant size in bytes. The grant size includes the entire MAC frame data PDU from the Frame Control byte to the end of the MAC frame. The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServiceWithAD' or 'unsolicitedGrantService', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Unsolicited Grant Size section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.15 NomGrantInterval*

This attribute specifies the nominal interval in microseconds between successive data grant opportunities on an upstream Service Flow. The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServiceWithAD' or 'unsolicitedGrantService(6)', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Nominal Grant Interval section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.16 TolGrantJitter*

This attribute specifies the maximum amount of time in microseconds that the transmission opportunities may be delayed from the nominal periodic schedule. The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServiceWithAD' or 'unsolicitedGrantService(6)', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Tolerated Grant Jitter section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.17 GrantsPerInterval*

This attribute specifies the number of data grants per Nominal Grant Interval (NomGrantInterval). The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServiceWithAD' or 'unsolicitedGrantService', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0.

References: [MULPI] Grants per Interval section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.18 *TosAndMask*

This attribute specifies the AND mask for the IP TOS byte for overwriting an IPv4 packet's TOS value or IPv6 packet's Traffic Class value. The IP packet TOS byte is bitwise ANDed with TosAndMask, then the result is bitwise ORed with TosORMask and the result is written to the IP packet TOS byte. A value of 'FFH' for TosAndMask and a value of '00H' for TosOrMask means that the IP Packet TOS byte is not overwritten. This combination is reported if the referenced parameter is not present in a QOS Parameter Set. The IP TOS octet as originally defined in [RFC 791] has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). The IPv6 Traffic Class octet [RFC 2460] is consistent with that new definition. Network operators should avoid specifying values of TosAndMask and TosORMask that would result in the modification of the ECN bits. In particular, operators should not use values of TosAndMask that have either of the least-significant two bits set to 0. Similarly, operators should not use values of TosORMask that have either of the least-significant two bits set to 1. Even though this attribute is only enforced by the CMTS, the CM reports the value as signaled in the referenced parameter.

References: [MULPI] IP Type Of Service (DSCP) Overwrite section in the Common Radio Frequency Interface Encodings Annex; [RFC 3168]; [RFC 3260]; [RFC 2460]; [RFC 791].

#### O.2.8.2.19 *TosOrMask*

This attribute specifies the OR mask for the IPv4 TOS value or IPv6 Traffic Class value. See the description of TosAndMask for further details. The IP TOS octet, as originally defined in [RFC 791] has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). The IPv6 Traffic Class octet [RFC 2460] is consistent with that new definition. Network operators should avoid specifying values of TosAndMask and TosORMask that would result in the modification of the ECN bits.

References: [MULPI] IP Type Of Service (DSCP) Overwrite section in the Common Radio Frequency Interface Encodings Annex; [RFC 3168]; [RFC 3260]; [RFC 2460]; [RFC 791].

#### O.2.8.2.20 *MaxLatency*

This attribute specifies the maximum latency between the reception of a packet by the CMTS on its NSI and the forwarding of the packet to the RF interface. A value of 0 signifies no maximum latency is enforced. This attribute only applies to downstream Service Flows. If the referenced parameter is not present in the corresponding downstream DOCSIS QOS Parameter Set, this attribute returns 0. This parameter is not applicable to upstream DOCSIS QOS Parameter Sets, so its value is reported as 0 in that case.

References: [MULPI] Maximum Downstream Latency section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.21 *Type*

This key represents the QoS Parameter Set Type of the Service Flow. The following values are defined: 'active' Indicates the Active QOS parameter set, describing the service currently being provided by the DOCSIS MAC domain to the service flow. 'admitted' Indicates the Admitted QOS Parameter Set, describing services reserved by the DOCSIS MAC domain for use by the service flow. 'provisioned' Indicates the QOS Parameter Set defined in the DOCSIS CM Configuration file for the service flow.

References: [MULPI] Service Flow Scheduling Type section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.2.22 *RequestPolicyOct*

This attribute specifies which transmit interval opportunities the CM omits for upstream transmission requests and packet transmissions. This object takes its default value for downstream Service Flows. Unless otherwise indicated, a bit value of 1 means that a CM must not use that opportunity for upstream transmission. The format of this string enumerated the bits from 0 to 31 from left to right, for example bit 0 corresponds to the left most bit of the fourth octet. (octets numbered from right to left). The bit positions are defined as follows:

'broadcastReqOpp' all CMs broadcast request opportunities

'priorityReqMulticastReq' priority request multicast request opportunities

'reqDataForReq' request/data opportunities for requests  
'reqDataForData' request/data opportunities for data  
'piggybackReqWithData' piggyback requests with data  
'concatenateData' concatenate data  
'fragmentData' fragment data  
'suppressPayloadHeaders' suppress payload headers

'dropPktsExceedUGSize' A value of 1 means that the service flow must drop packets that do not fit in the Unsolicited Grant size. If the referenced parameter is not present in a QOS Parameter Set, the value of this object is reported as '00000000'H.

References: [MULPI] Request/ Transmission Policy section in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.8.2.23 BitMap<sup>326</sup>

This attribute indicates the set of QOS Parameter Set parameters actually signaled in the DOCSIS registration or dynamic service request message that created or modified the QOS Parameter Set. A bit is set to 1 when the associated parameter is present in the original request as follows:

'trafficPriority' Traffic Priority  
'maxTrafficRate' Maximum Sustained Traffic Rate  
'maxTrafficBurst' Maximum Traffic Burst  
'minReservedRate' Minimum Reserved Traffic Rate  
'minReservedPkt' Assumed Minimum Reserved Rate Packet Size  
'activeTimeout' Timeout for Active QoS Parameters  
'admittedTimeout' Timeout for Admitted QoS Parameters  
'maxConcatBurst' Maximum Concatenated Burst  
'schedulingType' Service Flow Scheduling Type  
'requestPolicy' Request/Transmission Policy  
'nomPollInterval' Nominal Polling Interval  
'tolPollJitter' Tolerated Poll Jitter  
'unsolicitGrantSize' Unsolicited Grant Size  
'nomGrantInterval' Nominal Grant Interval  
'tolGrantJitter' Tolerated Grant Jitter  
'grantsPerInterval' Grants per Interval  
'tosOverwrite' IP Type of Service (DSCP) Overwrite  
'maxLatency' Maximum Downstream Latency  
'requiredAttrMask' Service Flow Required Attribute Mask  
'forbiddenAttrMask' Service Flow Forbidden Attribute Mask  
'attrAggrMask' Service Flow Attribute Aggregation Mask  
'applicationId' Application Identifier

<sup>326</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09 and per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

'multipCntnReqWindow' Multiplier to Contention Request Backoff Window  
 'multipBytesReq' Multiplier to Number of Bytes Requested  
 'maxReqPerSidCluster' Maximum Requests per SID Cluster  
 'maxOutstandingBytesPerSidCluster' Maximum Outstanding Bytes per SID Cluster  
 'maxTotalBytesReqPerSidCluster' Maximum Total Bytes Requested per SID Cluster  
 'maximumTimeInSidCluster' Maximum Time in the SID Cluster  
 'peakTrafficRate' Peak Traffic Rate  
 'dsResequencing' Downstream Resequencing

Note that when Service Class names are expanded, the registration or dynamic response message may contain parameters expanded by the CMTS based on a stored service class. These expanded parameters are not indicated by a 1 bit in this attribute. Note that even though some QOS Parameter Set parameters may not be signaled in a message (so that the parameter's bit in this object is 0), the DOCSIS specification requires that default values be used. These default values are reported as the corresponding attribute.

References: [MULPI] Service Flow Encodings section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.24 ServiceFlowId*

This key represents the Service Flow ID for the service flow.

References: [MULPI] Service Identifier section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.25 RequiredAttrMask*

This attribute specifies the Required Attribute Mask to compare with the Provisioned Required Attributes when selecting the bonding groups for the service flow.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns '00000000'H.

References: [MULPI] Service Flow Required Attribute Mask section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.26 ForbiddenAttrMask*

This attribute specifies the Forbidden Attribute Mask to compare with the Provisioned Forbidden Attributes when selecting the bonding groups for the service flow.

References: [MULPI] Service Flow Forbidden Attribute Mask section in the Common Radio Frequency Interface Encodings Annex.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns '00000000'H.

#### *O.2.8.2.27 AttrAggrRuleMask*

This attribute specifies the Attribute Aggregation Mask to compare the Service Flow Required and Forbidden Attributes with the CMTS dynamically-created bonding group when selecting the bonding groups for the service flow.

References: [MULPI] Service Flow Attribute Aggregation Mask section in the Common Radio Frequency Interface Encodings Annex.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns '00000000'H.

#### *O.2.8.2.28 AppId*

This attribute represents the Application Identifier associated with the service flow for purposes beyond the scope of this specification.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0.

References: [MULPI] Application Identifier section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.29 MultiplierContentionReqWindow*

This attribute specifies the multiplier to be applied by a CM when performing contention request backoff for data requests. This attribute only applies to upstream Service Flows in 3.0 operation. If the referenced parameter is not present in the upstream DOCSIS QOS Parameter Set, or is not applicable, this attribute returns 8.

References: [MULPI] Multiplier to Contention Request Backoff Window section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.30 MultiplierBytesReq*

This attribute specifies the assumed bandwidth request multiplier. This attribute only applies to upstream Service Flows in 3.0 operation. If the referenced parameter is not present in the upstream DOCSIS QOS Parameter Set, or is not applicable, this attribute returns 4.

References: [MULPI] Multiplier to Number of Bytes Requested section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.31 MaxReqPerSidCluster*<sup>327</sup>

This attribute specifies the maximum number of requests that a CM can make within a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0. If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with MaxReqPerSidCluster in the ServiceFlow object.

References: [MULPI] Maximum Requests per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.32 MaxOutstandingBytesPerSidCluster*<sup>328</sup>

This attribute specifies the maximum number of bytes for which a CM can have requests outstanding on a given SID Cluster. If defined number of bytes are outstanding and further requests are required, the CM must switch to a different SID Cluster if one is available. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0. If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with MaxOutstandingBytesPerSidCluster in the ServiceFlow object.

References: [MULPI] Maximum Outstanding Bytes per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### *O.2.8.2.33 MaxTotBytesReqPerSidCluster*<sup>329</sup>

This attribute specifies the maximum total number of bytes a CM can have requested using a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0. If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with MaxTotBytesReqPerSidCluster in the ServiceFlow object.

<sup>327</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

<sup>328</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

<sup>329</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

References: [MULPI] Maximum Total Bytes Requested per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.34 *MaxTimeInSidCluster***<sup>330</sup>

This attribute specifies the maximum time in milliseconds that a CM may use a particular SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0. If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with MaxTimeInSidCluster in the ServiceFlow object.

References: [MULPI] Maximum Time in the SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.35 *PeakTrafficRate***<sup>331</sup>

This attribute specifies the rate parameter 'P' of a token-bucket-based peak rate limiter for packets of a service flow. A value of 0 signifies no Peak Traffic Rate is enforced. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0.

References: [MULPI] Peak Traffic Rate section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.36 *DsResequencing***<sup>332</sup>

This attribute specifies if a resequencing DSID needs to be allocated to the service flow.

The value 'notApplicable' indicates the value of this attribute is not applicable.

The value 'resequencingDsid' indicates that a resequencing DSID is required if the service flow is assigned to a downstream bonding group

The value 'noResequencingDsid' indicates no resequencing DSID is associated with the service flow.

This attribute only applies to downstream Service Flows in 3.0 operation. If the referenced parameter is not present in the corresponding downstream DOCSIS QOS Parameter Set, this attribute returns 'notApplicable'. This parameter is not applicable to upstream DOCSIS QOS Parameter Sets, so the value 'notApplicable' is reported in that case.

References: [MULPI] Downstream Resequencing section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.37 *MinimumBuffer***<sup>333</sup>

This attribute represents the configured minimum buffer size for the service flow.

References: [MULPI] Buffer Control section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.38 *TargetBuffer***<sup>334</sup>

This attribute represents the configured target buffer size for the service flow. The value 0 indicates that no target buffer size was configured, and the device will use a vendor specific value.

References: [MULPI] Buffer Control section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.2.39 *MaximumBuffer***<sup>335</sup>

This attribute represents the configured maximum buffer size for the service flow. The value 4294967295 indicates that no maximum buffer size was configured, and thus there is no limit to the buffer size.

References: [MULPI] Buffer Control section in the Common Radio Frequency Interface Encodings Annex.

<sup>330</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

<sup>331</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

<sup>332</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09.

<sup>333</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>334</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>335</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

### 0.2.8.3 ServiceFlow Object <sup>336</sup>

This object describes the set of DOCSIS-QOS Service Flows in a managed device.

References: [MULPI] Service Flows and Classifiers section.

**Table O-24 - ServiceFlow Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
Id	unsignedInt	key		N/A	N/A
SID	unsignedShort	read-only		N/A	N/A
Direction	IfDirection	read-only		N/A	N/A
Primary	boolean	read-only		N/A	N/A
ParamSetTypeStatus	EnumBits	read-only	active(0) admitted(1) provisioned(2)	N/A	N/A
ChSetId	ChSetId	read-only		N/A	N/A
AttrAssignSuccess	boolean	read-only		N/A	N/A
Dsid	Dsid	read-only		N/A	N/A
MaxReqPerSidCluster	unsignedByte	read-only		requests	N/A
MaxOutstandingBytesPerSidCluster	unsignedInt	read-only		bytes	N/A
MaxTotBytesReqPerSidCluster	unsignedInt	read-only		bytes	N/A
MaxTimeInSidCluster	unsignedShort	read-only		milliseconds	N/A
BufferSize	unsignedInt	read-only		bytes	N/A

#### 0.2.8.3.1 ifIndex

This key represents the interface index of the MAC Domain of the Service Flow.

#### 0.2.8.3.2 Id

This key represents an identifier assigned to a Service Flow by CMTS within a MAC Domain. The value 0 is used only for the purpose of reporting instances of the PktClass object pertaining UDCs and not used for association of QOS classifiers to service flows.

References: [MULPI] Service Flow Identifier section in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.8.3.3 SID

Service Identifier (SID) assigned to an admitted or active Service Flow. This attribute reports a value of 0 if a Service ID is not associated with the Service Flow. Only active or admitted upstream Service Flows will have a Service ID (SID).

References: [MULPI] Service Identifier section in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.8.3.4 Direction

This attribute represents the direction of the Service Flow.

#### 0.2.8.3.5 Primary

This attribute reflects whether Service Flow is the primary or a secondary Service Flow.

#### 0.2.8.3.6 ParamSetTypeStatus

This attribute represents the status of the service flow based on the admission state. 'active' bit set to '1' indicates that the service flow is active and that the corresponding QOS ParamSet is stored in the CMTS. 'admitted' bit set to '1'

<sup>336</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 and per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

indicates that the service flow resources were reserved and that the corresponding QOS ParamSet is stored in the CMTS. 'provisioned' bit set to '1' indicates that the service flow was defined in the CM config file and that the corresponding QOS ParamSet is stored in the CMTS.

References: [MULPI] Service Flow Section.

#### **O.2.8.3.7 *ChSetId***

This attribute represents the Channel Set Id associated with the service flow.

#### **O.2.8.3.8 *AttrAssignSuccess***

If set to 'true', this attribute indicates that the current channel set associated with the service flow meets the Required and Forbidden Attribute Mask encodings. Since this attribute is not applicable for a CM, the CM always returns 'false'.

References: [MULPI] Service Flow section.

#### **O.2.8.3.9 *Dsid***

This attribute indicates the DSID associated with the downstream service flow. downstream service flows without a DSID or upstream Service Flows report the value zero.

#### **O.2.8.3.10 *MaxReqPerSidCluster***

This attribute specifies the maximum number of requests that a CM can make within a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

References: [MULPI] Maximum Requests per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.3.11 *MaxOutstandingBytesPerSidCluster***

This attribute specifies the maximum number of bytes for which a CM can have requests outstanding on a given SID Cluster. If defined number of bytes are outstanding and further requests are required, the CM must switch to a different SID Cluster if one is available. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

References: [MULPI] Maximum Outstanding Bytes per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.3.12 *MaxTotBytesReqPerSidCluster***

This attribute specifies the maximum total number of bytes a CM can have requested using a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

References: [MULPI] Maximum Total Bytes Requested per SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

#### **O.2.8.3.13 *MaxTimeInSidCluster***

This attribute specifies the maximum time in milliseconds that a CM may use a particular SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit. This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

References: [MULPI] Maximum Time in the SID Cluster section in the Common Radio Frequency Interface Encodings Annex.

### 0.2.8.3.14 *BufferSize*<sup>337</sup>

This attribute indicates the buffer size for the service flow. For the CM this attribute only applies to upstream Service Flows, for the CMTS this attribute only applies to downstream Service Flows, in other cases it is reported as 0.

References: [MULPI] Buffer Control section in the Common Radio Frequency Interface Encodings Annex.

### 0.2.8.4 *ServiceClass*<sup>338</sup>

This object describes a provisioned service class on a CMTS. Each object instance defines a template for certain DOCSIS QOS Parameter Set values. When a CM creates or modifies an Admitted QOS Parameter Set for a Service Flow, it may reference a Service Class Name instead of providing explicit QOS Parameter Set values. In this case, the CMTS populates the QOS Parameter Set with the applicable corresponding values from the named Service Class. Subsequent changes to a Service Class row do not affect the QOS Parameter Set values of any service flows already admitted. A service class template applies to only a single direction, as indicated in the ServiceClassDirection attribute.

**Table O-25 - ServiceClass Object<sup>339</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
Name	SnmpAdminString	key	SIZE(1..15)	N/A	N/A
Priority	unsignedByte	read-create		N/A	0
MaxTrafficRate	BitRate	read-create		bps	0
MaxTrafficBurst	unsignedInt	read-create		bytes	3044
MinReservedRate	BitRate	read-create		bps	0
MinReservedPkt	unsignedShort	read-create		bytes	N/A
MaxConcatBurst	unsignedShort	read-create		bytes	1522
NomPollInterval	unsignedInt	read-create		microseconds	0
TolPollJitter	unsignedInt	read-create		microseconds	0
UnsolicitGrantSize	unsignedShort	read-create		bytes	0
NomGrantInterval	unsignedInt	read-create		microseconds	0
TolGrantJitter	unsignedInt	read-create		microseconds	0
GrantsPerInterval	unsignedByte	read-create		dataGrants	0
MaxLatency	unsignedInt	read-create		microseconds	0
ActiveTimeout	unsignedShort	read-create		seconds	0
AdmittedTimeout	unsignedShort	read-create		seconds	200
SchedulingType	SchedulingType	read-create		N/A	bestEffort
RequestPolicy	hexBinary	read-create		N/A	'00000000'H
TosAndMask	hexBinary	read-create	SIZE(1)	N/A	N/A
TosOrMask	hexBinary	read-create	SIZE(1)	N/A	N/A
Direction	IfDirection	read-create		N/A	upstream
StorageType	StorageType	read-create		N/A	nonVolatile
DSCPOverwrite	DscpOrAny	read-create		N/A	-1
RequiredAttrMask	AttributeMask	read-create		N/A	'00000000'H
ForbiddenAttrMask	AttributeMask	read-create		N/A	'00000000'H
AttrAggregationMask	AttrAggrRuleMask	read-create		N/A	'00000000'H
Appld	unsignedInt	read-create		N/A	N/A
MultiplierContentionReqWindow	unsignedByte	read-create	4..12	eighths	8

<sup>337</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>338</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>339</sup> Revised per OSSIV3.0-N011.1019-1 on 11/7/11 by JB.

Attribute Name	Type	Access	Type Constraints	Units	Default
MultiplierBytesReq	unsignedByte	read-create	1   2   4   8   16	N/A	4
MaxReqPerSidCluster	unsignedByte	read-create	0 = unlimited	requests	0
MaxOutstandingBytesPerSidCluster	unsignedInt	read-create	0 = unlimited	bytes	0
MaxTotBytesReqPerSidCluster	unsignedInt	read-create	0 = unlimited	bytes	0
MaxTimeInSidCluster	unsignedShort	read-create	0 = unlimited	milliseconds	0
PeakTrafficRate	unsignedInt	read-create	0 = downstream peak traffic rate is not limited.	bps	0
DsResequencing	Enum	read-create	resequencingDsid(0) noResequencingDsid(1)	NA	0
MinimumBuffer	unsignedInt	read-create		bytes	0
TargetBuffer	unsignedInt	read-create	0 = vendor specific	bytes	0
MaximumBuffer	unsignedInt	read-create	4294967295 = unlimited	bytes	4294967295

#### 0.2.8.4.1 *Name*

This key indicates the Service Class Name associated with this object instance. DOCSIS specifies that the maximum size is 16 ASCII characters including a terminating zero. The terminating zero is not represented in this SnmpAdminString syntax attribute.

References: [MULPI] Service Class Name section in the Common Radio Frequency Interface Encodings Annex.

#### 0.2.8.4.2 *Priority*

This attribute is the template for the Priority attribute of the QoS Parameter Set.

#### 0.2.8.4.3 *MaxTrafficRate*

This attribute is the template for the MaxTrafficRate attribute of the QoS Parameter Set.

#### 0.2.8.4.4 *MaxTrafficBurst*

This attribute is the template for the MaxTrafficBurst attribute of the QoS Parameter Set.

#### 0.2.8.4.5 *MinReservedRate*

This attribute is the template for the MinReservedRate attribute of the QoS Parameter Set.

#### 0.2.8.4.6 *MinReservedPkt*

This attribute is the template for the MinReservedPkt attribute of the QoS Parameter Set.

#### 0.2.8.4.7 *MaxConcatBurst*

This attribute is the template for the MaxConcatBurst attribute of the QoS Parameter Set.

#### 0.2.8.4.8 *NomPollInterval*

This attribute is the template for the NomPollInterval attribute of the QoS Parameter Set.

#### 0.2.8.4.9 *TolPolJitter*

This attribute is the template for the TolPolJitter attribute of the QoS Parameter Set.

#### 0.2.8.4.10 *UnsolicitGrantSize*

This attribute is the template for the UnsolicitGrantSize attribute of the QoS Parameter Set.

#### 0.2.8.4.11 *NomGrantInterval*

This attribute is the template for the NomGrantInterval attribute of the QoS Parameter Set.

#### 0.2.8.4.12 *TolGrantJitter*

This attribute is the template for the TolGrantJitter attribute of the QoS Parameter Set.

#### O.2.8.4.13 GrantsPerInterval

This attribute is the template for the GrantsPerInterval attribute of the QoS Parameter Set.

#### O.2.8.4.14 MaxLatency

This attribute is the template for the MaxLatency attribute of the QoS Parameter Set.

#### O.2.8.4.15 ActiveTimeout

This attribute is the template for the ActiveTimeout attribute of the QoS Parameter Set.

#### O.2.8.4.16 AdmittedTimeout

This attribute is the template for the AddmitedTimeout attribute of the QoS Parameter Set.

#### O.2.8.4.17 SchedulingType

This attribute is the template for the SchedulingType attribute of the QoS Parameter Set.

#### O.2.8.4.18 RequestPolicy

This attribute is the template for the RequestPolicyOct attribute of the QoS Parameter Set.

#### O.2.8.4.19 TosAndMask

This attribute is the template for the TosAndMask attribute of the QoS Parameter Set.

#### O.2.8.4.20 TosOrMask

This attribute is the template for the TosOrMask attribute of the QoS Parameter Set.

#### O.2.8.4.21 Direction

This attribute is the template for the Direction attribute of the QoS Parameter Set.

#### O.2.8.4.22 StorageType

This attribute defines whether this row is kept in volatile storage and lost upon reboot or whether it is backed up by non-volatile or permanent storage. 'permanent' entries need not allow writable access to any instance attribute.

#### O.2.8.4.23 DSCPOverwrite

This attribute allows the overwrite of the DSCP field per RFC 3260.

If this attribute is -1, then the corresponding TosAndMask value is set to be 'FF'H and TosOrMask is set to '00'H. Otherwise, this attribute is in the range of 0..63, and the corresponding TosAndMask value is '03'H and TosOrMaskvalue is this attribute value shifted left by two bit positions.

#### O.2.8.4.24 RequiredAttrMask

This attribute is the template for the RequiredAttrMask attribute of the QoS Parameter Set.

#### O.2.8.4.25 ForbiddenAttrMask

This attribute is the template for the ForbiddenAttrMask attribute of the QoS Parameter Set.

#### O.2.8.4.26 AttrAggrRuleMask

This attribute is the template for the AttrAggregationMask attribute of the QoS Parameter Set.

#### O.2.8.4.27 AppId

This attribute is the template for the AppId attribute of the QoS Parameter Set.

#### O.2.8.4.28 MultiplierContentionReqWindow

This attribute is the template for the MultiplierContentionReqWindow attribute of the QoS Parameter Set.

#### O.2.8.4.29 MultiplierBytesReq

This attribute is the template for the MultiplierBytesReq attribute of the QoS Parameter Set.

#### 0.2.8.4.30 *MaxReqPerSidCluster*<sup>340</sup>

This attribute is the template for the MaxReqPerSidCluster attribute of the QoS Parameter Set.

This attribute has been deprecated and replaced with MaxReqPerSidCluster in the ServiceFlow object.

#### 0.2.8.4.31 *MaxOutstandingBytesPerSidCluster*

This attribute is the template for the MaxOutstandingBytesPerSidCluster attribute of the QoS Parameter Set.

This attribute has been deprecated and replaced with MaxOutstandingBytesPerSidCluster in the ServiceFlow object.

#### 0.2.8.4.32 *MaxTotBytesReqPerSidCluster*

This attribute is the template for the MaxTotBytesReqPerSidCluster attribute of the QoS Parameter Set.

This attribute has been deprecated and replaced with MaxTotBytesReqPerSidCluster in the ServiceFlow object.

#### 0.2.8.4.33 *MaxTimeInSidCluster*

This attribute is the template for the MaxTimeInSidCluster attribute of the QoS Parameter Set.

This attribute has been deprecated and replaced with MaxTimeInSidCluster in the ServiceFlow object.

#### 0.2.8.4.34 *PeakTrafficRate*

This attribute is the template for the PeakTrafficRate attribute of the QoS Parameter Set.

#### 0.2.8.4.35 *DsResequencing*

This attribute is the template for the DsResequencing attribute of the QoS Parameter Set.

#### 0.2.8.4.36 *MinimumBuffer*<sup>341</sup>

This attribute is the template for the MinimumBuffer attribute of the QoS Parameter Set.

#### 0.2.8.4.37 *TargetBuffer*<sup>342</sup>

This attribute is the template for the TargetBuffer attribute of the QoS Parameter Set.

#### 0.2.8.4.38 *MaximumBuffer*<sup>343</sup>

This attribute is the template for the MaximumBuffer attribute of the QoS Parameter Set.

### 0.2.8.5 PHS Object

This object describes the set of payload header suppression of Service Flows.

References: [MULPI] Payload Header Suppression section in the Common Radio Frequency Interface Encodings Annex.

**Table O-26 - PHS Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	key		N/A	N/A
PktClassId	unsignedInt	key		N/A	N/A
Field	hexBinary	read-only		N/A	N/A
Mask	hexBinary	read-only		N/A	N/A
Size	unsignedByte	read-only		bytes	N/A
Verify	boolean	read-only		N/A	N/A
Index	Integer32	read-only		N/A	N/A

<sup>340</sup> Revised per OSSIV3.0-N-09.0776-4 on 9/15/09 by JB.

<sup>341</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>342</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

<sup>343</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

#### O.2.8.5.1 *ifIndex*

This key represents the interface index of the MAC Domain of the Service Flow.

#### O.2.8.5.2 *ServiceFlowId*

This key represents an identifier assigned to a Service Flow by CMTS within a MAC Domain.

#### O.2.8.5.3 *PktClassId*

This key indicates the assigned identifier to the packet classifier instance by the CMTS, which is unique per Service Flow.

#### O.2.8.5.4 *Field*

This attribute indicates the Payload Header suppression field defines the bytes of the header that must be suppressed/restored by the sending/receiving device. The number of octets in this attribute should be the same as the value of PHSSize.

References: [MULPI] Payload Header Suppression Field (PHSF) section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.5.5 *Mask*

This attribute defines the bit mask that is used in combination with the PHSField. It defines which bytes in the header must be suppressed/restored by the sending or receiving device. Each bit of this bit mask corresponds to a byte in the PHSField, with the least significant bit corresponding to the first byte of the PHSField. Each bit of the bit mask specifies whether the corresponding byte should be suppressed in the packet. A bit value of '1' indicates that the byte should be suppressed by the sending device and restored by the receiving device. A bit value of '0' indicates that the byte should not be suppressed by the sending device or restored by the receiving device. If the bit mask does not contain a bit for each byte in the PHSField, then the bit mask is extended with bit values of '1' to be the necessary length.

References: [MULPI] Payload Header Suppression Mask (PHSM) section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.5.6 *Size*

This attribute specifies the number of bytes in the header to be suppressed and restored. The value of this attribute matches the number of bytes in the Field attribute.

References: [MULPI] Payload Header Suppression Size (PHSS) section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.5.7 *Verify*

If 'true', this attribute indicates that the sender must verify that the PHS Field is the same as the content in the packet to be suppressed.

References: [MULPI] Payload Header Suppression Verification (PHSV) section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.8.5.8 *Index*

This attribute uniquely references the PHS rule for a given service flow.

References: [MULPI] Payload Header Suppression Index (PHSI) section in the Common Radio Frequency Interface Encodings Annex.

### O.2.8.6 *CmtsMacToSrvFlow*

This object provides the mapping of unicast service flows with the cable modem the service flows belongs to.

**Table O-27 - CmtsMacToSrvFlow Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmMac	MacAddress	key		N/A	N/A
ServiceFlowId	unsignedInt	key		N/A	N/A
IfIndex	InterfaceIndex	read-only	Interface Index of MAC Domain interface	N/A	N/A

**O.2.8.6.1 CmMac**

This key represents the MAC address for the referenced CM.

**O.2.8.6.2 ServiceFlowId**

This key represents the identifier of the Service Flow.

**O.2.8.6.3 IfIndex**

This attribute represents the interface index of the MAC domain of the Service Flow and where the CableModem is registered.

**O.2.8.7 ServiceFlowSidCluster Object<sup>344</sup>**

This object defines the SID clusters associated with an upstream service flow.

References: [MULPI] Service Flow SID Cluster Assignments section in the Common Radio Frequency Interface Encodings Annex.

**Table O-28 - ServiceFlowSidCluster Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	Key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	Key	1.. 4294967295	N/A	N/A
Id	unsignedByte	Key	0..7	N/A	N/A
Ucid	Chld	Key	1..255	N/A	N/A
Sid	unsignedInt	Read-only	1..16383	N/A	N/A

**O.2.8.7.1 IfIndex**

This key represents the interface index of the MAC Domain of the Service Flow SID cluster.

**O.2.8.7.2 ServiceFlowId**

This key represents the Service Flow ID for the service flow.

**O.2.8.7.3 Id**

This key represents the identifier of the SID Cluster.

References: [MULPI] SID Cluster ID section in the Common Radio Frequency Interface Encodings Annex.

**O.2.8.7.4 Ucid**

This key represents the upstream Channel ID mapped to the corresponding SID.

**O.2.8.7.5 Sid**

This attribute represents the SID assigned to the upstream channel in this SID Cluster.

**O.2.8.8 GrpServiceFlow Object**

This object provides extensions to the service flow information for Group Service Flows (GSFs).

<sup>344</sup> Section revised per OSSIV3.0-N-07.0437-4, #1 on 5/9/07 per KN.

References: [MULPI] QoS Support for Joined IP Multicast Traffic section.

**Table O-29 - GrpServiceFlow Object<sup>345</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	key	1.. 4294967295	N/A	N/A
IsDef	boolean	read-only		N/A	N/A
QosCfgId	unsignedShort	read-only		N/A	N/A
NumSess	unsignedShort	read-only	1..65535	sessions	N/A
SrcAddr	InetAddress	read-only		N/A	N/A
GrpAddr	InetAddress	read-only		N/A	N/A

#### O.2.8.8.1 *ifIndex*

This key represents the interface index of the MAC Domain of the Group Service Flow.

#### O.2.8.8.2 *ServiceFlowId*

This key represents the Service Flow ID for the Service Flow.

References: [MULPI] QoS section.

#### O.2.8.8.3 *IsDef*

This attribute indicates whether the GSF QOS Parameter Set corresponds to the Default Group Service Flow.

References: Annex M.

#### O.2.8.8.4 *QosCfgId*

This attribute indicates the Group QoS Configuration (GQC) identifier used of the creation of this GSF. The value zero indicates that the service flow is using the default service flow policy.

References: Annex M.

#### O.2.8.8.5 *NumSess*

This attribute indicates the number of sessions that are configured in an aggregated Service Flow. If this is a single session replication, the value of this attribute is 1.

References: Annex M.

#### O.2.8.8.6 *SrcAddr*<sup>346</sup>

This attribute specifies the specific multicast Source Address that is configured in a single session Service Flow. If this is an aggregate Service Flow (NumSess attribute reports a value greater than 1) this attribute returns one of the multicast source addresses for the session. For the case of Any Source Multicast (ASM), this attribute reports a value of 0.0.0.0 for IPv4 or 0::/0 for IPv6.

References: Annex M

#### O.2.8.8.7 *GrpAddr*<sup>347</sup>

This attribute specifies the specific Multicast Group Address that is configured in a single session Service Flow. If this is an aggregate Service Flow (NumSess attribute reports a value greater than 1) this attribute returns the multicast group address associated with the SrcAddr for the session.

References: Annex M

<sup>345</sup> Table updated per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

<sup>346</sup> Section added per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

<sup>347</sup> Section added per OSSIV3.0-N-14.1151-2 on 7/14/14 by PO.

### **O.2.8.9    *GrpPktClass Object***

This object provides additional packet classification information for Group Classifier References (GCRs) in a Group Service Flow (GSF).

References: [MULPI] QoS Support for Joined IP Multicast Traffic section.

**Table O-30 - *GrpPktClass Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	key	1..4294967295	N/A	N/A
PktClassId	unsignedShort	key	1..65535	N/A	N/A
GrpCfgId	unsignedInt	read-only	1..4294967295	N/A	N/A

#### **O.2.8.9.1    *IfIndex***

This key represents the interface index of the MAC Domain to which this instance applies.

#### **O.2.8.9.2    *ServiceFlowId***

This key represents the Service Flow ID of the service flow.

References: [MULPI] QoS section.

#### **O.2.8.9.3    *PktClassId***

This key represents the Classifier ID of a GCR associated with a GSF.

References: [MULPI] QoS section.

#### **O.2.8.9.4    *GrpCfgId***

This attribute indicates the GC identifier used of the creation of this GSF.

References: Annex M.

### **O.2.8.10    *IP Multicast QoS Event Behaviors*<sup>348</sup>**

This section defines the behavior and trigger mechanisms for several of the Multicast QoS event definitions defined in Annex D.

Event ID 89010104 reflects that a particular Group Service Flow is dropping packets as a result of a) the incoming data rate exceeding the rate-shaping bounds defined by the combination of Maximum Sustained Traffic Rate, Maximum Traffic Burst, and Peak Traffic Rate in the Group QoS Configuration, or b) the available capacity of the DCS is insufficient to support forwarding. When event reporting is administratively enabled, the CMTS MUST generate event ID 89010104 when the condition of packet loss is detected. The CMTS SHOULD detect this condition when packet loss due to AQM or buffer overflow exceeds one packet per second for each of the most recent three seconds.

Event ID 89010105 reflects that a particular Group Service Flow is no longer dropping packets as a result of a) the incoming data rate exceeding the rate-shaping bounds defined by the combination of Maximum Sustained Traffic Rate, Maximum Traffic Burst, and Peak Traffic Rate in the Group QoS Configuration, or b) the available capacity of the DCS is insufficient to support forwarding. When event reporting is administratively enabled, the CMTS MUST generate Event ID 89010105 when the condition of packet loss is no longer detected. Once a particular multicast session is in a "dropping packets" state (as indicated by the generation of event ID 89010104) the CMTS SHOULD detect this condition when packet loss due to AQM or buffer overflow equals zero packets per second for each of the most recent three seconds.

<sup>348</sup> Section added per OSSIV3.0-14.1151-2 on 7/14/14 by PO.

Admitted Multicast Aggregate Bandwidth is defined as the sum of the Minimum Reserved Traffic Rates of each Group Service Flow that has been admitted on a given CMTS cable interface. Note that for some vendors this CMTS cable interface will be a cable-mac interface. For others, it will be a DOCSIS Downstream Channel Set. In either case, this CMTS cable interface exists as a row entry in the ifTable (and therefore has an ifIndex which can be referenced in the defined event messages).

The IGMP and MLD protocol event messages include a threshold for determining whether ingress packet loss is occurring for IGMP/MLD protocol messages received from clients. For the IGMP/MLD protocol packet loss Event IDs 89010106 through 89010111, the configuration and logic to determine how a threshold crossing is calculated for the high and low thresholds is vendor-specific.

### O.2.9 QOS Statistics Objects<sup>349</sup>

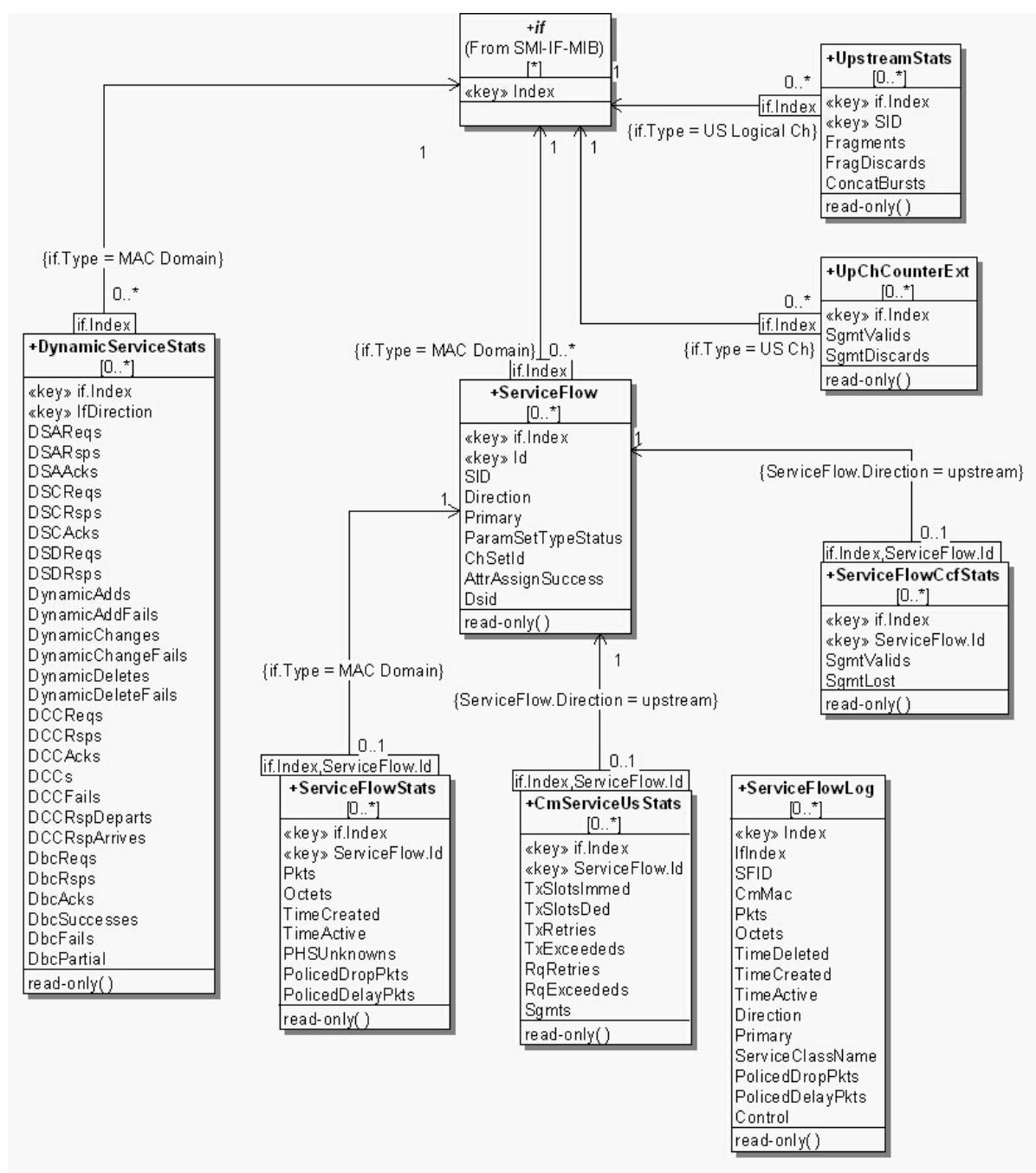


Figure O-8 - Qos Statistics Object Model Diagram

<sup>349</sup> Section replaced per OSSIV3.0-N-07.0480-3 by ab on 7/13/07.

### **O.2.9.1    *ServiceFlowStats***

This object describes statistics associated with the Service Flows in a managed device.

**Table O-31 - *ServiceFlowStats Object***

<b>Attribute Name</b>	<b>Type</b>	<b>Access</b>	<b>Type Constraints</b>	<b>Units</b>	<b>Default</b>
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	Unsigned32	key	1..4294967295	N/A	N/A
Pkts	Counter64	read-only		packets	N/A
Octets	Counter64	read-only		bytes	N/A
Created	TimeStamp	read-only		N/A	N/A
Active	Counter32	read-only		seconds	N/A
PHSUnknowns	Counter32	read-only		packets	N/A
PolicedDropPkts	Counter32	read-only		packets	N/A
PolicedDelayPkts	Counter32	read-only		packets	N/A

#### **O.2.9.1.1    *ifIndex***

This key represents the interface index of the MAC Domain of the Service Flow.

#### **O.2.9.1.2    *ServiceFlowId***

This key represents an identifier assigned to a Service Flow by CMTS within a MAC Domain.

#### **O.2.9.1.3    *Pkts***

For outgoing Service Flows, this attribute counts the number of Packet Data PDUs forwarded to this Service Flow. For incoming upstream CMTS service flows, this attribute counts the number of Packet Data PDUs actually received on the Service Flow identified by the SID for which the packet was scheduled. CMs not classifying downstream packets may report this attribute's value as 0 for downstream Service Flows. This attribute does not count MAC-specific management messages. Particularly for UGS flows, packets sent on the primary Service Flow in violation of the UGS grant size should be counted only by the instance of this attribute that is associated with the primary service flow. Unclassified upstream user data packets (i.e., non- MAC-management) forwarded to the primary upstream Service Flow should be counted by the instance of this attribute that is associated with the primary service flow. This attribute does include packets counted by ServiceFlowPolicedDelayPkts, but does not include packets counted by ServiceFlowPolicedDropPkts and ServiceFlowPHSUnknowns. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### **O.2.9.1.4    *Octets***

This attribute indicates the count of the number of octets from the byte after the MAC header HCS to the end of the CRC for all packets counted in the ServiceFlowPkts attribute for this row. Note that this counts the octets after payload header suppression and before payload header expansion have been applied. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### **O.2.9.1.5    *Created***

This attribute indicates the value of sysUpTime when the service flow was created.

#### **O.2.9.1.6    *Active***

This attribute indicates the number of seconds that the service flow has been active. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### **O.2.9.1.7    *PHSUnknowns***

For incoming upstream CMTS service flows, this attribute counts the number of packets received with an unknown payload header suppression index. The service flow is identified by the SID for which the packet was scheduled. On a CM, only this attribute's instance for the primary downstream service flow counts packets received with an unknown payload header suppression index. All other downstream service flows on CM report this attributes value

as 0. All outgoing service flows report this attribute's value as 0. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### O.2.9.1.8 *PolicedDropPkts*<sup>350</sup>

For outgoing service flows, this attribute counts the number of Packet Data PDUs classified to this service flow dropped due to: (1) exceeding the selected Buffer Size for the service flow (see the Buffer Control section in the Common Radio Frequency Interface Encodings Annex of [MULPI]); or (2) UGS packets dropped due to exceeding the Unsolicited Grant Size with a Request/Transmission policy that requires such packets to be dropped. Classified packets dropped due to other reasons must be counted in ifOutDiscards for the interface of this service flow. This attribute reports 0 for incoming service flows. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### O.2.9.1.9 *PolicedDelayPkts*

This attribute counts only outgoing packets delayed in order to maintain the Maximum Sustained Traffic Rate. This attribute will always report a value of 0 for UGS flows because the Maximum Sustained Traffic Rate does not apply. This attribute is 0 for incoming service flows. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

### O.2.9.2 *UpstreamStats*

This object describes statistics associated with upstream service flows. All counted frames must be received without a Frame Check Sequence (FCS) error.

**Table O-32 - UpstreamStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of Upstream Logical Channel	N/A	N/A
SID	unsignedShort	key		N/A	N/A
Fragments	Counter32	read-only		fragments	N/A
FragDiscards	Counter32	read-only		fragments	N/A
ConcatBursts	Counter32	read-only		headers	N/A

#### O.2.9.2.1 *ifIndex*

This key represents the interface index of the logical upstream interface to which this instance applies.

#### O.2.9.2.2 *SID*

This key identifies a service ID for an admitted or active upstream service flow.

#### O.2.9.2.3 *Fragments*

This attribute indicates the number of fragmentation headers received on an upstream service flow, regardless of whether the fragment was correctly reassembled into a valid packet. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### O.2.9.2.4 *FragDiscards*

This attribute indicates the number of upstream fragments discarded and not assembled into a valid upstream packet. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

#### O.2.9.2.5 *ConcatBursts*

This attribute indicates the number of concatenation headers received on an upstream service flow. This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index.

<sup>350</sup> Revised per OSSIV3.0-N-10.0966-2 on 1/21/11 by JB.

### **O.2.9.3    *DynamicServiceStats***

This object describes statistics associated with the Dynamic Service Flows, Dynamic Channel Changes and Dynamic Bonding Changes in a managed device within a MAC Domain. For each MAC Domain there are two instances for the upstream and downstream direction. On the CMTS, the downstream direction instance indicates messages transmitted or transactions originated by the CMTS. The upstream direction instance indicates messages received or transaction originated by the CM. On the CM, the downstream direction instance indicates messages received or transactions originated by the CMTS. The upstream direction instance indicates messages transmitted by the CM or transactions originated by the CM.

**Table O-33 - *DynamicServiceStats Object***

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
IfDirection	IfDirection	read-only		N/A	N/A
DSAReqs	Counter32	read-only		messages	N/A
DSARsp	Counter32	read-only		messages	N/A
DAAcks	Counter32	read-only		messages	N/A
DSCReq	Counter32	read-only		messages	N/A
DSCRsp	Counter32	read-only		messages	N/A
DSCAck	Counter32	read-only		messages	N/A
DSDReq	Counter32	read-only		messages	N/A
DSDRsp	Counter32	read-only		messages	N/A
DynamicAdds	Counter32	read-only		messages	N/A
DynamicAddFails	Counter32	read-only		messages	N/A
DynamicChanges	Counter32	read-only		messages	N/A
DynamicChangeFails	Counter32	read-only		messages	N/A
DynamicDeletes	Counter32	read-only		messages	N/A
DynamicDeleteFails	Counter32	read-only		messages	N/A
DCCReq	Counter32	read-only		messages	N/A
DCCRsp	Counter32	read-only		messages	N/A
DCCAck	Counter32	read-only		messages	N/A
DCC	Counter32	read-only		messages	N/A
DCCFail	Counter32	read-only		messages	N/A
DCCRspDepart	Counter32	read-only		messages	N/A
DCCRspArrive	Counter32	read-only		messages	N/A
DbcReq	Counter32	read-only		messages	N/A
DbcRsp	Counter32	read-only		messages	N/A
DbcAck	Counter32	read-only		messages	N/A
DbcSuccess	Counter32	read-only		transactions	N/A
DbcFail	Counter32	read-only		transactions	N/A
DbcPartial	Counter32	read-only		transactions	N/A

#### **O.2.9.3.1    *ifIndex***

This key represents the interface index of the MAC Domain.

#### **O.2.9.3.2    *IfDirection***

This attribute indicates the interface direction for the instance the statistics are collected.

#### 0.2.9.3.3 *DSAReqs*

This attribute indicates the number of Dynamic Service Addition Requests, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Addition section; [RFC 2863].

#### 0.2.9.3.4 *DSARsps*

The number of Dynamic Service Addition Responses, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Addition section; [RFC 2863].

#### 0.2.9.3.5 *DAAcks*

The number of Dynamic Service Addition Acknowledgements, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Addition section; [RFC 2863].

#### 0.2.9.3.6 *DSCReq*s

The number of Dynamic Service Change Requests, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.7 *DSCRsps*

The number of Dynamic Service Change Responses, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.8 *DCAcks*

The number of Dynamic Service Change Acknowledgements, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.9 *DSDReq*s

The number of Dynamic Service Delete Requests, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Deletion section; [RFC 2863].

#### 0.2.9.3.10 *DSDRsps*

The number of Dynamic Service Delete Responses, including retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.11 *DynamicAdds*

The number of successful Dynamic Service Addition transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Addition section; [RFC 2863].

#### 0.2.9.3.12 *DynamicAddFails*

The number of failed Dynamic Service Addition transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Addition section; [RFC 2863].

#### 0.2.9.3.13 *DynamicChanges*

The number of successful Dynamic Service Change transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.14 *DynamicChangeFails*

The number of failed Dynamic Service Change transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Change section; [RFC 2863].

#### 0.2.9.3.15 *DynamicDeletes*

The number of successful Dynamic Service Delete transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Delete section; [RFC 2863].

#### 0.2.9.3.16 *DynamicDeleteFails*

The number of failed Dynamic Service Delete transactions. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Service Delete section; [RFC 2863].

#### 0.2.9.3.17 *DCCReqs*

The number of Dynamic Channel Change Request messages traversing an interface. This count is nonzero only on downstream direction rows. This count should include the number of retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.18 *DCCRsp*s

The number of Dynamic Channel Change Response messages traversing an interface. This count is nonzero only on upstream direction rows. This count should include the number of retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.19 *DCCAcks*

The number of Dynamic Channel Change Acknowledgement messages traversing an interface. This count is nonzero only on downstream direction rows. This count should include the number of retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.20 *DCCs*

The number of successful Dynamic Channel Change transactions. This count is nonzero only on downstream direction rows. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.21 *DCCFails*

The number of failed Dynamic Channel Change transactions. This count is nonzero only on downstream direction rows. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.22 *DccRspDeparts*

This attribute contains the number of Dynamic Channel Change Response (depart) messages. It only applies to upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.23 *DccRspArrives*

This attribute contains the number of Dynamic Channel Change Response (arrive) messages and should include retries. It only applies to the upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863].

#### 0.2.9.3.24 *DbcReqs*

This attribute contains the number of Dynamic Bonding Change Requests, including retries. It only applies to the upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

#### 0.2.9.3.25 *DbcRsp*s

This attribute contains the number of Dynamic Bonding Change Responses, including retries. It only applies to the upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

#### 0.2.9.3.26 *DbcAcks*

This attribute contains the number of Dynamic Bonding Change Acknowledgements, including retries. It only applies to the downstream direction. Discontinuities in the value of this counter can occur at reinitialization of the

managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

#### 0.2.9.3.27 *DbcSuccesses*

This attribute contains the number of fully successful Dynamic Bonding Change transactions. It only applies to the downstream direction and does not include DBC transactions that result in Partial Service. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

#### 0.2.9.3.28 *DbcFails*

This attribute contains the number of failed Dynamic Bonding Change transactions. It only applies to the downstream direction. Note that Partial Service is not considered a failed transaction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

#### 0.2.9.3.29 *DbcPartial*

This attribute contains the number of unsuccessful Dynamic Bonding Change transactions that result in Partial Service. IT only applies to the downstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Dynamic Bonding Change (DBC) section; [RFC 2863].

### 0.2.9.4 *ServiceFlowLog*

This object contains a log of the disconnected Service Flows in a managed device.

**Table O-34 - ServiceFlowLog Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Index	unsignedInt	key		N/A	N/A
IfIndex	InterfaceIndex	read-only		N/A	N/A
SFID	unsignedInt	read-only		N/A	N/A
CmMac	MacAddress	read-only		N/A	N/A
Pkts	Counter64	read-only		packets	N/A
Octets	Counter64	read-only		bytes	N/A
TimeDeleted	TimeStamp	read-only		N/A	N/A
TimeCreated	TimeStamp	read-only		N/A	N/A
TimeActive	Counter32	read-only		seconds	N/A
Direction	RfMacIfDirection	read-only		N/A	N/A
Primary	boolean	read-only		N/A	N/A
ServiceClassName	SnmpAdminString	read-only		N/A	N/A
PolicedDropPkts	Counter32	read-only		packets	N/A
PolicedDelayPkts	Counter32	read-only		packets	N/A
Control	Enum	read-write	active(1) destroy(6)	N/A	N/A

**O.2.9.4.1 *Index***

This key indicates an unique index for a logged service flow.

**O.2.9.4.2 *IfIndex***

This attribute indicates the MAC Domain Interface index where the service flow was present.

**O.2.9.4.3 *SFID***

This attribute indicates the identifier assigned to the service flow.

**O.2.9.4.4 *CmMac***

This attribute indicates the MAC address of the cable modem associated with the service flow.

**O.2.9.4.5 *Pkts***

This attribute indicates the final value of the Pkts attribute in the ServiceFlowStats object for the service flow.

**O.2.9.4.6 *Octets***

This attribute indicates the final value of the Pkts attribute in the ServiceFlowStats object for the service flow.

**O.2.9.4.7 *TimeDeleted***

This attribute indicates the value of sysUpTime when the service flow was deleted.

**O.2.9.4.8 *TimeCreated***

This attribute indicates the value of sysUpTime when the service flow was created.

**O.2.9.4.9 *TimeActive***

This attribute indicates the total time that the service flow was active.

**O.2.9.4.10 *Direction***

This attribute indicates the value of Service Flow direction for the service flow.

**O.2.9.4.11 *Primary***

If set to 'true', this attribute indicates that the Service Flow in the log was a Primary Service Flow, otherwise, a Secondary Service Flow.

**O.2.9.4.12 *ServiceClassName***

This attribute indicates the value of ServiceClassName for the provisioned QOS Parameter Set of the service flow.

**O.2.9.4.13 *PolicedDropPkts***

This attribute indicates the final value of PolicedDropPkts attribute of the ServiceFlowStats object for the service flow.

**O.2.9.4.14 *PolicedDelayPkts***

This attribute indicates the final value of PolicedDelayPkts attribute of the ServiceFlowStats object for the service flow.

**O.2.9.4.15 *Control***

This attribute when set to 'destroy' removes this instance from the object. Reading this attribute returns the value 'active'.

**O.2.9.5 *UpChCounterExt Object***

This object provides extensions for upstream channel bonding.

References: [MULPI] Channel Bonding section.

**Table O-35 - UpChCounterExt Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of upstream channel	N/A	N/A
SgmtValids	Counter32	read-only		segments	N/A
SgmtDiscards	Counter32	read-only		segments	N/A

#### O.2.9.5.1 IfIndex

This key represents the interface index of the upstream channel to which this instance applies.

#### O.2.9.5.2 SgmtValids

This attribute contains the number of segments correctly received on the upstream channel. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated upstream channel.

References: [MULPI] Upstream and Downstream Common Aspects section; [RFC 2863].

#### O.2.9.5.3 SgmtDiscards

This attribute represents the total number of discarded segments on this channel due to segment HCS problems. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated upstream channel.

References: [MULPI] Continuous Concatenation and Fragmentation section; [RFC 2863].

### O.2.9.6 ServiceFlowCcfStats Object<sup>351</sup>

This object provides upstream service flow statistics on upstream fragments for Continuous Concatenation and Fragmentation (CCF). This table will only capture service flow statistics for flows with segment headers set to ON. Any service flow established with segment headers OFF will not be counted in this table and will instead be counted in the normal ServiceFlowStats table. The CMTS MAY choose to not instantiate this object for service flows that do not use CCF or return a zero value for the individual counter statistics.

References: [MULPI] Continuous Concatenation and Fragmentation section.

**Table O-36 - ServiceFlowCcfStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	key	1..4294967295	N/A	N/A
SgmtValids	Counter32	read-only		segments	N/A
SgmtLost	Counter32	read-only		segments	N/A

#### O.2.9.6.1 IfIndex

This key represents the interface index of the upstream channel to which this instance applies.

#### O.2.9.6.2 ServiceFlowId

This key represents the Service Flow ID for the service flow.

References: [MULPI] QoS section.

#### O.2.9.6.3 SgmtValids

This attribute contains the number of segments counted on this service flow regardless of whether the fragment was correctly reassembled into valid packets. This attribute only gathers information for Segment Header On service

<sup>351</sup> Modified per OSSIV3.0-N-09.0775-3 on 5/11/09 by JB.

flows. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Continuous Concatenation and Fragmentation section; [RFC 2863].

#### 0.2.9.6.4 *SgmtLost*

This attribute counts the number of segments which the CMTS segment reassembly function determines were lost. This attribute only gathers information for Segment Header On service flows. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Continuous Concatenation and Fragmentation section; [RFC 2863].

#### 0.2.9.7 *CmServiceUsStats Object*

This object defines DOCSIS MAC services primitive statistics of upstream service flows. In pre-3.0 DOCSIS devices these statistics exist per SID for either CoS or QoS services in the SNMP table docsIfCmServiceTable.

A 3.0 CM with CoS configuration (DOCSIS 1.0 mode) reports the statistics defined in the SNMP table docsIfCmServiceTable. A 3.0 CM with QoS configuration reports this object regardless of whether Multiple Transmit Channel is enabled or disabled.

References: [MULPI] Upstream Data Transmission section.

**Table O-37 - CmServiceUsStats Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
ServiceFlowId	unsignedInt	key	1.. 4294967295	N/A	N/A
TxSlotsImmed	Counter32	read-only		mini-slots	N/A
TxSlotsDed	Counter32	read-only		mini-slots	N/A
TxRetries	Counter32	read-only		attempts	N/A
TxExceededs	Counter32	read-only		attempts	N/A
RqRetries	Counter32	read-only		attempts	N/A
RqExceededs	Counter32	read-only		attempts	N/A
Sgmts	Counter32	read-only		segments	N/A

##### 0.2.9.7.1 *IfIndex*

This key represents the interface index of the MAC Domain to which this instance applies.

##### 0.2.9.7.2 *ServiceFlowId*

This key represents the Service Flow ID for the service flow.

References: [MULPI] QoS section.

##### 0.2.9.7.3 *TxSlotsImmed*

This attribute contains the number of upstream mini-slots which have been used to transmit data PDUs in immediate (contention) mode. This includes only those PDUs that are presumed to have arrived at the head-end (i.e., those which were explicitly acknowledged.) It does not include retransmission attempts or mini-slots used by Requests. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream Bandwidth Allocation section; [RFC 2863].

##### 0.2.9.7.4 *TxSlotsDed*

This attribute contains the number of upstream mini-slots which have been used to transmit data PDUs in dedicated mode (i.e., as a result of a unicast Data Grant). Discontinuities in the value of this counter can occur at

reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream Data Transmission section; [RFC 2863].

#### 0.2.9.7.5 *TxRetries*

This attribute contains the number of attempts to transmit data PDUs containing requests for acknowledgment that did not result in acknowledgment. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the associated MAC Domain interface index.

References: [MULPI] Upstream Bandwidth Allocation section; [RFC 2863].

#### 0.2.9.7.6 *TxExceededs*

This attribute contains the number of data PDUs transmission failures due to excessive retries without acknowledgment. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream Bandwidth Allocation section; [RFC 2863].

#### 0.2.9.7.7 *RqRetries*

This attribute contains the number of attempts to transmit bandwidth requests which did not result in acknowledgment. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream Bandwidth Allocation section; [RFC 2863].

#### 0.2.9.7.8 *RqExceededs*

This attribute contains the number of requests for bandwidth which failed due to excessive retries without acknowledgment. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream Bandwidth Allocation section; [RFC 2863].

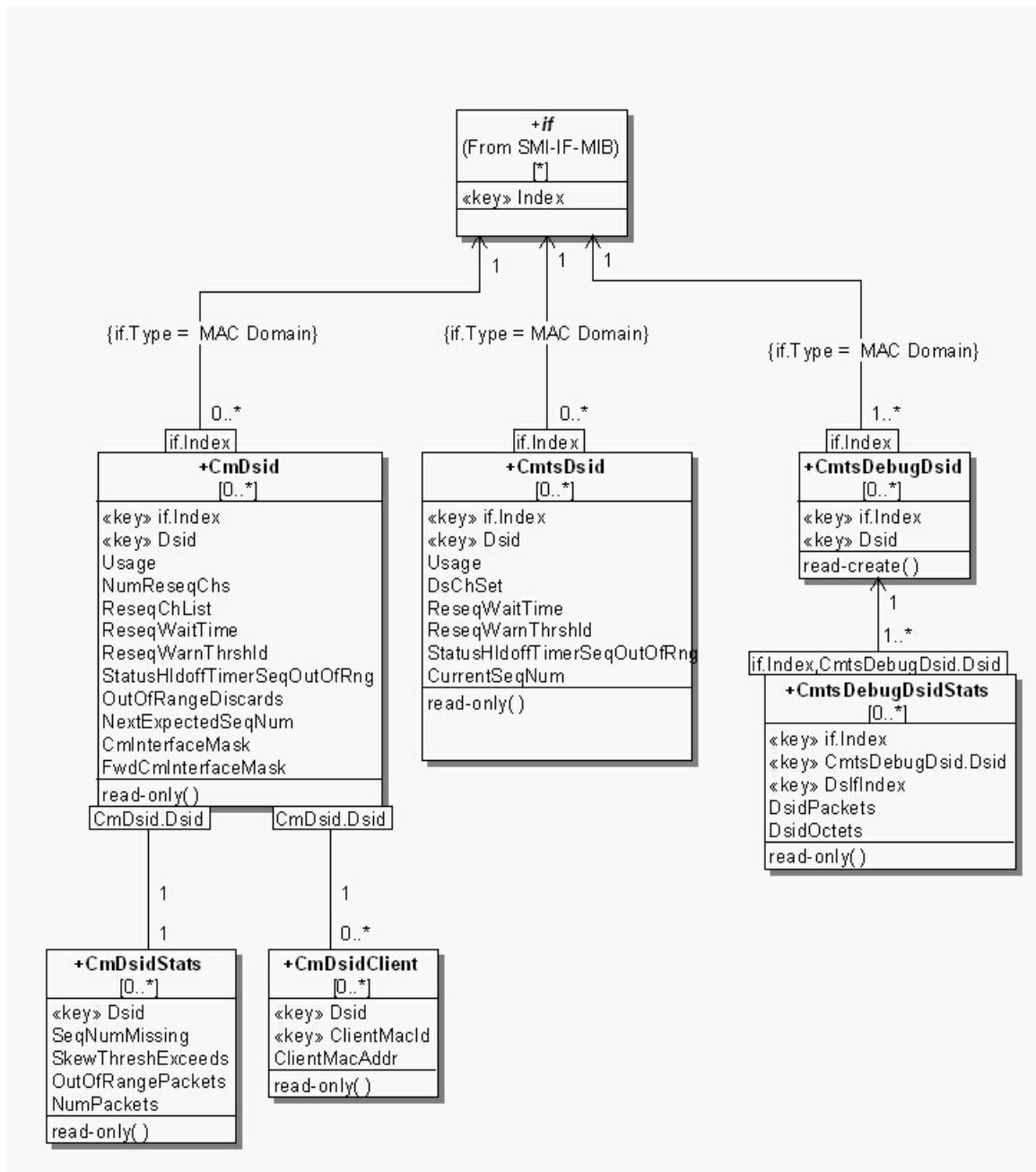
#### 0.2.9.7.9 *Sgmts*

This attribute contains the number of segments transmitted on this service flow. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index.

References: [MULPI] Upstream and Downstream Common Aspects section; [RFC 2863].

### O.2.10 DSID Objects<sup>352</sup>

This section defines Downstream Service Identifier (DSID) related objects.



**Figure O-9 - DSID Object Model Diagram**

<sup>352</sup> Figure replaced per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

### 0.2.10.1 *CmDsid Object*

This object describes the DSID information stored in the CM.

The CM reports the current status of existing DSIDs. When a DSID is created during the registration process or a DBC transaction, a corresponding object instance is created. If a DSID is deleted or changed via a DBC message the corresponding object instance is deleted or updated respectively.

**Table O-38 - CmDsid Object<sup>353</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
IflIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
Dsid	Dsid	key		N/A	N/A
Usage	EnumBits	read-only	resequencing(0) multicastCapable(1)	N/A	N/A
NumReseqChs	unsignedShort	read-only	0   1..65535	N/A	N/A
ReseqChList	ChannelList	read-only	SIZE (0 2..255)	N/A	N/A
ReseqWaitTime	unsignedByte	read-only	0   1..180	hundredMicroseconds	N/A
ReseqWarnThrshld	unsignedByte	read-only	0..179	hundredMicroseconds	N/A
StatusHldoffTimerSeqOutOfRng	unsignedShort	read-only		20 milliseconds	N/A
OutOfRangeDiscards	Counter32	read-only		N/A	N/A
NextExpectedSeqNum	unsignedShort	read-only		N/A	N/A
CmInterfaceMask	DocsL2vpnIfList	read-only		N/A	N/A
FwdCmInterfaceMask	DocsL2vpnIfList	read-only		N/A	N/A

#### 0.2.10.1.1 *IflIndex*

This key represents the interface index of the MAC Domain associated with the DSID.

#### 0.2.10.1.2 *Dsid*

This key represents the DSID.

#### 0.2.10.1.3 *Usage*

This attribute indicates the properties of the DSID. The bits are defined as follows:

- 'resequencing'

This bit is set to 1 for a Resequencing DSID.

- 'multicastCapable'

This bit is set to 1 for a DSID that is capable of transporting multicast traffic (e.g., the DSID has multicast forwarding attributes).

#### 0.2.10.1.4 *NumReseqChs*

This attribute represents the number of channels in the downstream resequencing channel list for this DSID. When a DSID is used only for a non-bonded multicast replication, this object returns a value of 0.<sup>354</sup>

#### 0.2.10.1.5 *ReseqChList*

This attribute represents the Downstream Channel Set over which the DSID is being resequenced.

<sup>353</sup> Table revised per OSSIV3.0-N-07.0412-2, #3 on 5/8/07 by KN, per OSSIV3.0-N-07.0480-3 by ab on 7/13/07, per OSSIV3.0-N-08.0645-5 on 5/1/08 by KN, and OSSIV3.0-N-08.0700-4 on 1/12/09 by JS.

<sup>354</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/13/09.

#### 0.2.10.1.6 *ReseqWaitTime*

This attribute represents the DSID Resequencing Wait Time that is used for this DSID. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### 0.2.10.1.7 *ReseqWarnThrshld*

This attribute represents the DSID Resequencing Warning Threshold that is used for this DSID. The value of 0 indicates that the threshold warnings are disabled. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### 0.2.10.1.8 *StatusHldoffTimerSeqOutOfRng*

This attribute represents the hold-off timer for reporting Out-of-Range Events via the CM-STATUS MAC Management message. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### 0.2.10.1.9 *OutOfRangeDiscards*<sup>355</sup>

This attribute represents the current count of out-of-range packets discarded by the CM for a given resequencing context since an in-range packet was received. When this count exceeds 1000 and more than two minutes have elapsed since an in-range packet was received, the CM will reacquire sequence numbers for this resequencing context.

#### 0.2.10.1.10 *NextExpectedSeqNum*

This attribute represents the Next Expected Packet Sequence Number for a given resequencing context. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### 0.2.10.1.11 *CmInterfaceMask*

This attribute represents the bitmap of the interfaces communicated to the CM in a Multicast DSID encoding.

#### 0.2.10.1.12 *FwdCmInterfaceMask*<sup>356</sup>

This attribute represents the bitmap of the interfaces to which the CM forwards multicast traffic: a logical OR of interfaces identified in CmInterfaceMask and interfaces associated with the client MAC addresses identified in the instances for this DSID.

### 0.2.10.2 *CmtsDsid Object*

This object describes DSID information stored in the CMTS.

The CMTS reports the current status of existing DSIDs. When a DSID is created during the registration process or a DBC transaction, a corresponding object instance is created. If a DSID is deleted or changed via a DBC message the corresponding object instance is deleted or updated respectively.

**Table O-39 - CmtsDsid Object**<sup>357</sup>

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
Dsid	Dsid	key		N/A	N/A
Usage	EnumBits	read-only	resequencing(0) multicastCapable(1) multicastReplication(2) bonding(3)	N/A	N/A

<sup>355</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/17/07.

<sup>356</sup> Revised per OSSIV3.0-N-09.0775-3 on 5/8/09 by JB.

<sup>357</sup> Table revised per OSSIV3.0-N-07.0412-2, #3 on 5/8/07 by KN.

Attribute Name	Type	Access	Type Constraints	Units	Default
DsChSet	ChSetId	read-only		N/A	N/A
ReseqWaitTime	unsignedByte	read-only	1..180	hundredMicroseconds	N/A
ReseqWarnThrshld	unsignedByte	read-only	0..179	hundredMicroseconds	N/A
StatusHldoffTimerSeqOutOfRng	unsignedShort	read-only		20 milliseconds	N/A
CurrentSeqNum	unsignedShort	read-only		N/A	N/A

#### O.2.10.2.1 *IfIndex*

This key represents the interface index of the MAC Domain associated with the DSID.

#### O.2.10.2.2 *Dsid*

This key represents the DSID.

#### O.2.10.2.3 *Usage*

This attribute indicates the properties of the DSID. The bits are defined as follows:

- 'resequencing'

This bit is set to 1 for a Resequencing DSID.

- 'multicastCapable'

This bit is set to 1 for a DSID that is capable of transporting multicast traffic (i.e., the DSID has multicast forwarding attributes).

- 'multicastReplication'

This bit is set to 1 for a DSID that is used for transporting a multicast replication (i.e., there is a corresponding instance of the CmtsReplSess object).

- 'bonding'

This bit is set to a 1 for a DSID that is associated with a bonding group.

References: Annex M; [MULPI] DSID Encodings section in the Common Radio Frequency Interface Encodings Annex.

#### O.2.10.2.4 *DsChSet*

This attribute represents the Downstream Channel Set over which the DSID is being resequenced.

#### O.2.10.2.5 *ReseqWaitTime*

This attribute represents the DSID Resequencing Wait Time that is used for this DSID. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### O.2.10.2.6 *ReseqWarnThrshld*

This attribute represents the DSID Resequencing Warning Threshold that is used for this DSID. The value of 0 indicates that the threshold warnings are disabled. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

#### O.2.10.2.7 *StatusHldoffTimerSeqOutOfRng*

This attribute represents the hold-off timer for reporting Out-of-Range Events via the CM-STATUS MAC Management message. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

### 0.2.10.2.8 *LastSeqNum*

This attribute reports the value of the most recent sequence number assigned by the CMTS for this DSID. This attribute is only valid when the Usage attribute has the resequencing bit set to 1. This attribute returns a value of 0 when the Usage attribute has the resequencing bit set to 0.

### 0.2.10.3 *CmDsidStats Object*

This object defines a set of statistics the CM collects per DSID.

**Table O-40 - CmDsidStats Object<sup>358</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
lifIndex	InterfaceIndex	key		N/A	N/A
Dsid	Dsid	key		N/A	N/A
SeqNumMissing	Counter32	read-only		N/A	N/A
SkewThreshExceeds	Counter32	read-only		packets	N/A
OutOfRangePackets	Counter32	read-only		packets	N/A
NumPackets	Counter64	read-only		packets	N/A

#### 0.2.10.3.1 *IfIndex*

This key represents the interface index of the MAC Domain associated with the DSID.

#### 0.2.10.3.2 *Dsid*

This key represents the DSID.

#### 0.2.10.3.3 *SeqNumMissing*<sup>359</sup>

This attribute counts the number of times the Next Expected Packet Sequence Number is declared lost. In this case one or more data packets are lost. This is generally caused by downstream packet loss.

References: [MULPI] Downstream Sequencing section.

#### 0.2.10.3.4 *SkewThreshExceeds*<sup>360</sup>

This attribute counts in-range sequenced packets which were successfully received by the CM after a wait time longer than the Resequencing Warning Threshold.

References: [MULPI] Downstream Sequencing section.

#### 0.2.10.3.5 *OutOfRangePackets*

This attribute counts the number of packets Counter received in a DSID reassembly context where the sequence number which is out of range.

References: [MULPI] Receive Channels section.

#### 0.2.10.3.6 *NumPackets*

This attribute counts the total number of data packets of a DSID context forwarded for further processing.

### 0.2.10.4 *CmDsidClient Object*

This object contains the client MAC addresses that the CMTS requests that the CM uses to replicate Multicast DSIDs during registration or during a DBC transaction.

When a DSID is created that includes client MAC addresses, or when client MAC addresses are added to a DSID, new rows are created to indicate the added client MAC addresses. When a Client MAC address is deleted from a DSID, the corresponding row is deleted. When a DSID is deleted, all corresponding rows are deleted, too.

<sup>358</sup> Table modified per OSSIV3.0-N-07.0480-3 on 1/30/08 by KN.

<sup>359</sup> Section modified per OSSIV3.0-N-07.0480-3 on 1/30/08 by KN.

<sup>360</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

References: [MULPI] DSID Encodings section in the Common Radio Frequency Interface Encodings Annex.

**Table O-41 - CmDsidClient Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Dsid	Dsid	key		N/A	N/A
MacId	unsignedShort	key	1..65535	N/A	N/A
MacAddr	MacAddress	read-only		N/A	N/A

#### O.2.10.4.1 *Dsid*

This key defines the DSID that the client MAC addresses are associated with.

#### O.2.10.4.2 *MacId*

This key defines a uniquely identified Client Mac Addresses associated with the DSID.

#### O.2.10.4.3 *MacAddr*

This attribute defines a client MAC address to which Multicast traffic labeled with this DSID should be forwarded.

### O.2.10.5 *CmtsDebugDsid Object*

The CMTS Debug DSID object contains the control of DSID debug statistics reporting

An instance in this object defines the DSID and MAC domain to which the CmtsDebugDsidStats collects statistics for the downstream channel associated with that DSID and MAC Domain. The deletion of an instance stops the reporting of statistics for the specified DSID.

This object supports instance creation and deletion.

The CMTS MUST support at least one instance of the CmtsDebugDsid object.<sup>361</sup>

Creation of a new instance of this object requires a valid MAC Domain and a current DSID value.

The CMTS MUST NOT persist instances created in the CmtsDebugDsid object across system reinitializations.

**Table O-42 - CmtsDebugDsid Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
IfIndex	InterfaceIndex	key		N/A	N/A
Dsid	Dsid	key		N/A	N/A

#### O.2.10.5.1 *IfIndex*

This attribute represents the interface index of the MAC Domain to which an instance of this object applies.

#### O.2.10.5.2 *Dsid*

This attribute represents the DSID value to be debugged, identified by the IfIndex attribute of this object.

### O.2.10.6 *CmtsDebugDsidStats Object*<sup>362</sup>

The CMTS Debug DSID Stats object describes statistics at the CMTS for the forwarding of DSID-labeled downstream packets.

The CMTS creates an instance for every combination of MAC Domain, DSID value, and downstream channel on which packets labeled with that DSID are transmitted. The CMTS MUST NOT delete CmtsDebugDsidStats instances while the corresponding CmtsDebugDsid object control instance exists.

The CMTS MUST NOT persist instances created in the CmtsDebugDsidStats object across reinitializations.

<sup>361</sup> Paragraph revised per OSSIV3.0-N-08.0613-1 on 4/10/08 by KN.

<sup>362</sup> Section revised per OSSIV3.0-N-08.0613-1 on 4/10/08 by KN.

**Table O-43 - CmtsDebugDsidStats Object**

<b>Attribute Name</b>	<b>Type</b>	<b>Access</b>	<b>Type Constraints</b>	<b>Units</b>	<b>Default</b>
ifIndex	InterfaceIndex	key	Interface Index of MAC Domain interface	N/A	N/A
Dsid	Dsid	key	0..1048575	N/A	N/A
DsIfIndex	InterfaceIndex	key	InterfaceIndex of downstream channel	N/A	N/A
DsidPackets	Counter32	read-only		packets	N/A
DsidOctets	Counter32	read-only		octets	N/A

#### O.2.10.6.1 ifIndex

This key represents the interface index of the MAC Domain to which this instance applies.

#### O.2.10.6.2 Dsid

This key represents the Downstream Service ID (DSID).

#### O.2.10.6.3 DsIfIndex

This key represents an Interface Index of a downstream channel that belongs to the DSID

#### O.2.10.6.4 DsidPackets<sup>363</sup>

This attribute is a counter which contains the number of packets transmitted by the CMTS which are labeled with the DSID on the downstream channel. Discontinuities in the value of this counter can occur as indicated by the value of ifCounterDiscontinuityTime of the associated Downstream interface index.

#### O.2.10.6.5 DsidOctets<sup>364</sup>

This attribute counts the number of bytes transmitted by the CMTS which are labeled with the DSID on the downstream interface. Discontinuities in the value of this counter can occur as indicated by the value of ifCounterDiscontinuityTime of the associated Downstream interface index.

<sup>363</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

<sup>364</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

### O.2.11 CM Provisioning Objects<sup>365</sup>

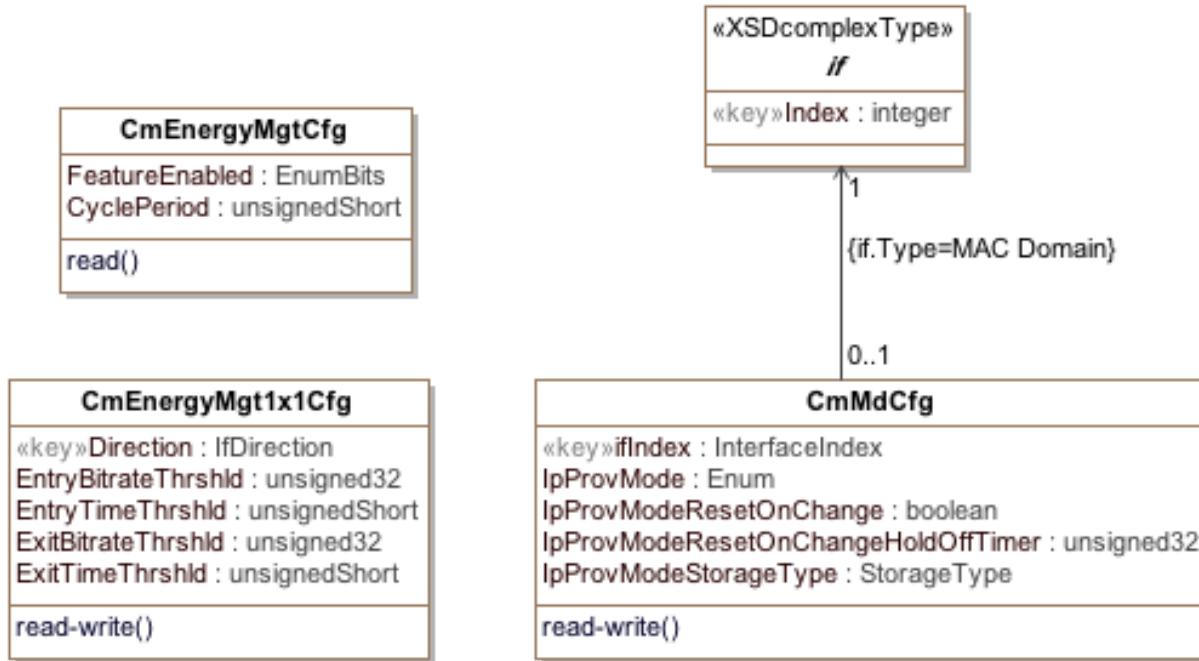


Figure O-10 - CM MAC Domain Configuration Object Model Diagram<sup>366</sup>

#### O.2.11.1 CmMdCfg Object<sup>367</sup>

This object contains MAC domain level control and configuration attributes for the CM.

References: [MULPI] IP Provisioning Mode Override section.

Table O-44 - CmMdCfg Object

Attribute Name	Type	Access	Type Constraints	Units	Default
ifIndex	InterfaceIndex	key	InterfaceIndex of MAC Domain interface	N/A	N/A
IpProvMode	Enum	read-write	ipv4Only(0) ipv6Only(1) honorMdd(4)	N/A	honorMdd
IpProvModeResetOnChange	TruthValue	read-write	true(1) false(2)	N/A	false
IpProvModeResetOnChangeHoldOffTimer	Unsigned32	read-write	0...300	second s	0
IpProvModeStorageType	StorageType	read-write	volatile(2) nonVolatile(3)	N/A	nonVolatile

##### O.2.11.1.1 ifIndex

This key represents the interface index of the MAC Domain to which this instance applies.

<sup>365</sup> Added section per OSSIV3.0-N-09.0881-3 on 1/5/10 by JB. Revised per OSSIV3.0-N-10.0908-3 on 5/20/10 by JB. Added figure per OSSIV3.0-N-10.0962-5 on 1/21/11 by JB.

<sup>366</sup> Figure replaced per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB, replaced per OSSIV3.0-N-12.1073-3 on 11-1-12 by PO.

<sup>367</sup> Revised per OSSIV3.0-N-10.0962-5 on 1/21/11 by JB.

### 0.2.11.1.2 *IpProvMode*

This attribute specifies whether the CM honors or ignores the CMTS MDD TLV 5.1 setting in order to configure its IP provisioning mode. The CM relies upon the CMTS to facilitate the successful IP address acquisition independently of the MDD.

When this attribute is set to 'ipv4Only' the CM will initiate the acquisition of a single IPv4 address for the CM management stack.

When this attribute is set to 'ipv6Only' the CM will initiate the acquisition of a single IPv6 address for the CM management stack.

When this attribute is set to 'honorMdd', the CM will initiate the acquisition of an IP address as directed by the MDD message sent by the CMTS.

References: [MULPI] IP Initialization Parameters TLV section.

### 0.2.11.1.3 *IpProvModeResetOnChange*<sup>368</sup>

This attribute determines whether the CM is to automatically reset upon a change to the IpProvMode attribute. The IpProvModeResetOnChange attribute has a default value of 'false' which means that the CM does not reset upon change to IpProvMode attribute. When this attribute is set to 'true', the CM resets upon a change to the IpProvMode attribute.

References: [MULPI] IP Initialization Parameters TLV section.

### 0.2.11.1.4 *IpProvModeResetOnChangeHoldOffTimer*<sup>369</sup>

This attribute determines how long a CM with IpProvModeResetOnChange set to 'true' waits to reset. When the IpProvModeResetOnChange attribute is set to 'true', the CM will decrement from the configured timer value before resetting. The default value of the IpProvModeResetOnChangeHoldOffTimer is 0 seconds which is equivalent to an immediate reset.

References: [MULPI] IP Initialization Parameters TLV section.

### 0.2.11.1.5 *IpProvModeStorageType*

This attribute determines if the CM persists the value of IpProvMode across a single reset or across all resets. The default value of IpProvModeStorageType is 'nonVolatile' which means that the CM persists the value of IpProvMode across all resets. The CM persists the value of IpProvMode across only a single reset when IpProvModeStorageType is set to 'volatile'.

References: [MULPI] IP Initialization Parameters TLV section.

## 0.2.11.2 *CmEnergyMgtCfg Object*<sup>370</sup>

This object provides configuration state information on the CM for Energy Management features.

**Table O-45 - CmEnergyMgtCfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
FeatureEnabled	EnumBits	read-only	em1x1Feature(0)	N/A	N/A
CyclePeriod	unsignedShort	read-only		seconds	900

### 0.2.11.2.1 *FeatureEnabled*

This attribute indicates which energy savings features have been enabled in the Cable Modem. The CM enables use of Energy Management Features only if both the Energy Management Feature Control TLV and Energy Management Modem Capability Response from the CMTS indicate that the feature is enabled. If bit 0 is set, the Energy Management 1x1 Mode feature is enabled.

<sup>368</sup> Revised per OSSIV3.0-N-10.0962-5 on 4/21/11 by JB.

<sup>369</sup> Revised per OSSIV3.0-N-10.0962-5 on 4/21/11 by JB.

<sup>370</sup> Section added per OSSIV3.0-N-12.1073-3 on 11/1/12 by PO.

References: [MULPI] Energy Management Feature Control section.

#### O.2.11.2.2 *CyclePeriod*

This attribute specifies a minimum time period (in seconds) that must elapse between EM-REQ transactions in certain situations:

- In the case of Energy Management 1x1 Mode, this attribute sets the minimum cycle time that a CM will use for sending requests to enter Energy Management 1x1 Mode.
- In the case that the CM fails to receive an EM-RSP message after the maximum number of retries, this attribute sets the minimum amount of time to elapse before the CM can attempt another EM-REQ transaction.

References: [MULPI] Energy Management Cycle Period section.

#### O.2.11.3 *CmEnergyMgt1x1Cfg Object*

This object provides configuration state information on the CM for the Energy Management 1x1 Mode feature.

The values of these attributes are not persisted across reinitialization.

Reference: Energy Management 1x1 Mode Encodings section.

**Table O-46—CmEnergyMgt1x1Cfg Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
Direction	IfDirection	key		N/A	N/A
EntryBitrateThrshld	unsigned32	read-write		bps	Vendor-specific
EntryTimeThrshld	unsignedShort	read-write	1..65535	seconds	Vendor-specific
ExitBitrateThrshld	unsigned32	read-write		bps	Vendor-specific
ExitTimeThrshld	unsignedShort	read-write	1..65535	seconds	Vendor-specific

##### O.2.11.3.1 *Direction*

This key attribute indicates whether the threshold applies to the upstream or downstream.

##### O.2.11.3.2 *EntryBitrateThrshld*

This attribute specifies the upstream or downstream bitrate threshold (in bps) below which the CM will request to enter Energy Management 1x1 Mode operation.

##### O.2.11.3.3 *EntryTimeThrshld*

This attribute specifies the number of consecutive seconds that the upstream or downstream data rate needs to remain below the Upstream or Downstream Entry Bitrate Threshold in order to determine that a transition to Energy Management 1x1 Mode is required.

##### O.2.11.3.4 *ExitBitrateThrshld*

This attribute specifies the upstream or downstream bitrate threshold (in bps) above which the CM will request to leave Energy Management 1x1 Mode operation.

##### O.2.11.3.5 *ExitTimeThrshld*

This attribute specifies the number of consecutive seconds that the upstream or downstream data rate needs to remain above the Upstream or Downstream Exit Bitrate Threshold in order to determine that a transition out of Energy Management 1x1 Mode is required.

## Annex P Subscriber Management Requirements (Normative)

### P.1 Overview

This Annex defines management objects for Subscriber Management. This model provides CMTS enforcement of CM and CPE packet filtering, maximum number of CM CPEs.

### P.2 Object Definitions<sup>371</sup>

This model provides the Subscriber Management packet filtering policies for CMs and CPE behind the CM. The Subscriber Management model provides the CMTS with policy management of upstream and downstream filtering traffic on a CM basis through DOCSIS defined CPE types. The components of the Subscriber Management model are:

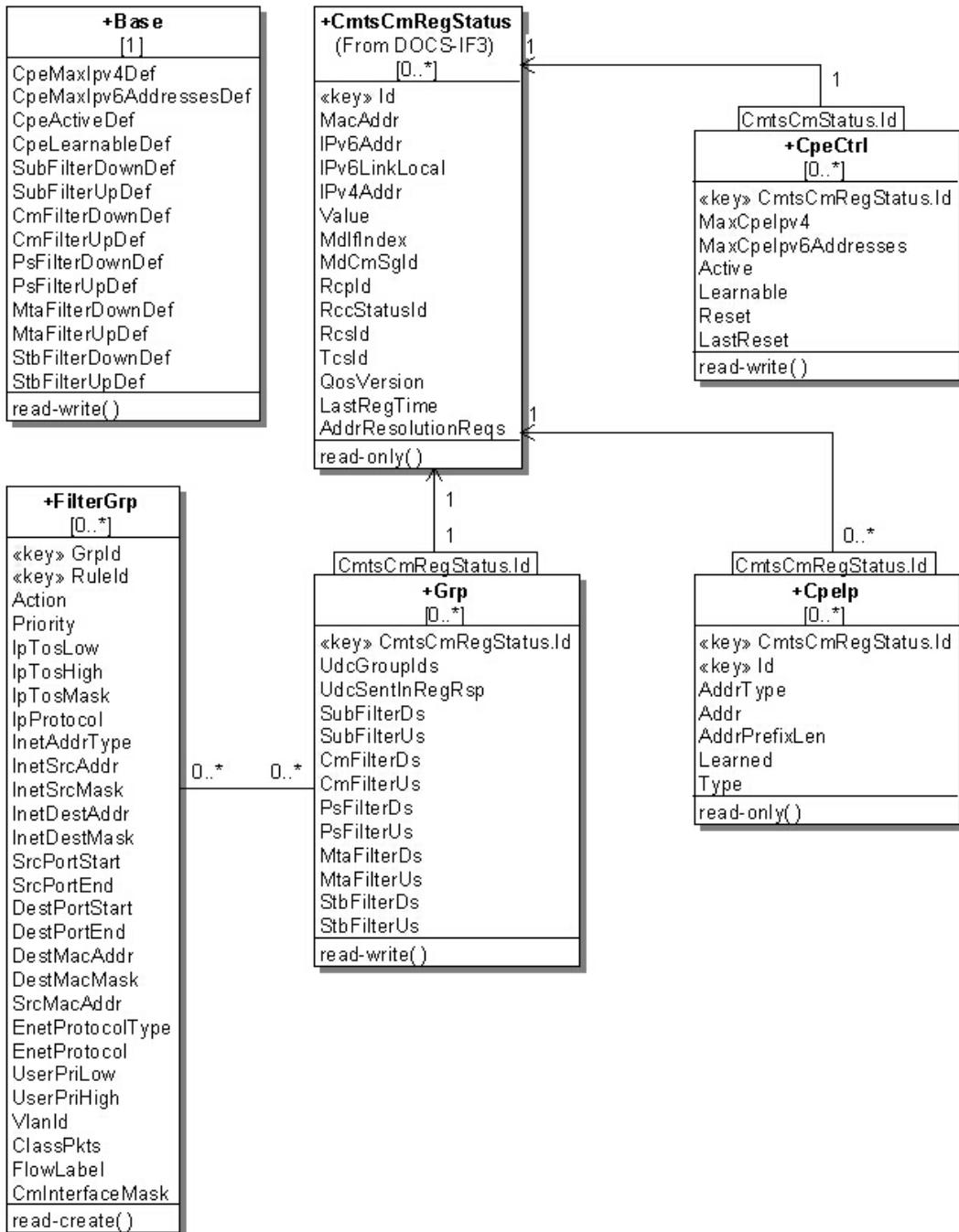
- Base, default configuration parameters
- CpeCtrl, per-CM control and usage of Subscriber Management features
- CpeIp, per-CM list of CPE's IPv4 addresses and IPv6 prefixes
- Grp, per-CM filter groups
- FilterGrp, list of classifiers of a filter group

DOCSIS 3.0 Subscriber Management aligns the packet classification parameters of the filters groups with the QOS classification criteria. To that extend, as an optional CMTS feature, a Subscriber Management Filter Group ID or a set of those IDs can be associated with Upstream Drop Classifier Group ID(s) (see [MULPI]). In this situation the CMTS Subscriber Management Filter groups are provisioned to the CM in the form of Upstream Drop Classifiers (UDCs) during the registration process.

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<sup>371</sup> Section revised per OSSIV3.0-N-07.0441-4, #1 on 5/9/07 by KN.

## P.2.1 Subscriber Management Objects



**Figure P-1 - Subscriber Management Object Model Diagram**<sup>372</sup>

<sup>372</sup> Figure P-1 replaced per OSSIV3.0-N-07.0445-3, #6 on 5/10/07 by KN and replaced per OSSIV3.0-N-10.0921-4 on 5/20/10 by JB.

### P.2.1.1 **Base Object**

This object defines the configuration parameters of Subscriber Management features for the CM in case the CM does not signal any of the parameters during the registration process.

**Table P-1 - Base Object**<sup>373</sup>

Attribute Name	Type	Access	Type Constraints	Units	Default
CpeMaxIpv4Def	unsignedShort	read-write	0..1023	N/A	16
CpeMaxIpv6AddressesDef	unsignedShort	read-write	0..1023	N/A	16
CpeActiveDef	boolean	read-write		N/A	false
CpeLearnableDef	boolean	read-write		N/A	false
SubFilterDownDef	unsignedShort	read-write	0..1024	N/A	0
SubFilterUpDef	unsignedShort	read-write	0..1024	N/A	0
CmFilterDownDef	unsignedShort	read-write	0..1024	N/A	0
CmFilterUpDef	unsignedShort	read-write	0..1024	N/A	0
PsFilterDownDef	unsignedShort	read-write	0..1024	N/A	0
PsFilterUpDef	unsignedShort	read-write	0..1024	N/A	0
MtaFilterDownDef	unsignedShort	read-write	0..1024	N/A	0
MtaFilterUpDef	unsignedShort	read-write	0..1024	N/A	0
StbFilterDownDef	unsignedShort	read-write	0..1024	N/A	0
StbFilterUpDef	unsignedShort	read-write	0..1024	N/A	0

#### P.2.1.1.1 **CpeMaxIpv4Def**

This attribute represents the maximum number of IPv4 addresses allowed for the CM's CPE if not signaled in the registration process.

#### P.2.1.1.2 **CpeMaxIpv6AddressesDef**<sup>374</sup>

This attribute represents the maximum number of IPv6 Prefixes and addresses allowed for the CM's CPEs if not signaled in the registration process. All IPv6 prefixes and addresses, including Link-Local and any address with a scope greater than 1 are counted against the CpeMaxIpv6AddressesDef.<sup>375</sup>

#### P.2.1.1.3 **CpeActiveDef**

This attribute represents the default value for enabling Subscriber Management filters and controls in the CM if the parameter is not signaled in the DOCSIS Registration process.

#### P.2.1.1.4 **CpeLearnableDef**

This attribute represents the default value for enabling the CPE learning process for the CM if the parameter is not signaled in the DOCSIS Registration process.

#### P.2.1.1.5 **SubFilterDownDef**

This attribute represents the default value for the subscriber (CPE) downstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

#### P.2.1.1.6 **SubFilterUpDef**

This attribute represents the default value for the subscriber (CPE) upstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

<sup>373</sup> First 2 rows modified per OSS13.0-N-07.0444-3, 5/10/07 per PO and revised per OSS1v3.0-N-10.0921-4 on 5/20/10 by JB.

<sup>374</sup> Revised per OSS1v3.0-N-10.0921-4 on 5/20/10 and per 10.0928-1 on 6/3/10 by JB.

<sup>375</sup> Section added per OSS13.0-N-07.0444-3, 5/10/07 per PO.

**P.2.1.1.7 CmFilterDownDef**

This attribute represents the default value for the CM stack downstream filter group applying to the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.8 CmFilterUpDef**

This attribute represents the default value for the CM stack upstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.9 PsFilterDownDef**

This attribute represents the default value for the PS or eRouter downstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.10 PsFilterUpDef**

This attribute represents the default value for the PS or eRouter upstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.11 MtaFilterDownDef**

This attribute represents the default value for the MTA downstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.12 MtaFilterUpDef**

This attribute represents the default value for the MTA upstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.13 StbFilterDownDef**

This attribute represents the default value for the STB downstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.1.14 StbFilterUpDef**

This attribute represents the default value for the STB upstream filter group for the CM if the parameter is not signaled in the DOCSIS Registration process.

**P.2.1.2 CpeCtrl Object**

This object maintains per-CM traffic policies enforced by the CMTS. The CMTS acquires the CM traffic policies through the CM registration process, or in the absence of some or all of those parameters, from the Base object. The CM information and controls are meaningful and used by the CMTS, but only after the CM is operational.

**Table P-2 - CpeCtrl Object<sup>376</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedShort	key	1..4294967295	N/A	N/A
MaxCpelpv4	unsignedShort	read-write	0..1023	N/A	N/A
MaxCpelpv6Addresses	unsignedShort	read-write	0..1023	N/A	N/A
Active	boolean	read-write		N/A	N/A
Learnable	boolean	read-write		N/A	N/A
Reset	boolean	read-write		N/A	N/A
LastReset	TimeStamp	read-write		N/A	N/A

**P.2.1.2.1 CmtsCmRegStatusId**

This key is the CMTS generated unique identifier of a CM for status report purposes.

<sup>376</sup> Table revised per OSS13.0-N-07.0444-3, 5/10/07 per PO and revised per OSSIV3.0-N-10.0921-4 on 5/20/10 by JB.

### *P.2.1.2.2 MaxCpeIpv4*

This attribute represents the number of simultaneous IPv4 addresses permitted for CPEs connected to the CM. When the MaxCpeIpv4 attribute is set to zero (0), all IPv4 CPE traffic from the CM is dropped. The CMTS configures this attribute with whichever of the 'Subscriber Management CPE IPv4 List' or 'Subscriber Management Control-MaxCpeIpv4' signaled encodings is greater, or in the absence of all of those provisioning parameters, with the CpeMaxIpv4Def from the Base object. This limit applies to learned and DOCSIS-provisioned entries but not to entries added through some administrative process (e.g., statically) at the CMTS. Note that this attribute is only meaningful when the Active attribute of the CM is set to 'true'.<sup>377</sup>

References: [MULPI] Subscriber Management TLVs section of the Common Radio Frequency Interface Encodings Annex.

### *P.2.1.2.3 MaxCpeIpv6Addresses*

This attribute represents the maximum number of simultaneous IPv6 prefixes and addresses that are permitted for CPEs connected to the CM. When the MaxCpeIpv6Prefix is set to zero (0), all IPv6 CPE traffic from the CM is dropped. The CMTS configures this attribute with whichever of the ('Subscriber Management CPE IPv6 List (TLV 67)' plus 'Subscriber Management CPE IPv6 Prefix List (TLV 61)') or ('Subscriber Management Control Max CPE IPv6 Addresses (TLV 63)') signaled encodings is greater, or in the absence of all of those provisioning parameters, with the MaxIpv6AddressDef from the Base object. This limit applies to learned and DOCSIS-provisioned entries but not to entries added through some administrative process at the CMTS. Note that this attribute is only meaningful when the Active attribute of the CM is set to 'true'.

All IPv6 addresses, including Link-Local and any address with a scope greater than 1 are counted against the CpeCtrlMaxCpeIpv6Addresses.

References: [MULPI] Subscriber Management TLVs section of the Common Radio Frequency Interface Encodings Annex.<sup>378</sup>

### *P.2.1.2.4 Active*

This attribute controls the application of subscriber management to this CM. If this is set to 'true', CMTS-based CPE control is active, and all the actions required by the various filter policies and controls apply at the CMTS. If this is set to false, no subscriber management filtering is done at the CMTS (but other filters may apply). If not set through DOCSIS provisioning, this object defaults to the value of the Active attribute of the Base object.

References: [MULPI] Subscriber Management TLVs section of the Common Radio Frequency Interface Encodings Annex.

### *P.2.1.2.5 Learnable*

This attribute controls whether the CMTS may learn (and pass traffic for) CPE IP addresses associated with a CM. If this is set to 'true', the CMTS may learn up to the CM MaxCpeIp value less any DOCSIS-provisioned entries related to this CM. The nature of the learning mechanism is not specified here. If not set through DOCSIS provisioning, this object defaults to the value of the CpeLearnableDef attribute from the Base object. Note that this attribute is only meaningful if docsSubMgtCpeCtrlActive is 'true' to enforce a limit in the number of CPEs learned. CPE learning is always performed for the CMTS for security reasons.

References: [MULPI] Subscriber Management TLVs section of the Common Radio Frequency Interface Encodings Annex.

### *P.2.1.2.6 Reset*

If set to 'true', this attribute commands the CMTS to delete the instances denoted as 'learned' addresses in the CpeIp object. This attribute always returns false on read.

### *P.2.1.2.7 LastReset*

This attribute represents the system Up Time of the last set to 'true' of the Reset attribute of this instance. Zero if never reset.

<sup>377</sup> Para revised per OSS13.0-N-07.0444-3, 5/10/07 per PO.

<sup>378</sup> Section added per OSS13.0-N-07.0444-3, 5/10/07 per PO and revised per OSS1v3.0-N-10.0921-4 on 5/20/10 by JB.

### P.2.1.3 *Cpelp Object*

This object defines the list of IP Addresses behind the CM known by the CMTS. If the Active attribute of the CpeCtrl object associated with a CM is set to 'true' and the CMTS receives an IP packet from a CM that contains a source IP address that does not match one of the CPE IP addresses associated with this CM, one of two things occurs. If the number of CPE IPs is less than the MaxCpeIp of the CpeCtrl object for that CM, the source IP address is added to this object and the packet is forwarded; otherwise, the packet is dropped.

**Table P-3 - Cpelp Object<sup>379</sup>**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedShort	key	1..4294967295	N/A	N/A
Id	unsignedInt	key	1..1023	N/A	N/A
AddrType	InetAddressType	read-only		N/A	N/A
Addr	InetAddress	read-only		N/A	N/A
AddrPrefixLen	InetAddressPrefixLength	read-only		N/A	N/A
Learned	boolean	read-only		N/A	N/A
Type	Enum	read-only	cpe(1) ps(2) mta(3) stb(4) tea(5) erouter(6)	N/A	N/A

#### P.2.1.3.1 *CmtsCmRegStatusId*

This key is the CMTS generated unique identifier of a CM for status reporting purposes.

#### P.2.1.3.2 *Id*

This attribute represents a unique identifier for a CPE IP of the CM. An instance of this attribute exists for each CPE provisioned in the 'Subscriber Management CPE IPv4 Table' or 'Subscriber Management CPE IPv6 Table' encodings. An entry is created either through the included CPE IP addresses in the provisioning object, or CPEs learned from traffic sourced from the CM.

References: [MULPI] Common Radio Frequency Interface Encodings Annex.

#### P.2.1.3.3 *AddrType*

The type of Internet address of the Addr attribute.

#### P.2.1.3.4 *Addr*

This attribute represents the IP address either set from provisioning or learned via address gleaning or other forwarding means.

#### P.2.1.3.5 *AddrPrefixLen*

This attribute represents the prefix length associated with the IP subnet prefix either set from provisioning or learned via address gleaning or other forwarding means. For IPv4 CPE addresses this attribute generally reports the value 32 (32 bits) to indicate a unicast IPv4 address. For IPv6 this attribute represents either a discrete IPv6 unicast address (a value of 128 bits, equal to /128 prefix length) or a subnet prefix length (such as 56 bits, equal to /56 prefix length).<sup>380</sup>

#### P.2.1.3.6 *Learned*

This attribute is set to 'true' when the IP address was learned from IP packets sent upstream rather than via the CM provisioning process.

<sup>379</sup> Table revised per OSS13.0-N-07.0444-3, 5/10/07 per PO.

<sup>380</sup> Section added per OSS13.0-N-07.0444-3, 5/10/07 per PO.

### P.2.1.3.7 Type

This attribute represents the type of CPE based on the following classifications: 'cpe' Regular CPE clients, 'ps' CableHome Portal Server (PS), 'mta' PacketCable Multimedia Terminal Adapter (MTA), 'stb' Digital Set-top Box (STB), 'tea' T1 Emulation adapter (TEA), 'erouter' Embedded Router (eRouter).

### P.2.1.4 Grp Object<sup>381</sup>

This object defines the set of downstream and upstream filter groups that the CMTS applies to traffic associated with that CM.

References: [MULPI] Subscriber Management TLVs section in the Common Radio Frequency Interface Encodings Annex.

**Table P-4 - Grp Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
CmtsCmRegStatusId	unsignedShort	key	1..4294967295	N/A	N/A
UdcGroupIds	TagList	read-only		N/A	"H
UdcSentInRegRsp	boolean	read-only		N/A	'false'
SubFilterDs	unsignedShort	read-write	0..1024	N/A	N/A
SubFilterUs	unsignedShort	read-write	0..1024	N/A	N/A
CmFilterDs	unsignedShort	read-write	0..1024	N/A	N/A
CmFilterUs	unsignedShort	read-write	0..1024	N/A	N/A
PsFilterDs	unsignedShort	read-write	0..1024	N/A	N/A
PsFilterUs	unsignedShort	read-write	0..1024	N/A	N/A
MtaFilterDs	unsignedShort	read-write	0..1024	N/A	N/A
MtaFilterUs	unsignedShort	read-write	0..1024	N/A	N/A
StbFilterDs	unsignedShort	read-write	0..1024	N/A	N/A
StbFilterUs	unsignedShort	read-write	0..1024	N/A	N/A

#### P.2.1.4.1 CmtsCmRegStatusId

This key is the CMTS generated unique identifier of a CM for status report purposes.

#### P.2.1.4.2 UdcGroupIds

This attribute represents the filter group(s) associated with the CM signaled 'Upstream Drop Classifier Group ID' encodings during the registration process. UDC Group IDs are integer values and this attribute reports them as decimal numbers that are space-separated. The zero-length string indicates that the CM didn't signal UDC Group IDs.

This attribute provides two functions:

- Communicate the CM the configured UDC Group ID(s), irrespective of the CM being provisioned to filter upstream traffic based on IP Filters or UDCs.
- Optionally, and with regards to the CMTS, if the value of the attribute UdcSentInReqRsp is 'true', indicates that the filtering rules associated with the Subscriber Management Group ID(s) will be sent during registration to the CM. It is vendor specific whether the CMTS updates individual CM UDCs after registration when rules are changed in the Grp object.

#### P.2.1.4.3 UdcSentInRegRsp

This attribute represents the CMTS upstream filtering status for this CM. The value 'true' indicates that the CMTS has sent UDCs to the CM during registration process. In order for a CMTS to send UDCs to a CM, the CMTS MAC Domain needs to be enabled via the MAC Domain attribute SendUdcRulesEnabled and the CM had indicated the

<sup>381</sup> Section revised per OSSIV3.0-N-07.0441-4, #20 on 5/9/07 by KN.

UDC capability support during the registration process. The value 'false' indicates that the CMTS was not enabled to send UDCs to the CMs in the MAC Domain, or the CM did not advertise UDC support in its capabilities encodings, or both. Since the CMTS capability to send UDCs to CMs during the registration process is optional, the CMTS is not required to instantiate this attribute.

#### P.2.1.4.4 *SubFilterDs*

This attribute represents the filter group applied to traffic destined for subscriber's CPE attached to the referenced CM (attached to CM CPE interfaces). This value corresponds to the 'Subscriber Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to hosts attached to this CM.

#### P.2.1.4.5 *SubFilterUs*

This attribute represents the filter group applied to traffic originating from subscriber's CPE attached to the referenced CM (attached to CM CPE interfaces). This value corresponds to the 'Subscriber Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from hosts attached to this CM.

#### P.2.1.4.6 *CmFilterDs*

This attribute represents the filter group applied to traffic destined for the CM itself. This value corresponds to the 'CM Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the CmFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to this CM.

#### P.2.1.4.7 *CmFilterUs*<sup>382</sup>

This attribute represents the filter group applied to traffic originating from the CM itself. This value corresponds to the 'CM Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the CmFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from this CM.

#### P.2.1.4.8 *PsFilterDs*

This attribute represents the filter group applied to traffic destined to the Embedded CableHome Portal Services Element or the Embedded Router on the referenced CM. This value corresponds to the 'PS Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the PsFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to the Embedded CableHome Portal Services Element or Embedded Router on this CM.

#### P.2.1.4.9 *PsFilterUs*

This attribute represents the filter group applied to traffic originating from the Embedded CableHome Portal Services Element or Embedded Router on the referenced CM. This value corresponds to the 'PS Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the PsFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded CableHome Portal Services Element or Embedded Router on this CM.

#### P.2.1.4.10 *MtaFilterDs*

This attribute represents the filter group applied to traffic destined to the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on the referenced CM. This value corresponds to the 'MTA Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the MtaFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to the Embedded

<sup>382</sup> OSSIV3.1-N-13.1125-1 made changes in Sections P.2.1.4.7 – P.2.1.4.13

PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on this CM.

#### P.2.1.4.11 *MtaFilterUs*

This attribute represents the filter group applied to traffic originating from the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on the referenced CM. This value corresponds to the 'MTA Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the MtaFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on this CM.

#### P.2.1.4.12 *StbFilterDs*

This attribute represents the filter group applied to traffic destined for the Embedded Set-Top Box or CableCARD™ on the referenced CM. This value corresponds to the 'STB Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the StbFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to the Embedded Set-Top Box or CableCARD on this CM.

#### P.2.1.4.13 *StbFilterUs*

This attribute represents the filter group applied to traffic originating from the Embedded Set-Top Box or CableCARD on the referenced CM. This value corresponds to the 'STB Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the StbFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded Set-Top Box or CableCARD on this CM.

### P.2.1.5 *FilterGrp Object*<sup>383</sup>

This object describes a set of filter or classifier criteria. Classifiers are assigned by group to the individual CMs. That assignment is made via the 'Subscriber Management TLVs' encodings sent upstream from the CM to the CMTS during registration, or in their absence, default values configured in the CMTS.

A Filter Group ID (GrpId) is a set of rules that correspond to the expansion of a UDC Group ID into individual UDC rules. The UDC Group IDs are linked to Ids of the FilterGrp object so the CMTS can signal those filter rules as UDCs to the CM during the registration process. Implementation of L2 classification criteria is optional for the CMTS; LLC/MAC upstream and downstream filter criteria can be ignored during the packet matching process.

**Table P-5 - FilterGrp Object**

Attribute Name	Type	Access	Type Constraints	Units	Default
GrpId	unsignedShort	key	1..1024	N/A	N/A
RuleId	unsignedShort	key	1..65535	N/A	N/A
Action	Enum	read-create	permit(1) deny(2)	N/A	permit
Priority	unsignedShort	read-create		N/A	0
IpTosLow	hexBinary	read-create	SIZE (1)	N/A	'00'H
IpTosHigh	hexBinary	read-create	SIZE (1)	N/A	'00'H
IpTosMask	hexBinary	read-create	SIZE (1)	N/A	'00'H
IpProtocol	unsignedShort	read-create	0..257	N/A	256
InetAddrType	InetAddressType	read-create		N/A	unknown
InetSrcAddr	InetAddress	read-create		N/A	"H

<sup>383</sup> Section revised per OSSIV3.0-N-07.0441-4, #2 & 4 on 5/9/07 by KN and per OSSIV3.0-N-10.0921-4 on 5/20/10 by JB.

Attribute Name	Type	Access	Type Constraints	Units	Default
InetSrcMask	InetAddress	read-create		N/A	"H
InetDestAddr	InetAddress	read-create		N/A	"H
InetDestMask	InetAddress	read-create		N/A	"H
SrcPortStart	InetPortNumber	read-create		N/A	0
SrcPortEnd	InetPortNumber	read-create		N/A	65535
DestPortStart	InetPortNumber	read-create		N/A	0
DestPortEnd	InetPortNumber	read-create		N/A	65535
DestMacAddr	MacAddress	read-create		N/A	'000000000000'H
DestMacMask	MacAddress	read-create		N/A	'000000000000'H
SrcMacAddr	MacAddress	read-create		N/A	'FFFFFFFFFFFF'H
EnetProtocolType	Enum	read-create	none(0) ethertype(1) dsap(2) mac(3) all(4)	N/A	none
EnetProtocol	unsignedShort	read-create		N/A	0
UserPriLow	unsignedShort	read-create	0..7	N/A	0
UserPriHigh	unsignedShort	read-create	0..7	N/A	7
VlanId	unsignedShort	read-create	0   1..4094	N/A	0
ClassPkts	Counter64	read-only		N/A	N/A
FlowLabel	unsignedInt	read-create	0..1048575	N/A	0
CmInterfaceMask	DocsL2vpnIfList	read-create		N/A	"H

#### P.2.1.5.1 *GrpId*

This key is an identifier for a set of classifiers known as a filter group. Each CM may be associated with several filter groups for its upstream and downstream traffic, one group per target end point on the CM as defined in the Grp object. Typically, many CMs share a common set of filter groups. The range for this attribute is 1 to 1024 to align it with the values used in the Base Object.

#### P.2.1.5.2 *RuleId*<sup>384</sup>

This key represents an ordered classifier identifier within the group. Filters are applied in order if the Priority attribute is not supported. The CMTS MUST support at least 50 rules per filter group.

#### P.2.1.5.3 *Action*

This attribute represents the action to take upon this filter matching. 'permit' means to stop the classification matching and accept the packet for further processing. 'deny' means to drop the packet.

#### P.2.1.5.4 *Priority*

This attribute defines the order in which the classifiers are compared against packets. The higher the value, the higher the priority.

#### P.2.1.5.5 *IpTosLow*

This attribute represents the low value of a range of ToS (Type of Service) octet values. The IP ToS octet, as originally defined in [RFC 791], has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). This attribute is defined as an 8-bit octet as per the DOCSIS Specification for packet classification.

References: [MULPI]; [RFC 791]; [RFC 3168]; [RFC 3260].

<sup>384</sup> Section revised per OSSIV3.0-N-13.1125-1 on 3/26/14 by PO.

**P.2.1.5.6 *IpTosHigh***

This attribute represents the high value of a range of ToS octet values. The IP ToS octet, as originally defined in [RFC 791], has been superseded by the 6-bit Differentiated Services Field (DSField, [RFC 3260]) and the 2-bit Explicit Congestion Notification Field (ECN field, [RFC 3168]). This attribute is defined as an 8-bit octet as per the DOCSIS Specification for packet classification.

References: [MULPI]; [RFC 791]; [RFC 3168]; [RFC 3260].

**P.2.1.5.7 *IpTosMask***

This attribute represents the mask value that is bitwise ANDed with ToS octet in an IP packet, and the resulting value is used for range checking of IpTosLow and IpTosHigh.

**P.2.1.5.8 *IpProtocol***

This attribute represents the value of the IP Protocol field required for IP packets to match this rule. The value 256 matches traffic with any IP Protocol value. The value 257 by convention matches both TCP and UDP.

**P.2.1.5.9 *InetAddrType***

The type of the Internet address for InetSrcAddr, InetSrcMask, InetDestAddr, and InetDestMask.

**P.2.1.5.10 *InetSrcAddr***

This attribute specifies the value of the IP Source Address required for packets to match this rule. An IP packet matches the rule when the packet's IP Source Address bitwise ANDed with the InetSrcMask value equals the InetSrcAddr value. The address type of this object is specified by the InetAddrType attribute.

**P.2.1.5.11 *InetSrcMask***

This attribute represents which bits of a packet's IP Source Address are compared to match this rule. An IP packet matches the rule when the packet's IP Source Address bitwise ANDed with the InetSrcMask value equals the InetSrcAddr value. The address type of this object is specified by InetAddrType.

**P.2.1.5.12 *InetDestAddr***

This attribute specifies the value of the IP Destination Address required for packets to match this rule. An IP packet matches the rule when the packet's IP Destination Address bitwise ANDed with the InetSrcMask value equals the InetDestAddr value. The address type of this object is specified by the InetAddrType attribute.

**P.2.1.5.13 *InetDestMask***

This attribute represents which bits of a packet's IP Destination Address are compared to match this rule. An IP packet matches the rule when the packet's IP Destination Address bitwise ANDed with the InetDestMask value equals the InetDestAddr value. The address type of this object is specified by InetAddrType.

**P.2.1.5.14 *SrcPortStart***

This attribute represents the low-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets.

**P.2.1.5.15 *SrcPortEnd***

This attribute represents the high-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets.

**P.2.1.5.16 *DestPortStart***

This attribute represents the low-end inclusive range of TCP/UDP destination port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets.

**P.2.1.5.17 *DestPortEnd***

This attribute represents the high-end inclusive range of TCP/UDP destination port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets.

#### P.2.1.5.18 *DestMacAddr*

This attribute represents the criteria to match against an Ethernet packet MAC address bitwise ANDed with DestMacMask.

#### P.2.1.5.19 *DestMacMask*

An Ethernet packet matches an entry when its destination MAC address bitwise ANDed with the DestMacMask attribute equals the value of the DestMacAddr attribute.

#### P.2.1.5.20 *SrcMacAddr*

This attribute represents the value to match against an Ethernet packet source MAC address.

#### P.2.1.5.21 *EnetProtocolType*<sup>385</sup>

This attribute indicates the format of the layer 3 protocol ID in the Ethernet packet. A value of 'none' means that the rule does not use the layer 3 protocol type as a matching criteria. A value of 'ethertype' means that the rule applies only to frames that contain an EtherType value. Ethertype values are contained in packets using the DEC-Intel-Xerox (DIX) encapsulation or the [RFC 1042] Sub-Network Access Protocol (SNAP) encapsulation formats. A value of 'dsap' means that the rule applies only to frames using the IEEE802.3 encapsulation format with a Destination Service Access Point (DSAP) other than 0xAA (which is reserved for SNAP). A value of 'mac' means that the rule applies only to MAC management messages for MAC management messages. A value of 'all' means that the rule matches all Ethernet packets. If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1p/Q header.

The value 'mac' is only used for passing UDCs to CMs during Registration. The CMTS ignores filter rules that include the value of this attribute set to 'mac' for CMTS enforced upstream and downstream subscriber management filter group rules.

References: [RFC 1042] Sub-Network Access Protocol (SNAP) encapsulation formats.

#### P.2.1.5.22 *EnetProtocol*

This attribute represents the Ethernet protocol type to be matched against the packets. For EnetProtocolType set to 'none', this attribute is ignored when considering whether a packet matches the current rule. If the attribute EnetProtocolType is 'ethertype', this attribute gives the 16-bit value of the EtherType that the packet must match in order to match the rule. If the attribute EnetProtocolType is 'dsap', the lower 8 bits of this attribute's value must match the DSAP byte of the packet in order to match the rule. If the Ethernet frame contains an 802.1p/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1p/Q header.

#### P.2.1.5.23 *UserPriLow*

This attribute applies only to Ethernet frames using the 802.1p/Q tag header (indicated with EtherType 0x8100). Such frames include a 16-bit Tag that contains a 3-bit Priority field and a 12-bit VLAN number. Tagged Ethernet packets must have a 3-bit Priority field within the range of PriLow to PriHigh in order to match this rule.

#### P.2.1.5.24 *UserPriHigh*

This attribute applies only to Ethernet frames using the 802.1p/Q tag header (indicated with EtherType 0x8100). Such frames include a 16-bit Tag that contains a 3-bit Priority field and a 12-bit VLAN number. Tagged Ethernet packets must have a 3-bit Priority field within the range of PriLow to PriHigh in order to match this rule.

#### P.2.1.5.25 *VlanId*

This attribute applies only to Ethernet frames using the 802.1p/Q tag header. Tagged packets must have a VLAN Identifier that matches the value in order to match the rule.

#### P.2.1.5.26 *ClassPkts*

This attribute counts the number of packets that have been classified (matched) using this rule entry. This includes all packets delivered to a Service Flow maximum rate policing function, whether or not that function drops the

<sup>385</sup> Section revised per OSSIV3.0-N-07.0441-4, #9 on 5/9/07 by KN.

packets. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface.

#### *P.2.1.5.27 FlowLabel*

This attribute represents the Flow Label field in the IPv6 header to be matched by the classifier.

The value zero indicates that the Flow Label is not specified as part of the classifier and is not matched against packets.

#### *P.2.1.5.28 CmInterfaceMask*

This attribute represents a bit-mask of the CM in-bound interfaces to which this classifier applies.

This attribute only applies to upstream Drop Classifiers being sent to CMs during the registration process.

## Annex Q DOCSIS 3.0 SNMP MIB Modules (Normative)

This Annex includes the SNMP MIB modules which define the DOCSIS 3.0 management objects.

### Q.1 DOCS-DIAG-MIB<sup>386</sup>

```
DOCS-DIAG-MIB DEFINITIONS ::= BEGIN
IMPORTS
    NOTIFICATION-TYPE,
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32,
    Gauge32,
    Counter32
        FROM SNMPv2-SMI
    TruthValue,
    MacAddress,
    DateAndTime,
    TEXTUAL-CONVENTION
        FROM SNMPv2-TC
    OBJECT-GROUP,
    MODULE-COMPLIANCE,
    NOTIFICATION-GROUP
        FROM SNMPv2-CONF
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB
    CmtsCmRegState,
    docsIf3CmtsCmRegStatusId
        FROM DOCS-IF3-MIB
    docsDevEvLevel,
    docsDevEvid
        FROM DOCS-CABLE-DEVICE-MIB
    clabProjDocsis
        FROM CLAB-DEF-MIB;

docsDiagMib MODULE-IDENTITY
LAST-UPDATED      "20071206000Z" -- December 6, 2007
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
    "Postal: Cable Television Laboratories
     858 Coal Creek Circle
     Louisville, CO 80027-9750
     U.S.A.
     Phone: +1 303-661-9100
     Fax:   +1 303-661-9199
     E-mail: mibs@cablelabs.com"
DESCRIPTION
    "This is the MIB Module for the Diagnostic Log for
     DOCSIS-compliant Cable Modem Termination Systems (CMTS).

The purpose of the Diagnostic Log is to prevent service
interruptions by early detection of potential problems.
It can also be used for fault management and for
troubleshooting the cable network.

The Diagnostic Log contains Cable Modems that show certain
potential problematic behaviors, as determined by the CMTS.
These detection criteria are defined as diagnostic
```

<sup>386</sup> Section revised per OSSIV3.0-N-07.0412-2, #2 on 5/8/07, OSSIV3.0-N-07.0410-4 on 5/8/07, and OSSIV3.0-N-07.0602-1 on 1/29/08 by KN.

triggers.

The diagnostic trigger is an information filter to avoid inundating a management agent with data which is less meaningful as a function of size.

There are 2 diagnostic triggers defined. Each trigger maintains a counter for each Cable Modem that is caught by that trigger.

- (1) Registration Trigger
- (2) Ranging Retry Trigger

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All rights reserved."

REVISION "200712060000Z" -- December 6, 2007

DESCRIPTION

"Revised version includes ECN  
OSSIv3.0-N-07.0550-2 and published as I05."

REVISION "200705180000Z" -- May 18, 2007

DESCRIPTION

"Revised Version includes ECN OSSIv3.0-N-07.0410-4  
and published as I03."

REVISION "200612070000Z" -- December 7, 2006

DESCRIPTION

"Initial version, published as part of the CableLabs  
OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207."

::= { clabProjDocsis 9 }

--

-- Textual Conventions

--

TriggerFlag ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This type defines the Diagnostic Log Trigger Type.  
Bit 0 selects the registration trigger.  
Bit 1 selects the ranging retry trigger."

SYNTAX BITS {  
    registration(0),  
    rangingRetry(1)  
}

RegistrationDetailFlag ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This data type defines an enumerated union of CM states used for the registration trigger detection. The named bits associated with this type correspond to a subset of the names for the enumerations in CmtsCmRegState data type."

SYNTAX BITS {  
    other(0),  
    initialRanging(1),  
    rangingAutoAdjComplete(2),  
    startEae(3),  
    startDhcpv4(4),  
    startDhcpv6(5),  
    dhcpv4Complete(6),  
    dhcpv6Complete(7),  
    startConfigFileDownload(8),  
    configFileDownloadComplete(9),

```
        startRegistration(10),
        registrationComplete(11),
        bpiInit(12),
        operational(13)
    }

-- Diagnostic Sub-tree Definitions
--

docsDiagLogNotifications      OBJECT IDENTIFIER ::= { docsDiagMib 0 }
docsDiagLogMibObjects         OBJECT IDENTIFIER ::= { docsDiagMib 1 }
docsDiagLogGlobal              OBJECT IDENTIFIER
                                ::= { docsDiagLogMibObjects 1 }
docsDiagLogTriggersCfg        OBJECT IDENTIFIER
                                ::= { docsDiagLogMibObjects 2 }

-- Diagnostic Log global objects
--

docsDiagLogMaxSize OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    UNITS       "entries"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "The maximum number of Cable Modem entries that
         docsDiagLogTable can report."
    DEFVAL { 100 }
    ::= { docsDiagLogGlobal 1 }

docsDiagLogCurrentSize OBJECT-TYPE
    SYNTAX      Gauge32 (0..4294967295)
    UNITS       "entries"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The total number of Cable Modem entries reported in the
         docsDiagLogTable.
        The maximum value possible will be docsDiagLogMaxSize."
    ::= { docsDiagLogGlobal 2 }

docsDiagLogNotifyLogSizeHighThrshld OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    UNITS       "entries"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "If the number of entries in docsDiagLogTable exceeds
         this value, CMTS will trigger the appropriate event."
    DEFVAL { 80 }
    ::= { docsDiagLogGlobal 3 }

docsDiagLogNotifyLogSizeLowThrshld OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    UNITS       "entries"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "If the number of entries in docsDiagLogTable exceeded
         docsDiagLogNotifyLogSizeHighThrshld earlier and then drops
         to this value, CMTS will trigger the appropriate event."
    DEFVAL { 60 }
    ::= { docsDiagLogGlobal 4 }
```

```

docsDiagLogAging OBJECT-TYPE
    SYNTAX      Unsigned32 (15..86400)
    UNITS      "minutes"
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "Aging threshold for the Diagnostic Log. Periodically, a
        process scans through the Diagnostic log and removes those
        Cable Modems from docsDiagLogTable and
        docsDiagLogDetailTable that have no new detections for a
        time interval longer than this threshold in minutes."
    DEFVAL { 10080 } -- one week
    ::= { docsDiagLogGlobal 5 }

docsDiagLogResetAll OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "If set to 'true', all counter objects for
        all entries in docsDiagLogTable and docsDiagLogDetailTable
        are reset to zero. Reading this object always returns
        'false'.""
    ::= { docsDiagLogGlobal 6 }

docsDiagLogLastResetTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "The last time that all the counters in the
        docsDiagLogTable and docsDiagLogDetailTable are
        reset to 0. The special value of all '00'Hs indicates
        that the Entries in these tables have never been reset."
    ::= { docsDiagLogGlobal 7 }

docsDiagLogClearAll OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "If set to 'true', all entries from the
        docsDiagLogTable and docsDiagLogDetailTable are removed.
        Reading this object always returns 'false'.""
    ::= { docsDiagLogGlobal 8 }

docsDiagLogLastClearTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "The last time that all the entries in the docsDiagLogTable
        and docsDiagLogDetailTable are destroyed. The special
        value of all '00'Hs indicates that the
        entries in these tables have never been destroyed."
    ::= { docsDiagLogGlobal 9 }

docsDiagLogNotifCtrl OBJECT-TYPE
    SYNTAX BITS {
        highThresholdReached(0),
        lowThresholdReached(1),
        full(2)
    }

```

```
        }
MAX-ACCESS read-write
STATUS current
DESCRIPTION
    "Used to enable diagnostic log related notifications.

        Setting bit 0 enables notification for reaching log size
        high threshold,

        Setting bit 1 enables notification for returning back to
        log size low threshold after reaching log size high
        threshold,

        Setting bit 2 enables notification for diagnostic log size
        full."
DEFVAL { ''H }
 ::= { docsDiagLogGlobal 10 }

-- Configuration parameters for Diagnostic Triggers
-- Configuration parameters for Diagnostic Triggers
docsDiagLogIncludeTriggers OBJECT-TYPE
    SYNTAX      TriggerFlag
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Turns individual diagnostic triggers on and off.
        Multiple triggers can be turned on or off at a given time.
        Setting a particular bit to '1' turns on corresponding
        diagnostic trigger. Setting a particular bit to '0' turns
        off corresponding diagnostic trigger."
DEFVAL { 'C0'H }
 ::= { docsDiagLogTriggersCfg 1 }

docsDiagLogEnableAgingTriggers OBJECT-TYPE
    SYNTAX      TriggerFlag
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Enables and disables the aging of triggers
        based on the trigger type. Aging out can be enabled or
        disabled for multiple triggers at a given time. Setting
        a particular bit to '1' enables the aging out of log
        entries that are created by corresponding diagnostic
        trigger. Setting a particular bit to '0' disables the
        aging out of log entries that are created by corresponding
        diagnostic trigger."
DEFVAL { ''H }
 ::= { docsDiagLogTriggersCfg 2 }

docsDiagLogRegTimeInterval OBJECT-TYPE
    SYNTAX      Unsigned32 (60..86400)
    UNITS      "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Configurable parameter for the Registration trigger.
        The registration time interval is an empirically derived,
        worst-case number of seconds which the Cable Modem requires
        to complete registration. If the Cable Modem has not
        completed the registration stage within this registration
        time interval, the Cable Modem will be added to the
        Diagnostic Log."
```

```

DEFVAL { 90 }
 ::= { docsDiagLogTriggersCfg 3 }

docsDiagLogRegDetail OBJECT-TYPE
    SYNTAX RegistrationDetailFlag
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "Setting a bit representing a CM registration state will
         enable counting the number of times the CMTS determines
         that such CM reaches that state as the last state before
         failing to proceed further in the registration process and
         within the time interval considered for the CM
         registration trigger detection."
    DEFVAL { 'H' }
 ::= { docsDiagLogTriggersCfg 4 }

docsDiagLogRangingRetryType OBJECT-TYPE
    SYNTAX      INTEGER {
        consecutiveMiss(1),
        missRatio(2)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Configuration parameter for the Ranging Retry Trigger.
         When a Cable Modem failed to perform ranging when a ranging
         opportunity is scheduled by CMTS, it is counted as ranging
         miss.
         Ranging retry trigger can be configured to either look at
         consecutive ranging misses or ranging miss ratio over
         total number of station maintenance opportunities for a
         certain time period.

         If set to '1', this will select consecutive ranging
         misses as ranging retry trigger criteria.

         If set to '2', this will select ranging miss ratio
         as ranging retry trigger criteria."
    DEFVAL { 1 }
 ::= { docsDiagLogTriggersCfg 5 }

docsDiagLogRangingRetryThrhld OBJECT-TYPE
    SYNTAX      Unsigned32 (3..12)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "Configurable parameter for the Ranging Retry Trigger.
         When the number of times a Cable Modem does not acknowledge
         a MAC-layer station maintenance message from a CMTS exceeds
         this threshold, the Cable Modem will be add to the
         Diagnostic Log.
         The value of docsDiagLogRangingRetryType, decides if
         consecutive ranging miss or ranging miss ratio is used as
         trigger."
    DEFVAL { 6 }
 ::= { docsDiagLogTriggersCfg 6 }

docsDiagLogRangingRetryStationMaintNum OBJECT-TYPE
    SYNTAX      Unsigned32 (60..65535)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION

```

```

"Number of station maintenance opportunities to monitor for
ranging retry trigger. This value implies time intervals
in a certain range. DOCSIS requires the CMTS to schedule
ranging opportunity to Cable Modem sufficiently smaller
than T4.
There is no fixed formula to derive at a fixed time
interval, how many ranging opportunities would be offered
to a Cable Modem by the CMTS, hence using the number of
station maintenance opportunities provides ratio with the
fixed denominators while also taking time factor into
consideration."
DEFVAL { 90 }
 ::= { docsDiagLogTriggersCfg 7 }

-- 
-- Diagnostic Log Table
--
docsDiagLogTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsDiagLogEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table keeps the Diagnostic Log of the Cable Modems,
         it is indexed by docsIf3CmtsCmRegStatusId."
    REFERENCE
        "DOCSIS 3.0 Operation and Support System Interface
         Specification CM-SP-OSSIv3.0-I01-061207, Diagnostic Log
         Annex."
    ::= { docsDiagLogMibObjects 3 }

docsDiagLogEntry OBJECT-TYPE
    SYNTAX      DocsDiagLogEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row entry in this table is a per Cable Modem
         summary of the diagnostic information detected by one or
         more triggers.
         There can be only one entry in this for a given Cable
         Modem."
    INDEX {
        docsIf3CmtsCmRegStatusId
    }
    ::= { docsDiagLogTable 1 }

DocsDiagLogEntry ::= SEQUENCE {
    docsDiagLogCmMacAddr                      MacAddress,
    docsDiagLogLastUpdateTime                  DateAndTime,
    docsDiagLogCreateTime                     DateAndTime,
    docsDiagLogLastRegTime                   DateAndTime,
    docsDiagLogRegCount                      Counter32,
    docsDiagLogRangingRetryCount             Counter32
}

docsDiagLogCmMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "MAC address of the Cable Modem."
    ::= { docsDiagLogEntry 1 }

docsDiagLogLastUpdateTime OBJECT-TYPE

```

```

SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The time and date value when this entry was last updated.
     When a Cable Modem is detected by one of the diagnostic
     trigger, if this table already has an entry for that
     Cable Modem, the entry will be updated."
 ::= { docsDiagLogEntry 2 }

docsDiagLogCreateTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The time and date value that this entry was added to this
         table. When a Cable Modem is detected by one of the
         diagnostic triggers, if this table has no entry for that
         cable mode, a new entry will be created. If an entry is
         removed and then re-added, there can be a discontinuity in
         the statistical objects associated with this entry.
         This timestamp can be used to detect those discontinuities."
 ::= { docsDiagLogEntry 3 }

docsDiagLogLastRegTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The last time this Cable Modem registered."
 ::= { docsDiagLogEntry 4 }

docsDiagLogRegCount OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times the registration trigger condition was
         detected for this Cable Modem."
 ::= { docsDiagLogEntry 5 }

docsDiagLogRangingRetryCount OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of times the ranging retry trigger condition was
         detected for this Cable Modem."
 ::= { docsDiagLogEntry 6 }

-- 
-- Detailed Log Table
-- 

docsDiagLogDetailTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsDiagLogDetailEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This table contains detailed diagnostic information
         for Cable Modems already in docsDiagLogTable."
    REFERENCE
        "DOCSIS 3.0 Operation and Support System Interface
         Specification CM-SP-OSSIv3.0-I01-061207, Diagnostic Log"

```

```
Annex."
 ::= { docsDiagLogMibObjects 4 }

docsDiagLogDetailEntry OBJECT-TYPE
    SYNTAX      DocsDiagLogDetailEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row in this table contains one single type of
         detailed diagnostic information for a Cable Modem.

    This table shall be instantiated only if at least one
    detail condition is enabled, via docsDiagLogRegDetail.

    There can be multiple entries in this table for a given
    cable modem, if more than one detail condition is enabled."
INDEX {
    docsIf3CmtsCmRegStatusId,
    docsDiagLogDetailTypeValue
}
 ::= { docsDiagLogDetailTable 1 }

DocsDiagLogDetailEntry ::= SEQUENCE {
    docsDiagLogDetailTypeValue      CmtsCmRegState,
    docsDiagLogDetailCount         Counter32,
    docsDiagLogDetailLastUpdate    DateAndTime,
    docsDiagLogDetailLastErrorText SnmpAdminString
}

docsDiagLogDetailTypeValue OBJECT-TYPE
    SYNTAX      CmtsCmRegState
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The diagnostic detail type this entry represents."
    ::= { docsDiagLogDetailEntry 1 }

docsDiagLogDetailCount OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The counter value of this Cable Modem that reached
         this diagnostic detail state as the last state before
         it failed to proceed further."
    ::= { docsDiagLogDetailEntry 2 }

docsDiagLogDetailLastUpdate OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Time and date value when this entry was last updated."
    ::= { docsDiagLogDetailEntry 3 }

docsDiagLogDetailLastErrorText OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Contains the Event ID and Event Text of the event condition
         that triggers this entry.  The format is:
         <Event ID> Event Text"
```

```

REFERENCE
    "DOCSIS 3.0 Operation and Support System Interface
     Specification CM-SP-OSSIv3.0-I01-061207, Format and Content
     for Event, Syslog, and SNMP Notification. Annex."
 ::= { docsDiagLogDetailEntry 4 }

-- 
-- Notifications
--

docsDiagLogSizeHighThrshldReached      NOTIFICATION-TYPE
    OBJECTS {
        docsDevEvLevel,
        docsDevEvId,
        docsDiagLogIncludeTriggers,
        docsDiagLogMaxSize
    }
    STATUS current
    DESCRIPTION
        "This notification indicates that the current size of
         Diagnostic Log grows beyond
         docsDiagLogNotifyLogSizeHighThrshld."
 ::= { docsDiagLogNotifications 1 }

docsDiagLogSizeLowThrshldReached      NOTIFICATION-TYPE
    OBJECTS {
        docsDevEvLevel,
        docsDevEvId,
        docsDiagLogIncludeTriggers,
        docsDiagLogMaxSize
    }
    STATUS current
    DESCRIPTION
        "This notification indicates that the current size of
         Diagnostic Log drops to docsDiagLogNotifyLogSizeLowThrshld
         after it exceeded docsDiagLogNotifyLogSizeHighThrshld
         earlier."
 ::= { docsDiagLogNotifications 2 }

docsDiagLogSizeFull      NOTIFICATION-TYPE
    OBJECTS {
        docsDevEvLevel,
        docsDevEvId,
        docsDiagLogIncludeTriggers,
        docsDiagLogMaxSize
    }
    STATUS current
    DESCRIPTION
        "This notification indicates that the Diagnostic Log is
         full."
 ::= { docsDiagLogNotifications 3 }

-- 
-- Conformance definitions
--

docsDiagLogConformance   OBJECT IDENTIFIER ::= { docsDiagMib 2 }
docsDiagLogCompliances   OBJECT IDENTIFIER
                           ::= { docsDiagLogConformance 1 }
docsDiagLogGroups        OBJECT IDENTIFIER
                           ::= { docsDiagLogConformance 2 }

docsDiagLogCompliance MODULE-COMPLIANCE
    STATUS      current
    DESCRIPTION

```

"The compliance statement for the diagnostic log MIB for DOCSIS compliant Cable Modem Termination Systems"

```
MODULE -- docsDiagMib

GROUP docsDiagLogBaseGroup
DESCRIPTION
    "Mandatory in all CMTSes"

GROUP docsDiagLogNotificationGroup
DESCRIPTION
    "Mandatory in all CMTSes"

 ::= { docsDiagLogCompliances 1 }

docsDiagLogBaseGroup OBJECT-GROUP
OBJECTS {
    docsDiagLogMaxSize,
    docsDiagLogCurrentSize,
    docsDiagLogNotifyLogSizeHighThrshld,
    docsDiagLogNotifyLogSizeLowThrshld,
    docsDiagLogAging,
    docsDiagLogResetAll,
    docsDiagLogLastResetTime,
    docsDiagLogClearAll,
    docsDiagLogLastClearTime,
    docsDiagLogNotifCtrl,

    docsDiagLogIncludeTriggers,
    docsDiagLogEnableAgingTriggers,
    docsDiagLogRegTimeInterval,
    docsDiagLogRegDetail,
    docsDiagLogRangingRetryType,
    docsDiagLogRangingRetryThrshld,
    docsDiagLogRangingRetryStationMaintNum,

    docsDiagLogCmMacAddr,
    docsDiagLogLastUpdateTime,
    docsDiagLogCreateTime,
    docsDiagLogLastRegTime,
    docsDiagLogRegCount,
    docsDiagLogRangingRetryCount,

    docsDiagLogDetailCount,
    docsDiagLogDetailLastUpdate,
    docsDiagLogDetailLastErrorText
}
STATUS current
DESCRIPTION
    "CMTS is required to support objects in this group"
 ::= { docsDiagLogGroups 1 }

docsDiagLogNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
    docsDiagLogSizeHighThrshldReached,
    docsDiagLogSizeLowThrshldReached,
    docsDiagLogSizeFull
}
STATUS current
DESCRIPTION
    "CMTS is required to support objects in this group"
 ::= { docsDiagLogGroups 2 }
END
```

## Q.2 DOCS-SUBMGT3-MIB<sup>387</sup>

```
DOCS-SUBMGT3-MIB DEFINITIONS ::= BEGIN
IMPORTS
```

```
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32,
    Counter64
        FROM SNMPv2-SMI          -- RFC 2578
    RowStatus,
    TruthValue,
    TimeStamp,
    MacAddress
        FROM SNMPv2-TC          -- RFC 2579
    OBJECT-GROUP,
    MODULE-COMPLIANCE
        FROM SNMPv2-CONF         -- RFC 2580
    InetAddressType,
    InetAddress,
    InetAddressPrefixLength,
    InetPortNumber
        FROM INET-ADDRESS-MIB    -- RFC 4001
    docsIf3CmtsCmRegStatusEntry,
    docsIf3CmtsCmRegStatusId
        FROM DOCS-IF3-MIB
    SnmpTagList
        FROM SNMP-TARGET-MIB     -- RFC 3411
    clabProjDocsis,
    DocsL2vpnIfList
        FROM CLAB-DEF-MIB;
```

```
docsSubmgt3Mib MODULE-IDENTITY
LAST-UPDATED      "201404030000Z" -- April 3, 2014
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
"
Postal: Cable Television Laboratories, Inc.
858 Coal Creek Circle
Louisville, Colorado 80027-9750
U.S.A.
Phone: +1 303-661-9100
Fax:   +1 303-661-9199
E-mail: mibs@cablelabs.com"

DESCRIPTION
"This MIB module contains the management objects for the
CMTS control of the IP4 and IPv6 traffic with origin and
destination to CMs and/or CPEs behind the CM."
REVISION      "201404030000Z" -- April 3, 2014
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-13.1125-2
and published as I23"
REVISION      "201106230000Z" -- June 23, 2011
DESCRIPTION
"Revised Version includes ECNs"
```

<sup>387</sup> Section revised per OSSIv3.0-N-07.0441-4, #3, 6, 7, 10, 19, 22, & 23 on 5/9/07 and OSSIv3.0-N-07.0445-3, #12 on 5/10/07 by KN. Section updated per 07.0444-3 5/10/07, #10, 12, & 13, by PO, revised per OSSIv3.0-N-08.0700-4 by JS on 1/12/09, revised per OSSIv3.0-N-10.0921-4 on 5/20/10 and per OSSIv3.0-N-10.0928-1 on 6/3/10, and per OSSIv3.0-N-11.0996-1 on 6/2/11 by JB, revised per OSSIv3.0-N-13.1125-1 on 3/26/14 by PO.

```
OSSIv3.0-N-11.0996-1
and published as I15"
REVISION "201006110000Z" -- June 11, 2010
DESCRIPTION
    "Revised Version includes ECNs
OSSIv3.0-N-10.0906-2
OSSIv3.0-N-10.0921-4
and published as I12"
REVISION "200901210000Z" -- January 21, 2009
DESCRIPTION
    "Revised Version includes ECNs
OSSIv3.0-N-08.0651-3
OSSIv3.0-N-08.0700-4
and published as I08"
REVISION "200705180000Z" -- May 18, 2007
DESCRIPTION
    "Revised Version includes ECNs
OSSIv3.0-N-07.0445-3
OSSIv3.0-N-07.0444-3
OSSIv3.0-N-07.0441-4
and published as I03"
REVISION "200612071700Z" -- Dec 7, 2006
DESCRIPTION
    "Initial version, published as part of the CableLabs
OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207
Copyright 1999-2009 Cable Television Laboratories, Inc.
All rights reserved."
 ::= { labProjDocsis 10 }

-- Textual Conventions

-- Object Definitions
docsSubmgt3MibObjects OBJECT IDENTIFIER ::= { docsSubmgt3Mib 1 }

docsSubmgt3Base OBJECT IDENTIFIER ::= { docsSubmgt3MibObjects 1 }

docsSubmgt3BaseCpeMaxIpv4Def OBJECT-TYPE
SYNTAX Unsigned32 (0..1023)
MAX-ACCESS read-write
STATUS current
DESCRIPTION
    "This attribute represents the maximum number of IPv4
    Addresses allowed for the CM's CPEs if not signaled in the
    registration process."
DEFVAL { 16 }
 ::= { docsSubmgt3Base 1 }

docsSubmgt3BaseCpeMaxIpv6AddressesDef OBJECT-TYPE
SYNTAX Unsigned32 (0..1023)
MAX-ACCESS read-write
STATUS current
DESCRIPTION
    "This attribute represents the maximum number of IPv6
    prefixes or addresses allowed for the CM's CPEs if not signaled in
    the registration process. All IPv6
    addresses, including Link-Local and any address with
    a scope greater than 1 are counted against the
    docsSubmgt3BaseCpeMaxIpv6AddressesDef."
DEFVAL { 16 }
 ::= { docsSubmgt3Base 2 }

docsSubmgt3BaseCpeActiveDef OBJECT-TYPE
SYNTAX TruthValue
```

```

MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for enabling
    Subscriber Management filters and controls
    in the CM if the parameter is not signaled in the DOCSIS
    Registration process."
DEFVAL { false }
 ::= { docssSubmgt3Base 3 }

docssSubmgt3BaseCpeLearnableDef OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for enabling
    the CPE learning process for the CM if the parameter
    is not signaled in the DOCSIS Registration process."
DEFVAL { true }
 ::= { docssSubmgt3Base 4 }

docssSubmgt3BaseSubFilterDownDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    subscriber (CPE) downstream filter group for the
    CM if the parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 5 }

docssSubmgt3BaseSubFilterUpDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    subscriber (CPE) upstream filter group for the CM
    if the parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 6 }

docssSubmgt3BaseCmFilterDownDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    CM stack downstream filter group applying to the CM
    if the parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 7 }

docssSubmgt3BaseCmFilterUpDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the

```

```
    CM stack upstream filter group applying to the CM if
    the parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 8 }

docssSubmgt3BasePsFilterDownDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    PS or eRouter downstream filter group for the CM if
    the parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 9 }

docssSubmgt3BasePsFilterUpDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    PS or eRouter upstream filter group for the CM if the
    parameter is not signaled in the DOCSIS Registration
    process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 10 }

docssSubmgt3BaseMtaFilterDownDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    MTA, DVA, SG, or TEA downstream filter group for the
    CM if the parameter is not signaled in the DOCSIS
    Registration process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 11 }

docssSubmgt3BaseMtaFilterUpDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    MTA, DVA, SG, or TEA upstream filter group for the CM
    if the parameter is not signaled in the DOCSIS
    Registration process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 12 }

docssSubmgt3BaseStbFilterDownDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute represents the default value for the
    STB or CableCARD downstream filter group for the CM
    if the parameter is not signaled in the DOCSIS
    Registration process."
```

```

DEFVAL { 0 }
 ::= { docssSubmgt3Base 13 }

docssSubmgt3BaseStbFilterUpDef OBJECT-TYPE
SYNTAX      Unsigned32 (0..1024)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute represents the default value for the
  STB or CableCARD upstream filter group for the CM if
  the parameter is not signaled in the DOCSIS
  Registration process."
DEFVAL { 0 }
 ::= { docssSubmgt3Base 14 }

docssSubmgt3CpeCtrlTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocssSubmgt3CpeCtrlEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "This object maintains per-CM traffic policies enforced
  by the CMTS. The CMTS acquires the CM traffic policies
  through the CM registration process, or in the
  absence of some or all of those parameters, from the
  Base object. The CM information and controls are meaningful
  and used by the CMTS, but only after the CM is
  operational."
 ::= { docssSubmgt3MibObjects 2}

docssSubmgt3CpeCtrlEntry OBJECT-TYPE
SYNTAX      DocssSubmgt3CpeCtrlEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "The conceptual row of docssSubmgt3CpeCtrlTable.
  The CMTS does not persist the instances of the CpeCtrl
  object across reinitializations."
AUGMENTS { docssIf3CmtsCmRegStatusEntry }
 ::= { docssSubmgt3CpeCtrlTable 1 }

DocssSubmgt3CpeCtrlEntry ::= SEQUENCE {
  docssSubmgt3CpeCtrlMaxCpeIpv4
    Unsigned32,
  docssSubmgt3CpeCtrlMaxCpeIpv6Addresses
    Unsigned32,
  docssSubmgt3CpeCtrlActive
    TruthValue,
  docssSubmgt3CpeCtrlLearnable
    TruthValue,
  docssSubmgt3CpeCtrlReset
    TruthValue,
  docssSubmgt3CpeCtrlLastReset
    TimeStamp
}

docssSubmgt3CpeCtrlMaxCpeIpv4 OBJECT-TYPE
SYNTAX      Unsigned32 (0..1023)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute represents the number of simultaneous
  IP v4 addresses permitted for CPE connected to the CM.

```

When the MaxCpeIpv4 attribute is set to zero (0), all Ipv4 CPE traffic from the CM is dropped. The CMTS configures this attribute with whichever of the 'Subscriber Management CPE IPv4 List' or 'Subscriber Management Control-Max\_CpeIpv4' signaled encodings is greater, or in the absence of all of those provisioning parameters, with the CpeMaxIp v4Def from the Base object. This limit applies to learned and DOCSIS-provisioned entries but not to entries added through some administrative process at the CMTS. Note that this attribute is only meaningful when the Active attribute of the CM is set to 'true'."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I04-070518, Subscriber Management TLVs section in the Common Radio Frequency Interface Encodings Annex."

```
::= { docssSubmgt3CpeCtrlEntry 1 }
```

**docssSubmgt3CpeCtrlMaxCpeIpv6Addresses OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..1023)

**MAX-ACCESS** read-write

**STATUS** current

**DESCRIPTION**

"This attribute represents the maximum number of simultaneous IPv6 prefixes and addresses that are permitted for CPEs connected to the CM. When the MaxCpeIpv6Prefix is set to zero (0), all IPv6 CPE traffic from the CM is dropped. The CMTS configures this attribute with whichever of the ('Subscriber Management CPE IPv6 List (TLV 67)' plus 'Subscriber Management CPE IPv6 Prefix List (TLV 61)') or ('Subscriber Management Control Max CPE IPv6 Addresses (TLV 63)') signaled encodings is greater, or in the absence of all of those provisioning parameters, with the MaxIpv6AddressDef from the Base object. This limit applies to learned and DOCSIS-provisioned entries but not to entries added through some administrative process at the CMTS. Note that this attribute is only meaningful when the Active attribute of the CM is set to 'true'.

All IPv6 addresses, including Link-Local and any address with a scope greater than 1 are counted against the docssSubmgt3CpeCtrlMaxCpeIpv6Addresses."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I04-070518, Subscriber Management TLVs section in the Common Radio Frequency Interface Encodings Annex."

```
::= { docssSubmgt3CpeCtrlEntry 2 }
```

**docssSubmgt3CpeCtrlActive OBJECT-TYPE**

**SYNTAX** TruthValue

**MAX-ACCESS** read-write

**STATUS** current

**DESCRIPTION**

"This attribute controls the application of subscriber management to this CM. If this is set to 'true', CMTS-based CPE control is active, and all the actions required by the various filter policies and controls apply at the CMTS. If this is set to false, no subscriber management filtering is done at the CMTS (but other filters may apply). If not set through DOCSIS provisioning, this object defaults to the value of the Active attribute of the Base object."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I04-070518, Subscriber Management

```

Control section in the Common Radio Frequency Interface
Encodings Annex."
 ::= { docssSubmgt3CpeCtrlEntry 3 }

docssSubmgt3CpeCtrlLearnable OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute controls whether the CMTS may learn
  (and pass traffic for) CPE IP addresses associated
  with a CM. If this is set to 'true', the CMTS may learn up
  to the CM MaxCpeIp value less any DOCSIS-provisioned
  entries related to this CM. The nature of the learning
  mechanism is not specified here. If not set through
  DOCSIS provisioning, this object defaults to the
  value of the CpeLearnableDef attribute from the Base
  object. Note that this attribute is only meaningful
  if docssSubmgtCpeControlActive is 'true' to enforce
  a limit in the number of CPEs learned. CPE learning
  is always performed for the CMTS for security reasons."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I04-070518, Subscriber Management
  Control section in the Common Radio Frequency Interface
  Encodings Annex."
 ::= { docssSubmgt3CpeCtrlEntry 4 }

docssSubmgt3CpeCtrlReset OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "If set to 'true', this attribute commands the CMTS
  to delete the instances denoted as 'learned' addresses
  in the CpeIp object. This attribute always returns
  false on read."
 ::= { docssSubmgt3CpeCtrlEntry 5 }

docssSubmgt3CpeCtrlLastReset OBJECT-TYPE
SYNTAX      TimeStamp
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute represents the system Up Time of the
  last set to 'true' of the Reset attribute of this instance.
  Zero if never reset."
 ::= { docssSubmgt3CpeCtrlEntry 6 }

docssSubmgt3CpeIpTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocssSubmgt3CpeIpEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "This object defines the list of IP Addresses behind
  the CM known by the CMTS.

  If the Active attribute of the CpeCtrl object associated
  with a CM is set to 'true' and the CMTS receives an
  IP packet from a CM that contains a source IP address that
  does not match one of the CPE IP addresses associated
  with this CM, one of two things occurs. If the number
  of CPE IPs is less than the MaxCpeIp of the CpeCtrl object

```

```

for that CM, the source IP address is added to this
object and the packet is forwarded; otherwise, the
packet is dropped."
 ::= { docssSubmgt3MibObjects 3}

docssSubmgt3CpeIpEntry OBJECT-TYPE
  SYNTAX      DocssSubmgt3CpeIpEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docssSubmgt3CpeIpTable."
  INDEX {
    docsiIf3CmtsCmRegStatusId,
    docssSubmgt3CpeIpId
  }
 ::= { docssSubmgt3CpeIpTable 1 }

DocssSubmgt3CpeIpEntry ::= SEQUENCE {
  docssSubmgt3CpeIpId
    Unsigned32,
  docssSubmgt3CpeIpAddrType
    InetAddressType,
  docssSubmgt3CpeIpAddr
    InetAddress,
  docssSubmgt3CpeIpAddrPrefixLen
    InetAddressPrefixLength,
  docssSubmgt3CpeIpLearned
    TruthValue,
  docssSubmgt3CpeIpType
    INTEGER
}

docssSubmgt3CpeIpId OBJECT-TYPE
  SYNTAX      Unsigned32 (1..1023)
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute represents a unique identifier for
    a CPE IP of the CM. An instance of this attribute exists
    for each CPE provisioned in the 'Subscriber Management
    CPE IPv4 Table' or 'Subscriber Management CPE
    IPv6 Table' encodings. An entry is created either through
    the included CPE IP addresses in the provisioning
    object, or CPEs learned from traffic sourced from the
    CM."
 ::= { docssSubmgt3CpeIpEntry 1 }

docssSubmgt3CpeIpAddrType OBJECT-TYPE
  SYNTAX      InetAddressType
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The type of Internet address of the Addr attribute."
 ::= { docssSubmgt3CpeIpEntry 2 }

docssSubmgt3CpeIpAddr OBJECT-TYPE
  SYNTAX      InetAddress
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the IP address either set
    from provisioning or learned via address gleaning
    or other forwarding means."

```

```

 ::= { docssSubmgt3CpeIpEntry 3 }

docssSubmgt3CpeIpAddrPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the prefix length associated with
         the IP subnet prefix either set from provisioning or learned
         via address gleaning or other forwarding means. For IPv4 CPE
         addresses this attribute generally reports the value 32
         (32 bits) to indicate a unicast IPv4 address. For IPv6, this
         attribute represents either an IPv6 unicast address
         (128 bits, equal to /128 prefix length) or a subnet prefix
         length (for example 56 bits, equal to /56 prefix length)."
 ::= { docssSubmgt3CpeIpEntry 4 }

docssSubmgt3CpeIpLearned OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute is set to 'true' when the IP address
         was learned from IP packets sent upstream rather than
         via the CM provisioning process."
 ::= { docssSubmgt3CpeIpEntry 5 }

docssSubmgt3CpeIpType OBJECT-TYPE
    SYNTAX      INTEGER {
                    cpe(1),
                    ps(2),
                    mta(3),
                    stb(4),
                    tea(5),
                    erouter(6),
                    dva(7),
                    sg(8),
                    card(9)
                }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the type of CPE based on
         the following classification below:
            'cpe' Regular CPE clients.
            'ps' CableHome Portal Server (PS)
            'mta' PacketCable Multimedia Terminal Adapter (MTA)
            'stb' Digital Set-top Box (STB).
            'tea' T1 Emulation adapter (TEA)
            'erouter' Embedded Router (eRouter)
            'dva' Digital Voice Adapter (DVA)
            'sg' Security Gateway (SG)
            'card' CableCARD"
 ::= { docssSubmgt3CpeIpEntry 6 }

docssSubmgt3GrpTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocssSubmgt3GrpEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object defines the set of downstream and upstream
         filter groups that the CMTS applies to traffic associated

```

```

with that CM."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I01-060804, Subscriber
  Management TLVs section in the Common Radio Frequency
  Interface Encodings Annex."
 ::= { docssSubmgt3MibObjects 4}

docssSubmgt3GrpEntry OBJECT-TYPE
SYNTAX      DocssSubmgt3GrpEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "The conceptual row of docssSubmgt3GrpTable.
  The CMTS does not persist the instances of the Grp
  object across reinitializations."
AUGMENTS { docssIf3CmtsCmRegStatusEntry }
 ::= { docssSubmgt3GrpTable 1 }

DocssSubmgt3GrpEntry ::= SEQUENCE {
  docssSubMgt3GrpUdcGroupIds
    SnmpTagList,
  docssSubMgt3GrpUdcSentInReqRsp
    TruthValue,
  docssSubmgt3GrpSubFilterDs
    Unsigned32,
  docssSubmgt3GrpSubFilterUs
    Unsigned32,
  docssSubmgt3GrpCmFilterDs
    Unsigned32,
  docssSubmgt3GrpCmFilterUs
    Unsigned32,
  docssSubmgt3GrpPsFilterDs
    Unsigned32,
  docssSubmgt3GrpPsFilterUs
    Unsigned32,
  docssSubmgt3GrpMtaFilterDs
    Unsigned32,
  docssSubmgt3GrpMtaFilterUs
    Unsigned32,
  docssSubmgt3GrpStbFilterDs
    Unsigned32,
  docssSubmgt3GrpStbFilterUs
    Unsigned32
}

docssSubMgt3GrpUdcGroupIds OBJECT-TYPE
SYNTAX      SnmpTagList
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute represents the filter group(s) associated
  with the CM signaled 'Upstream Drop Classifier Group ID'
  encodings during the registration process. UDC Group IDs are
  integer values and this attribute reports them as decimal
  numbers that are space-separated. The zero-length string indicates
  that the CM didn't signal UDC Group IDs.
  This attribute provides two functions:
  - Communicate the CM the configured UDC Group ID(s), irrespective
  of the CM being provisioned to filter upstream traffic based
  on IP Filters or UDCs.
  - Optionally, and with regards to the CMTS, if the value of the
  attribute UdcSentInReqRsp is 'true', indicates that the filtering

```

rules associated with the Subscriber Management Group ID(s) will be sent during registration to the CM. It is vendor specific whether the CMTS updates individual CM UDCs after registration when rules are changed in the Grp object."

```
DEFVAL { ''H }
 ::= { docssSubmgt3GrpEntry 1 }
```

**docssSubMgt3GrpUdcSentInRegRsp** OBJECT-TYPE

SYNTAX	TruthValue
MAX-ACCESS	read-write
STATUS	current

DESCRIPTION

"This attribute represents the CMTS upstream filtering status for this CM. The value 'true' indicates that the CMTS has sent UDCs to the CM during registration process.

In order for a CMTS to send UDCs to a CM, the CMTS MAC Domain needed to be enabled via the MAC Domain attribute SendUdcRulesEnabled and the CM had indicated the UDC capability support during the registration process. The value 'false' indicates that the CMTS was not enabled to send UDCs to the CMs in the MAC Domain, or the CM does not advertised UDC support in its capabilities encodings, or both. Since the CMTS capability to send UDCs to CMs during the registration process is optional, the CMTS is not required to implement the value 'true'."

```
DEFVAL { false }
 ::= { docssSubmgt3GrpEntry 2 }
```

**docssSubmgt3GrpSubFilterDs** OBJECT-TYPE

SYNTAX	Unsigned32 (0..1024)
MAX-ACCESS	read-write
STATUS	current

DESCRIPTION

"This attribute represents the filter group applied to traffic destined for subscriber's CPE attached to the referenced CM (attached to CM CPE interfaces). This value corresponds to the 'Subscriber Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to hosts attached to this CM."

```
::= { docssSubmgt3GrpEntry 3 }
```

**docssSubmgt3GrpSubFilterUs** OBJECT-TYPE

SYNTAX	Unsigned32 (0..1024)
MAX-ACCESS	read-write
STATUS	current

DESCRIPTION

"This attribute represents the filter group applied to traffic originating from subscriber's CPE attached to the referenced CM (attached to CM CPE interfaces). This value corresponds to the 'Subscriber Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from hosts attached to this CM."

```
::= { docssSubmgt3GrpEntry 4 }
```

```
docsSubmgt3GrpCmFilterDs OBJECT-TYPE
    SYNTAX      Unsigned32 (0..1024)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute represents the filter group applied
        to traffic destined for the CM itself. This value corresponds
        to the 'CM Downstream Group' value of the
        'Subscriber Management Filter Groups' encoding signaled
        during the CM registration or in its absence,
        to the CmFilterDownDef attribute of the Base object.
        The value zero or a filter group ID not configured in
        the CMTS means no filtering is applied to traffic destined
        to the CM."
    ::= { docsSubmgt3GrpEntry 5 }

docsSubmgt3GrpCmFilterUs OBJECT-TYPE
    SYNTAX      Unsigned32 (0..1024)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute represents the filter group applied
        to traffic originating from the CM itself. This value
        corresponds to the 'Subscriber Upstream Group'
        value of the 'Subscriber Management Filter Groups'
        encoding signaled during the CM registration or in its
        absence, to the SubFilterUpDef attribute of the Base
        object. The value zero or a filter group ID not configured
        in the CMTS means no filtering is applied to traffic
        originating from this CM."
    ::= { docsSubmgt3GrpEntry 6 }

docsSubmgt3GrpPsFilterDs OBJECT-TYPE
    SYNTAX      Unsigned32 (0..1024)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute represents the filter group applied
        to traffic destined to the Embedded CableHome Portal
        Services Element or the Embedded Router on the referenced
        CM. This value corresponds to the 'PS Downstream
        Group' value of the 'Subscriber Management Filter
        Groups' encoding signaled during the CM registration
        or in its absence, to the SubFilterDownDef attribute
        of the Base object. The value zero or a filter
        group ID not configured in the CMTS means no filtering
        is applied to traffic destined to the Embedded CableHome
        Portal Services Element or Embedded Router on
        this CM."
    ::= { docsSubmgt3GrpEntry 7 }

docsSubmgt3GrpPsFilterUs OBJECT-TYPE
    SYNTAX      Unsigned32 (0..1024)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute represents the filter group applied
        to traffic originating from the Embedded CableHome
        Portal Services Element or Embedded Router on the
        referenced CM. This value corresponds to the 'PS Upstream
        Group' value of the 'Subscriber Management Filter
        Groups' encoding signaled during the CM registration
```

or in its absence, to the SubFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded CableHome Portal Services Element or Embedded Router on this CM."

```
::= { docssSubmgt3GrpEntry 8 }
```

docssSubmgt3GrpMtaFilterDs OBJECT-TYPE

SYNTAX Unsigned32 (0..1024)

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"This attribute represents the filter group applied to traffic destined to the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on the referenced CM. This value corresponds to the 'MTA Downstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on this CM."

```
::= { docssSubmgt3GrpEntry 9 }
```

docssSubmgt3GrpMtaFilterUs OBJECT-TYPE

SYNTAX Unsigned32 (0..1024)

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"This attribute represents the filter group applied to traffic originating from the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on the referenced CM. This value corresponds to the 'MTA Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded PacketCable Multimedia Terminal Adapter, Embedded PacketCable 2.0 Digital Voice Adaptor, Embedded PacketCable Security, Monitoring, and Automation Gateway, or Embedded T1/E1 TDM Emulation Adapter on this CM."

```
::= { docssSubmgt3GrpEntry 10 }
```

docssSubmgt3GrpStbFilterDs OBJECT-TYPE

SYNTAX Unsigned32 (0..1024)

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"This attribute represents the filter group applied to traffic destined for the Embedded Set-Top Box or CableCARD on the referenced CM. This value corresponds to the 'STB Downstream Group' value of the 'Subscriber

Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterDownDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic destined to the Embedded Set-Top Box or CableCARD on this CM."

```
 ::= { docssSubmgt3GrpEntry 11 }
```

**docssSubmgt3GrpStbFilterUs** OBJECT-TYPE

SYNTAX Unsigned32 (0..1024)  
MAX-ACCESS read-write  
STATUS current  
DESCRIPTION "This attribute represents the filter group applied to traffic originating from the Embedded Set-Top Box or CableCARD on the referenced CM. This value corresponds to the 'STB Upstream Group' value of the 'Subscriber Management Filter Groups' encoding signaled during the CM registration or in its absence, to the SubFilterUpDef attribute of the Base object. The value zero or a filter group ID not configured in the CMTS means no filtering is applied to traffic originating from the Embedded Set-Top Box or CableCARD on this CM."  

```
 ::= { docssSubmgt3GrpEntry 12 }
```

**docssSubmgt3FilterGrpTable** OBJECT-TYPE

SYNTAX SEQUENCE OF DocssSubmgt3FilterGrpEntry  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION "This object describes a set of filter or classifier criteria. Classifiers are assigned by group to the individual CMs. That assignment is made via the 'Subscriber Management TLVs' encodings sent upstream from the CM to the CMTS during registration or in their absence, default values configured in the CMTS.  
A Filter Group ID (GrpId) is a set of rules that correspond to the expansion of a UDC Group ID into UDC individual classification rules. The Filter Group IDs are generated whenever the CMTS is configured to send UDCs during the CM registration process. Implementation of L2 classification criteria is optional for the CMTS; LLC/MAC upstream and downstream filter criteria can be ignored during the packet matching process."  

```
 ::= { docssSubmgt3MibObjects 5 }
```

**docssSubmgt3FilterGrpEntry** OBJECT-TYPE

SYNTAX DocssSubmgt3FilterGrpEntry  
MAX-ACCESS not-accessible  
STATUS current  
DESCRIPTION "The conceptual row of docssSubmgt3FilterGrpTable. The CMTS persists all instances of the FilterGrp object across reinitializations."  
INDEX {  
 docssSubmgt3FilterGrpGrpId,  
 docssSubmgt3FilterGrpRuleId  
}  

```
 ::= { docssSubmgt3FilterGrpTable 1 }
```

DocssSubmgt3FilterGrpEntry ::= SEQUENCE {  
 docssSubmgt3FilterGrpGrpId

```

        Unsigned32,
docssSubmgt3FilterGrpRuleId
        Unsigned32,
docssSubmgt3FilterGrpAction
        INTEGER,
docssSubmgt3FilterGrpPriority
        Unsigned32,
docssSubmgt3FilterGrpIpTosLow
        OCTET STRING,
docssSubmgt3FilterGrpIpTosHigh
        OCTET STRING,
docssSubmgt3FilterGrpIpTosMask
        OCTET STRING,
docssSubmgt3FilterGrpIpProtocol
        Unsigned32,
docssSubmgt3FilterGrpInetAddrType
        InetAddressType,
docssSubmgt3FilterGrpInetSrcAddr
        InetAddress,
docssSubmgt3FilterGrpInetSrcMask
        InetAddress,
docssSubmgt3FilterGrpInetDestAddr
        InetAddress,
docssSubmgt3FilterGrpInetDestMask
        InetAddress,
docssSubmgt3FilterGrpSrcPortStart
        InetPortNumber,
docssSubmgt3FilterGrpSrcPortEnd
        InetPortNumber,
docssSubmgt3FilterGrpDestPortStart
        InetPortNumber,
docssSubmgt3FilterGrpDestPortEnd
        InetPortNumber,
docssSubmgt3FilterGrpDestMacAddr
        MacAddress,
docssSubmgt3FilterGrpDestMacMask
        MacAddress,
docssSubmgt3FilterGrpSrcMacAddr
        MacAddress,
docssSubmgt3FilterGrpEonetProtocolType
        INTEGER,
docssSubmgt3FilterGrpEonetProtocol
        Unsigned32,
docssSubmgt3FilterGrpUserPriLow
        Unsigned32,
docssSubmgt3FilterGrpUserPriHigh
        Unsigned32,
docssSubmgt3FilterGrpVlanId
        Unsigned32,
docssSubmgt3FilterGrpClassPkts
        Counter64,
docssSubmgt3FilterGrpFlowLabel
        Unsigned32,
docssSubmgt3FilterGrpCmInterfaceMask
        DocsL2vpnIfList,
docssSubmgt3FilterGrpRowStatus
        RowStatus
    }

docssSubmgt3FilterGrpGrpId OBJECT-TYPE
SYNTAX      Unsigned32 (1..1024)
MAX-ACCESS  not-accessible
STATUS      current

```

```

DESCRIPTION
  "This key is an identifier for a set of classifiers known
  as a filter group. Each CM may be associated with
  several filter groups for its upstream and downstream
  traffic, one group per target end point on the CM as
  defined in the Grp object. Typically, many CMs share
  a common set of filter groups."
 ::= { docssSubmgt3FilterGrpEntry 1 }

docssSubmgt3FilterGrpRuleId OBJECT-TYPE
  SYNTAX      Unsigned32 (1..65535)
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents an ordered classifier identifier
    within the group. Filters are applied in order if
    the Priority attribute is not supported."
 ::= { docssSubmgt3FilterGrpEntry 2 }

docssSubmgt3FilterGrpAction OBJECT-TYPE
  SYNTAX      INTEGER {
                permit(1),
                deny(2)
              }
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the action to take upon
    this filter matching. 'permit' means to stop the classification
    matching and accept the packet for further
    processing. 'deny' means to drop the packet."
  DEFVAL { permit }
 ::= { docssSubmgt3FilterGrpEntry 3 }

docssSubmgt3FilterGrpPriority OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute defines the order in which classifiers
    are compared against packets. The higher the value,
    the higher the priority."
  DEFVAL { 0 }
 ::= { docssSubmgt3FilterGrpEntry 4 }

docssSubmgt3FilterGrpIpTosLow OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE (1))
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the low value of a range
    of ToS (Type of Service) octet values. This object is
    defined as an 8-bit octet as per the DOCSIS Specification
    for packet classification.
    The IP ToS octet, as originally defined in RFC 791, has
    been superseded by the 6-bit Differentiated Services
    Field (DSField, RFC 3260) and the 2-bit Explicit
    Congestion Notification Field (ECN field, RFC 3168)."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I01-060804.
    RFC 791.
    RFC 3260.

```

```

RFC 3168."
DEFVAL { '00'H }
 ::= { docssSubmgt3FilterGrpEntry 5 }

docssSubmgt3FilterGrpIpTosHigh OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (1))
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute represents the high value of a range
  of ToS octet values. This object is defined as an 8-bit
  octet as per the DOCSIS Specification for packet classification.
  The IP ToS octet, as originally defined in RFC 791, has
  been superseded by the 6-bit Differentiated Services
  Field (DSField, RFC 3260) and the 2-bit Explicit
  Congestion Notification Field (ECN field, RFC 3168)."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I01-060804.
  RFC 791.
  RFC 3260.
  RFC 3168."
DEFVAL { '00'H }
 ::= { docssSubmgt3FilterGrpEntry 6 }

docssSubmgt3FilterGrpIpTosMask OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (1))
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute represents the mask value that is bitwise
  ANDed with ToS octet in an IP packet, and the resulting value
  is used for range checking of IpTosLow and IpTosHigh."
DEFVAL { '00'H }
 ::= { docssSubmgt3FilterGrpEntry 7 }

docssSubmgt3FilterGrpIpProtocol OBJECT-TYPE
SYNTAX Unsigned32 (0..257)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute represents the value of the IP Protocol
  field required for IP packets to match this rule.
  The value 256 matches traffic with any IP Protocol value.
  The value 257 by convention matches both TCP and
  UDP."
DEFVAL { 256 }
 ::= { docssSubmgt3FilterGrpEntry 8 }

docssSubmgt3FilterGrpInetAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "The type of the Internet address for InetSrcAddr,
  InetSrcMask, InetDestAddr, and InetDestMask."
DEFVAL { unknown }
 ::= { docssSubmgt3FilterGrpEntry 9 }

docssSubmgt3FilterGrpInetSrcAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current

```

```
DESCRIPTION
    "This attribute specifies the value of the IP Source Address
     required for packets to match this rule. An IP packet
     matches the rule when the packet's IP Source Address
     bitwise ANDed with the InetSrcMask value equals
     the InetSrcAddr value. The address type of this object
     is specified by the InetAddressType attribute."
DEFVAL { ''H }
 ::= { docssSubmgt3FilterGrpEntry 10 }

docssSubmgt3FilterGrpInetSrcMask OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents which bits of a packet's
     IP Source Address are compared to match this rule. An
     IP packet matches the rule when the packet's IP Source
     Address bitwise ANDed with the InetSrcMask value equals
     the InetSrcAddr value. The address type of this
     object is specified by InetAddrType."
DEFVAL { ''H }
 ::= { docssSubmgt3FilterGrpEntry 11 }

docssSubmgt3FilterGrpInetDestAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute specifies the value of the IP Destination
     Address required for packets to match this rule.
     An IP packet matches the rule when the packet's IP Destination
     Address bitwise ANDed with the InetSrcMask
     value equals the InetDestAddr value. The address type
     of this object is specified by the InetAddrType attribute."
DEFVAL { ''H }
 ::= { docssSubmgt3FilterGrpEntry 12 }

docssSubmgt3FilterGrpInetDestMask OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents which bits of a packet's
     IP Destination Address are compared to match this rule.
     An IP packet matches the rule when the packet's IP Destination
     Address bitwise ANDed with the InetDestMask value
     equals the InetDestAddr value. The address type
     of this object is specified by InetAddrType."
DEFVAL { ''H }
 ::= { docssSubmgt3FilterGrpEntry 13 }

docssSubmgt3FilterGrpSrcPortStart OBJECT-TYPE
SYNTAX      InetPortNumber
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents the low-end inclusive
     range of TCP/UDP source port numbers to which a packet
     is compared. This attribute is irrelevant for non-TCP/UDP
     IP packets."
DEFVAL { 0 }
 ::= { docssSubmgt3FilterGrpEntry 14 }
```

```

docsSubmgt3FilterGrpSrcPortEnd OBJECT-TYPE
  SYNTAX      InetPortNumber
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the high-end inclusive
     range of TCP/UDP source port numbers to which a packet
     is compared. This attribute is irrelevant for non-TCP/UDP
     IP packets."
  DEFVAL { 65535 }
  ::= { docsSubmgt3FilterGrpEntry 15 }

docsSubmgt3FilterGrpDestPortStart OBJECT-TYPE
  SYNTAX      InetPortNumber
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the low-end inclusive
     range of TCP/UDP destination port numbers to which a
     packet is compared. This attribute is irrelevant for
     non-TCP/UDP IP packets."
  DEFVAL { 0 }
  ::= { docsSubmgt3FilterGrpEntry 16 }

docsSubmgt3FilterGrpDestPortEnd OBJECT-TYPE
  SYNTAX      InetPortNumber
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the high-end inclusive
     range of TCP/UDP destination port numbers to which a packet
     is compared. This attribute is irrelevant for non-TCP/UDP
     IP packets."
  DEFVAL { 65535 }
  ::= { docsSubmgt3FilterGrpEntry 17 }

docsSubmgt3FilterGrpDestMacAddr OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the criteria to match against
     an Ethernet packet MAC address bitwise ANDed
     with DestMacMask."
  DEFVAL { '000000000000'H }
  ::= { docsSubmgt3FilterGrpEntry 18 }

docsSubmgt3FilterGrpDestMacMask OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "An Ethernet packet matches an entry when its
     destination MAC address bitwise ANDed with
     the DestMacMask attribute equals the value of
     the DestMacAddr attribute."
  DEFVAL { '000000000000'H }
  ::= { docsSubmgt3FilterGrpEntry 19 }

docsSubmgt3FilterGrpSrcMacAddr OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-create

```

```

STATUS      current
DESCRIPTION
    "This attribute represents the value to match against
    an Ethernet packet source MAC address."
DEFVAL { 'FFFFFFFFFFFF'H }
 ::= { docsSubmgt3FilterGrpEntry 20 }

docsSubmgt3FilterGrpEnetProtocolType OBJECT-TYPE
SYNTAX      INTEGER {
                none(0),
                ethertype(1),
                dsap(2),
                mac(3),
                all(4)
            }
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute indicates the format of the layer 3
    protocol ID in the Ethernet packet. A value of 'none'
    means that the rule does not use the layer 3 protocol
    type as a matching criteria. A value of 'ethertype'
    means that the rule applies only to frames that contain
    an EtherType value. EtherType values are contained
    in packets using the DEC-Intel-Xerox (DIX) encapsulation
    or the RFC 1042 Sub-Network Access Protocol
    (SNAP) encapsulation formats. A value of 'dsap' means
    that the rule applies only to frames using the IEEE802.3
    encapsulation format with a Destination Service
    Access Point (DSAP) other than 0xAA (which is reserved
    for SNAP). A value of 'mac' means that the rule
    applies only to MAC management messages for MAC management
    messages. A value of 'all' means that the rule
    matches all Ethernet packets. If the Ethernet frame
    contains an 802.1P/Q Tag header (i.e., EtherType
    0x8100), this attribute applies to the embedded EtherType
    field within the 802.1p/Q header.
    The value 'mac' is only used for passing UDCs to CMs during
    Registration. The CMTS ignores filter rules that include
    the value of this attribute set to 'mac' for CMTS enforced
    upstream and downstream subscriber management filter group
    rules."
REFERENCE
    "RFC1042 Sub-Network Access Protocol (SNAP) encapsulation
    formats."
DEFVAL { none }
 ::= { docsSubmgt3FilterGrpEntry 21 }

docsSubmgt3FilterGrpEnetProtocol OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents the Ethernet protocol
    type to be matched against the packets. For EnetProtocolType
    set to 'none', this attribute is ignored when considering
    whether a packet matches the current rule.
    If the attribute EnetProtocolType is 'ethertype',
    this attribute gives the 16-bit value of the EtherType
    that the packet must match in order to match the rule.
    If the attribute EnetProtocolType is 'dsap', the lower
    8 bits of this attribute's value must match the DSAP
    octet of the packet in order to match the rule. If the Ethernet

```

```

frame contains an 802.1p/Q Tag header (i.e.,
EtherType 0x8100), this attribute applies to the embedded
EtherType field within the 802.1p/Q header."
DEFVAL { 0 }
 ::= { docssSubmgt3FilterGrpEntry 22 }

docssSubmgt3FilterGrpUserPriLow OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute applies only to Ethernet frames using
  the 802.1p/Q tag header (indicated with EtherType
  0x8100). Such frames include a 16-bit Tag that contains
  a 3-bit Priority field and a 12-bit VLAN number.
  Tagged Ethernet packets must have a 3-bit Priority
  field within the range of PriLow to PriHigh in order to
  match this rule."
DEFVAL { 0 }
 ::= { docssSubmgt3FilterGrpEntry 23 }

docssSubmgt3FilterGrpUserPriHigh OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute applies only to Ethernet frames using
  the 802.1p/Q tag header (indicated with EtherType
  0x8100). Such frames include a 16-bit Tag that contains
  a 3-bit Priority field and a 12-bit VLAN number.
  Tagged Ethernet packets must have a 3-bit Priority
  field within the range of PriLow to PriHigh in order to
  match this rule."
DEFVAL { 7 }
 ::= { docssSubmgt3FilterGrpEntry 24 }

docssSubmgt3FilterGrpVlanId OBJECT-TYPE
SYNTAX Unsigned32 (0 | 1..4094)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
  "This attribute applies only to Ethernet frames using
  the 802.1p/Q tag header. Tagged packets must have
  a VLAN Identifier that matches the value in order to
  match the rule."
 ::= { docssSubmgt3FilterGrpEntry 25 }

docssSubmgt3FilterGrpClassPkts OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
  "This attribute counts the number of packets
  that have been classified (matched) using this rule
  entry. This includes all packets delivered to a Service
  Flow maximum rate policing function, whether
  or not that function drops the packets. Discontinuities
  in the value of this counter can occur at re-initialization
  of the managed system, and at other times
  as indicated by the value of ifCounterDiscontinuityTime
  for the CM MAC Domain interface."
 ::= { docssSubmgt3FilterGrpEntry 26 }

```

```

docsSubmgt3FilterGrpFlowLabel OBJECT-TYPE
  SYNTAX      Unsigned32 (0..1048575)
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents the Flow Label field in
     the IPv6 header to be matched by the classifier.
     The value zero indicates that the Flow Label is not specified
     as part of the classifier and is not matched against packets."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I03-070223, IPv6 Flow
     Label section in the Common Radio Frequency Interface
     Encodings Annex."
  ::= { docsSubmgt3FilterGrpEntry 27 }

docsSubmgt3FilterGrpCmInterfaceMask OBJECT-TYPE
  SYNTAX      DocsL2vpnIfList
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute represents a bit-mask of the CM in-bound
     interfaces to which this classifier applies.
     This attribute only applies to upstream Drop Classifiers
     being sent to CMs during the registration process."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I03-070223, CM
     Interface Mask (CMIM) Encoding section in the Common
     Radio Frequency Interface Encodings Annex."
  ::= { docsSubmgt3FilterGrpEntry 28 }

docsSubmgt3FilterGrpRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "The conceptual row status of this object."
  ::= { docsSubmgt3FilterGrpEntry 29 }

-- Conformance Definitions
docsSubmgt3MibConformance OBJECT IDENTIFIER ::= { docsSubmgt3Mib 2 }
docsSubmgt3MibCompliances OBJECT IDENTIFIER
  ::= { docsSubmgt3MibConformance 1 }
docsSubmgt3MibGroups      OBJECT IDENTIFIER
  ::= { docsSubmgt3MibConformance 2 }

docsSubmgt3Compliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
  "The compliance statement for devices that implement the DOCSIS
   Subscriber Management 3 MIB.

  MODULE -- this MODULE
  MANDATORY-GROUPS {
    docsSubmgt3Group
  }
  ::= { docsSubmgt3MibCompliances 1 }
  docsSubmgt3Group OBJECT-GROUP
    OBJECTS {
      docsSubmgt3BaseCpeMaxIpv4Def,
      docsSubmgt3BaseCpeMaxIpv6AddressesDef,
      docsSubmgt3BaseCpeActiveDef,
    }

```

```
docssSubmgt3BaseCpeLearnableDef,
docssSubmgt3BaseSubFilterDownDef,
docssSubmgt3BaseSubFilterUpDef,
docssSubmgt3BaseCmFilterDownDef,
docssSubmgt3BaseCmFilterUpDef,
docssSubmgt3BasePsFilterDownDef,
docssSubmgt3BasePsFilterUpDef,
docssSubmgt3BaseMtaFilterDownDef,
docssSubmgt3BaseMtaFilterUpDef,
docssSubmgt3BaseStbFilterDownDef,
docssSubmgt3BaseStbFilterUpDef,
docssSubmgt3CpeCtrlMaxCpeIpv4,
docssSubmgt3CpeCtrlMaxCpeIpv6Addresses,
docssSubmgt3CpeCtrlActive,
docssSubmgt3CpeCtrlLearnable,
docssSubmgt3CpeCtrlReset,
docssSubmgt3CpeCtrlLastReset,
docssSubmgt3CpeIpAddrType,
docssSubmgt3CpeIpAddr,
docssSubmgt3CpeIpAddrPrefixLen,
docssSubmgt3CpeIpLearned,
docssSubmgt3CpeIpType,
docssSubMgt3GrpUdcGroupIds,
docssSubMgt3GrpUdcSentInRegRsp,
docssSubmgt3GrpSubFilterDs,
docssSubmgt3GrpSubFilterUs,
docssSubmgt3GrpCmFilterDs,
docssSubmgt3GrpCmFilterUs,
docssSubmgt3GrpPsFilterDs,
docssSubmgt3GrpPsFilterUs,
docssSubmgt3GrpMtaFilterDs,
docssSubmgt3GrpMtaFilterUs,
docssSubmgt3GrpStbFilterDs,
docssSubmgt3GrpStbFilterUs,
docssSubmgt3FilterGrpAction,
docssSubmgt3FilterGrpPriority,
docssSubmgt3FilterGrpIpTosLow,
docssSubmgt3FilterGrpIpTosHigh,
docssSubmgt3FilterGrpIpTosMask,
docssSubmgt3FilterGrpIpProtocol,
docssSubmgt3FilterGrpInetAddrType,
docssSubmgt3FilterGrpInetSrcAddr,
docssSubmgt3FilterGrpInetSrcMask,
docssSubmgt3FilterGrpInetDestAddr,
docssSubmgt3FilterGrpInetDestMask,
docssSubmgt3FilterGrpSrcPortStart,
docssSubmgt3FilterGrpSrcPortEnd,
docssSubmgt3FilterGrpDestPortStart,
docssSubmgt3FilterGrpDestPortEnd,
docssSubmgt3FilterGrpDestMacAddr,
docssSubmgt3FilterGrpDestMacMask,
docssSubmgt3FilterGrpSrcMacAddr,
docssSubmgt3FilterGrpEnetProtocolType,
docssSubmgt3FilterGrpEnetProtocol,
docssSubmgt3FilterGrpUserPriLow,
docssSubmgt3FilterGrpUserPriHigh,
docssSubmgt3FilterGrpVlanId,
docssSubmgt3FilterGrpClassPkts,
docssSubmgt3FilterGrpFlowLabel,
docssSubmgt3FilterGrpCmInterfaceMask,
docssSubmgt3FilterGrpRowStatus
}

STATUS      current
```

```

DESCRIPTION
    "Group of objects implemented in the CMTS."
 ::= { docssSubmgt3MibGroups 1 }
END

```

### **Q.3 DOCS-SEC-MIB<sup>388</sup>**

```

DOCS-SEC-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32,
    Counter32
        FROM SNMPv2-SMI          -- RFC 2578
    TruthValue,
    MacAddress,
    RowStatus,
    DateAndTime
        FROM SNMPv2-TC          -- RFC 2579
    OBJECT-GROUP,
    MODULE-COMPLIANCE
        FROM SNMPv2-CONF         -- RFC 2580
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB -- RFC 3411
    SnmpTagList
        FROM SNMP-TARGET-MIB    -- RFC 3411
    InetAddressType,
    InetAddress,
    InetAddressPrefixLength,
    InetPortNumber
        FROM INET-ADDRESS-MIB   -- RFC 4001
    docssIf3CmtsCmRegStatusEntry,
    docssIf3CmtsCmRegStatusId
        FROM DOCS-IF3-MIB
    clabProjDocsis
        FROM CLAB-DEF-MIB;

docssSecMib MODULE-IDENTITY
LAST-UPDATED      "201001150000Z" -- January 15, 2010
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
"
Postal: Cable Television Laboratories, Inc.
858 Coal Creek Circle
Louisville, Colorado 80027-9750
U.S.A.
Phone: +1 303-661-9100
Fax:   +1 303-661-9199
E-mail: mibs@cablelabs.com"
DESCRIPTION
"This MIB module contains the management objects for the
management of the security requirements in the DOCSIS
Security Specification."
REVISION      "201001150000Z" -- January 15, 2010
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-09.0872-4
and published as I10"

```

<sup>388</sup> Text in this MIB changed per OSSIv3.0-N-06.0357-1 on 2/7/07, per OSSIv3.0-N-07.0445-3, #8 on 5/10/07 by KN and per OSSIv3.0-N-09-0773-1 on 5/8/09 by JB. Revised per OSSIv3.0-N-09.0872-4 on 1/5/10 by JB.

REVISION "200905290000Z" -- May 29, 2009  
 DESCRIPTION  
     "Revised Version includes ECNs  
     OSSIv3.0-N-09.0773-1  
     OSSIv3.0-N-09.0775-3  
     OSSIv3.0-N-09.0777-2  
     and published as I09"

REVISION "200702230000Z" -- February 23, 2007  
 DESCRIPTION  
     "Revised Version includes ECN OSSIv3.0-N-06.0357-1  
     and published as I02"

REVISION "200612071700Z" -- December 7, 2006  
 DESCRIPTION  
     "Initial version, published as part of the CableLabs  
     OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207  
     Copyright 1999-2006 Cable Television Laboratories, Inc.  
     All rights reserved."  
     ::= { clabProjDocsis 11 }

-- Textual Conventions

-- Object Definitions

docsSecMibObjects OBJECT IDENTIFIER ::= { docsSecMib 1 }

docsSecCmtsServerCfg OBJECT IDENTIFIER ::= { docsSecMibObjects 1 }

docsSecCmtsServerCfgTftpOptions OBJECT-TYPE  
 SYNTAX       BITS {  
                 hwAddr(0),  
                 netAddr(1)  
         }  
 MAX-ACCESS  read-write  
 STATUS       current  
 DESCRIPTION  
     "This attribute instructs the CMTS to insert the source  
     IP address and/or MAC address of received TFTP packets  
     into the TFTP option fields before forwarding  
     the packets to the Config File server.  
     This attribute is only applicable when the TftpProxyEnabled  
     attribute of the MdCfg object is 'true'.  
 REFERENCE  
     "DOCSIS 3.0 Operations Support System Interface  
     Specification CM-SP-OSSIv3.0-I01-061207,  
     MdCfg Object Section in the Media Access Control (MAC)  
     Requirements Annex."  
 DEFVAL { ''H }  
 ::= { docsSecCmtsServerCfg 1 }

docsSecCmtsServerCfgConfigFileLearningEnable OBJECT-TYPE  
 SYNTAX       TruthValue  
 MAX-ACCESS  read-write  
 STATUS       current  
 DESCRIPTION  
     "This attribute enables and disables Configuration  
     File Learning functionality.  
     If this attribute is set to 'true' the CMTS will respond  
     with Authentication Failure in the REG-RSP message  
     when there is a mismatch between learned config file  
     parameters and REG-REQ parameters. If this attribute  
     is set to 'false', the CMTS will not execute config

```

file learning and mismatch check.
This attribute is only applicable when the TftpProxyEnabled
attribute of the MdCfg object is 'true'."
```

**REFERENCE**

```

"DOCSIS 3.0 Operations Support System Interface
Specification CM-SP-OSSIv3.0-I01-061207,
MdCfg Object Section in the Media Access Control (MAC)
Requirements Annex.
DOCSIS 3.0 Security Specification
CM-SP-SECv3.0-I01-060804, Secure Provisioning Section.
DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I01-060804."
```

**DEFVAL { true }**

**::= { docssSecCmtsServerCfg 2 }**

**docssSecCmtsEncrypt OBJECT IDENTIFIER ::= { docssSecMibObjects 2 }**

**docssSecCmtsEncryptEncryptAlgPriority OBJECT-TYPE**

**SYNTAX SnmpTagList**

**MAX-ACCESS read-write**

**STATUS current**

**DESCRIPTION**

```

"This attribute allows for configuration of a prioritized
list of encryption algorithms the CMTS will
use when selecting the primary SAID encryption algorithm
for a given CM. The CMTS selects the highest priority
encryption algorithm from this list that the CM
supports. By default the following encryption algorithms
are listed from highest to lowest priority (left
being the highest): 128 bit AES, 56 bit DES, 40 bit
DES.
An empty list indicates that the CMTS attempts to use
the latest and robust encryption algorithm supported
by the CM. The CMTS will ignore unknown values or unsupported
algorithms."
```

**DEFVAL { "aes128CbcMode des56CbcMode des40CbcMode" }**

**::= { docssSecCmtsEncrypt 1 }**

**docssSecCmtsCmEaeExclusionTable OBJECT-TYPE**

**SYNTAX SEQUENCE OF DocssSecCmtsCmEaeExclusionEntry**

**MAX-ACCESS not-accessible**

**STATUS current**

**DESCRIPTION**

```

"This object defines a list of CMs or CM groups to exclude
from Early Authentication and Encryption (EAE).
This object allows overrides to the value of EAE Control
for individual CMs or group of CMs for purposes
such as debugging. The CMTS supports a minimum of
30 instances of the CmtsCmEaeExclusion object.
This object is only applicable when the EarlyAuthEncryptCtrl
attribute of the MdCfg object is enabled.

This object supports the creation and deletion of multiple
instances."
```

**REFERENCE**

```

"DOCSIS 3.0 Operations Support System Interface
Specification CM-SP-OSSIv3.0-I01-061207,
MdCfg Object Section in the Media Access Control (MAC)
Requirements Annex.
DOCSIS 3.0 Security Specification
CM-SP-SECv3.0-I01-060804, Early Authentication And
Encryption (EAE) Section."
```

**::= { docssSecMibObjects 3 }**

```

docsSecCmtsCmEaeExclusionEntry OBJECT-TYPE
  SYNTAX      DocsSecCmtsCmEaeExclusionEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsSecCmtsCmEaeExclusion.
     The CMTS persists all instances of CmtsCmEaeExclusion
     across reinitializations."
  INDEX {
    docsSecCmtsCmEaeExclusionId
  }
 ::= { docsSecCmtsCmEaeExclusionTable 1 }

DocsSecCmtsCmEaeExclusionEntry ::= SEQUENCE {
  docsSecCmtsCmEaeExclusionId
    Unsigned32,
  docsSecCmtsCmEaeExclusionMacAddr
    MacAddress,
  docsSecCmtsCmEaeExclusionMacAddrMask
    MacAddress,
  docsSecCmtsCmEaeExclusionRowStatus
    RowStatus
}

docsSecCmtsCmEaeExclusionId OBJECT-TYPE
  SYNTAX      Unsigned32 (1..4294967295)
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key uniquely identifies the exclusion MAC address
     rule."
 ::= { docsSecCmtsCmEaeExclusionEntry 1 }

docsSecCmtsCmEaeExclusionMacAddr OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute identifies the CM MAC address. A match
     is made when a CM MAC address bitwise ANDed with the
     MacAddrMask attribute equals the value of this attribute."
  DEFVAL { '000000000000'H }
 ::= { docsSecCmtsCmEaeExclusionEntry 2 }

docsSecCmtsCmEaeExclusionMacAddrMask OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute identifies the CM MAC address mask
     and is used with the MacAddr attribute."
  DEFVAL { 'FFFFFFFFFFFF'H }
 ::= { docsSecCmtsCmEaeExclusionEntry 3 }

docsSecCmtsCmEaeExclusionRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "Controls and reflects the status of rows in this
     table. There is no restriction on changing values in
     a row of this table while the row is active."

```

```

 ::= { docssSecCmtsCmEaeExclusionEntry 4 }

docssSecCmtsSavControl OBJECT IDENTIFIER ::= { docssSecMibObjects 4 }

docssSecCmtsSavControlCmAuthEnable OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute enables or disables Source Address
     Verification (SAV) for CM configured policies in the
     SavCmAuth object. If this attribute is set to 'false',
     the CM configured policies in the SavCmAuth object
     are ignored.
    This attribute is only applicable when the
    SrcAddrVerificationEnabled attribute of the MdCfg object is
    'true'.."
  REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
     Specification CM-SP-OSSIv3.0-I01-061207,
     MdCfg Object Section in the Media Access Control (MAC)
     Requirements Annex."
  DEFVAL { true }
  ::= { docssSecCmtsSavControl 1 }

docssSecSavCmAuthTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocssSecSavCmAuthEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object defines a read-only set of SAV policies
     associated with a CM that the CMTS will use in addition
     to the CMTS verification of an operator assigned IP
     Address being associated with a CM. When the CMTS has
     not resolved a source address of a CM CPE, the CMTS verifies
     if the CM CPE is authorized to pass traffic based
     on this object. These object policies include a list
     of subnet prefixes (defined in the SavStaticList
     object) or a SAV Group Name that could reference a CMTS
     configured list of subnet prefixes (defined in SavCfgList
     object) or vendor-specific policies. The CMTS
     populates the attributes of this object for a CM from
     that CM's config file.
    This object is only applicable when the
    SrcAddrVerificationEnabled attribute of the MdCfg object is
    'true' and the CmAuthEnable attribute of the CmtssSavCtrl
    object is 'true'.
    The CMTS is not required to persist instances of this
    object across reinitializations."
  REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
     Specification CM-SP-OSSIv3.0-I01-061207,
     MdCfg Object Section in the Media Access Control (MAC)
     Requirements Annex.
     DOCSIS 3.0 Security Specification
     CM-SP-SECv3.0-I01-060804, Secure Provisioning Section.
     DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I01-060804,
     Common Radio Frequency Interface Encodings Annex."
  ::= { docssSecMibObjects 5}

docssSecSavCmAuthEntry OBJECT-TYPE
  SYNTAX      DocssSecSavCmAuthEntry

```

```

MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsSecSavCmAuth."
INDEX {
    docsIf3CmtsCmRegStatusId
}
 ::= { docsSecSavCmAuthTable 1 }

DocsSecSavCmAuthEntry ::= SEQUENCE {
    docsSecSavCmAuthGrpName
        SnmpAdminString,
    docsSecSavCmAuthStaticPrefixListId
        Unsigned32
}

docsSecSavCmAuthGrpName OBJECT-TYPE
SYNTAX      SnmpAdminString
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute references the Name attribute of the
    SavCfgList object of a CM. If the CM signaled group
    name is not configured in the CMTS, the CMTS ignores this
    attribute value for the purpose of Source Address
    Verification. The CMTS must allow the modification
    of the GrpName object and use the updated SAV rules for
    newly discovered CPEs from CMs. When a source IP address
    is claimed by two CMs (e.g., detected as duplicated),
    the CMTS must use the current SAV rules defined
    for both CMs in case the SAV GrpName rules may have been
    updated. In the case of a persisting conflict, it is
    up to vendor-implementation to decide what CM should
    hold the SAV authorization.
    The zero-length string indicates that no SAV Group was
    signaled by the CM. The zero-length value or a non-existing
    reference in the SavCfgList object means the
    SavCfgListName is ignored for the purpose of SAV."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I01-060804,
    Common Radio Frequency Interface Encodings Annex."
 ::= { docsSecSavCmAuthEntry 1 }

docsSecSavCmAuthStaticPrefixListId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute identifies the reference to a CMTS
    created subnet prefix list based on the CM signaled static
    prefix list TLV elements. The CMTS may reuse this
    attribute value to reference more than one CM when
    those CMs have signaled the same subnet prefix list to
    the CMTS.
    The value zero indicates that no SAV static prefix encodings
    were signaled by the CM."
 ::= { docsSecSavCmAuthEntry 2 }

docsSecSavCfgListTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsSecSavCfgListEntry
MAX-ACCESS  not-accessible
STATUS      current

```

```

DESCRIPTION
    "This object defines the CMTS configured subnet prefix
    extension to the SavCmAuth object.
    This object supports the creation and deletion of multiple
    instances.
    Creation of a new instance of this object requires the
    PrefixAddrType and PrefixAddr attributes to be set."
 ::= { docsSecMibObjects 6}

docsSecSavCfgListEntry OBJECT-TYPE
    SYNTAX      DocsSecSavCfgListEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsSecSavCfgList.
        The CMTS persists all instances of SavCfgList
        across reinitializations."
    INDEX {
        docsSecSavCfgListName,
        docsSecSavCfgListRuleId
    }
 ::= { docsSecSavCfgListTable 1 }

DocsSecSavCfgListEntry ::= SEQUENCE {
    docsSecSavCfgListName
        SnmpAdminString,
    docsSecSavCfgListRuleId
        Unsigned32,
    docsSecSavCfgListPrefixAddrType
        InetAddressType,
    docsSecSavCfgListPrefixAddr
        InetAddress,
    docsSecSavCfgListPrefixLen
        InetAddressPrefixLength,
    docsSecSavCfgListRowStatus
        RowStatus
}

docsSecSavCfgListName OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE (1..16))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute is the key that identifies the instance
        of the SavCmAuth object to which this object extension
        belongs."
 ::= { docsSecSavCfgListEntry 1 }

docsSecSavCfgListRuleId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute is the key that identifies a particular
        subnet prefix rule of an instance of this object."
 ::= { docsSecSavCfgListEntry 2 }

docsSecSavCfgListPrefixAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute identifies the IP address type of this

```

```

        subnet prefix rule."
 ::= { docssSecSavCfgListEntry 3 }

docssSecSavCfgListPrefixAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute corresponds to the IP address of this
         subnet prefix rule in accordance to the PrefixAddrType
         attribute."
 ::= { docssSecSavCfgListEntry 4 }

docssSecSavCfgListPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute defines the length of the subnet prefix
         to be matched by this rule."
 ::= { docssSecSavCfgListEntry 5 }

docssSecSavCfgListRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The row creation control of this conceptual row.
         An entry in this table can be set to active
         only when the following attributes are correctly
         assigned:
             PrefixAddrType
             PrefixAddress
         There are no restrictions to modify or delete
         entries in this table."
 ::= { docssSecSavCfgListEntry 6 }

```

```

docssSecSavStaticListTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocssSecSavStaticListEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object defines a subnet prefix extension to the
         SavCmAuth object based on CM statically signaled
         subnet prefixes to the CMTS.
         When a CM signals to the CMTS static subnet prefixes,
         the CMTS must create a List Id to be referenced by the CM
         in the SavCmAuth StaticPrefixListId attribute, or
         the CMTS may reference an existing List Id associated
         to previously registered CMs in case of those subnet
         prefixes associated with the List Id match the ones
         signaled by the CM."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I01-060804,
         Common Radio Frequency Interface Encodings Annex."
 ::= { docssSecMibObjects 7 }

```

```

docssSecSavStaticListEntry OBJECT-TYPE
    SYNTAX      DocssSecSavStaticListEntry
    MAX-ACCESS  not-accessible

```

```

STATUS      current
DESCRIPTION
    "The conceptual row of docssSecSavStaticList.
     The CMTS may persist instances of this object
     across reinitializations."
INDEX {
    docssSecSavStaticListId,
    docssSecSavStaticListRuleId
}
 ::= { docssSecSavStaticListTable 1 }

DocssSecSavStaticListEntry ::= SEQUENCE {
    docssSecSavStaticListId
        Unsigned32,
    docssSecSavStaticListRuleId
        Unsigned32,
    docssSecSavStaticListPrefixAddrType
        InetAddressType,
    docssSecSavStaticListPrefixAddr
        InetAddress,
    docssSecSavStaticListPrefixLen
        InetAddressPrefixLength
}

docssSecSavStaticListId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key uniquely identifies the index that groups
    multiple subnet prefix rules. The CMTS assigns this
    value per CM or may reuse it among multiple CMs that share
    the same list of subnet prefixes."
 ::= { docssSecSavStaticListEntry 1 }

docssSecSavStaticListRuleId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key identifies a particular static subnet prefix
    rule of an instance of this object."
 ::= { docssSecSavStaticListEntry 2 }

docssSecSavStaticListPrefixAddrType OBJECT-TYPE
SYNTAX      InetAddressType
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute identifies the IP address type of this
    subnet prefix rule."
 ::= { docssSecSavStaticListEntry 3 }

docssSecSavStaticListPrefixAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute corresponds to the IP address of this
    subnet prefix rule in accordance to the PrefixAddrType
    attribute."
 ::= { docssSecSavStaticListEntry 4 }

```

```

docsSecSavStaticListPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute defines the length of the subnet prefix
         to be matched by this rule."
    ::= { docsSecSavStaticListEntry 5 }

docsSecCmtsCmSavStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsSecCmtsCmSavStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object provides a read-only list of SAV counters
         for different service theft indications."
    ::= { docsSecMibObjects 8 }

docsSecCmtsCmSavStatsEntry OBJECT-TYPE
    SYNTAX      DocsSecCmtsCmSavStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsSecCmtsCmSavStats."
    AUGMENTS { docsIf3CmtsCmRegStatusEntry }
    ::= { docsSecCmtsCmSavStatsTable 1 }

DocsSecCmtsCmSavStatsEntry ::= SEQUENCE {
    docsSecCmtsCmSavStatsSavDiscards
        Counter32
}

docsSecCmtsCmSavStatsSavDiscards OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute provides the information about number
         of dropped upstream packets due to SAV failure."
    ::= { docsSecCmtsCmSavStatsEntry 1 }

docsSecCmtsCertificate OBJECT IDENTIFIER ::= { docsSecMibObjects 9 }

docsSecCmtsCertificateCertRevocationMethod OBJECT-TYPE
    SYNTAX      INTEGER {
        none(1),
        crl(2),
        ocsp(3),
        crlAndOcsp(4)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute identifies which certificate revocation
         method is to be used by the CMTS to verify the cable
         modem certificate validity. The certificate revocation
         methods include Certification Revocation
         List (CRL) and Online Certificate Status Protocol
         (OCSP).
        The following options are available:
        The option 'none' indicates that the CMTS does not attempt
        to determine the revocation status of a certificate.

```

The option 'crl' indicates the CMTS uses a Certificate Revocation List (CRL) as defined by the Url attribute of the CmtsCertRevocationList object. When the value of this attribute is changed to 'crl', it triggers the CMTS to retrieve the CRL from the URL specified by the Url attribute. If the value of this attribute is 'crl' when the CMTS starts up, it triggers the CMTS to retrieve the CRL from the URL specified by the Url attribute.

The option 'ocsp' indicates the CMTS uses the Online Certificate Status Protocol (OCSP) as defined by the Url attribute of the CmtsOnlineCertStatusProtocol object.

The option 'crlAndOcsp' indicates the CMTS uses both the CRL as defined by the Url attribute in the CmtsCertRevocationList object and OCSP as defined by the Url attribute in the CmtsOnlineCertStatusProtocol object.

The CMTS persists the values of the CertRevocationMethod attribute across reinitializations."

```
DEFVAL { none }
 ::= { docsSecCmtsCertificate 1 }
```

```
docsSecCmtsCertRevocationList OBJECT IDENTIFIER
 ::= { docsSecMibObjects 10 }
```

```
docsSecCmtsCertRevocationListUrl OBJECT-TYPE
 SYNTAX     SnmpAdminString
 MAX-ACCESS read-write
 STATUS     current
 DESCRIPTION
   "This attribute contains the URL from where the CMTS will retrieve the CRL. When this attribute is set to a URL value different from the current value, it triggers the CMTS to retrieve the CRL from that URL. If the value of this attribute is a zero-length string, the CMTS does not attempt to retrieve the CRL.
   The CMTS persists the value of Url across reinitializations."
REFERENCE
   "DOCSIS 3.0 Security Specification
    CM-SP-SECv3.0-I01-060804, BPI+ X.509 Certificate Profile and Management Section."
DEFVAL { "" }
 ::= { docsSecCmtsCertRevocationList 1 }
```

```
docsSecCmtsCertRevocationListRefreshInterval OBJECT-TYPE
 SYNTAX     Unsigned32 (1..524160)
 UNITS      "minutes"
 MAX-ACCESS read-write
 STATUS     current
 DESCRIPTION
   "This attribute contains the refresh interval for the CMTS to retrieve the CRL (referred to in the Url attribute) with the purpose of updating its Certificate Revocation List. This attribute is meaningful if the tbsCertList.nextUpdate attribute does not exist in the last retrieved CRL, otherwise the value 0 is returned.
   The CMTS persists the value of RefreshInterval across reinitializations."
REFERENCE
```

```

"DOCSIS 3.0 Security Specification
CM-SP-SECv3.0-I01-060804, BPI+ X.509 Certificate Profile
and Management Section."
DEFVAL { 10080 }
 ::= { docsSecCmtsCertRevocationList 2 }

docsSecCmtsCertRevocationListLastUpdate OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the last date and time when
    the CRL was retrieved by the CMTS.
    If the CRL has not been updated, then this variable
    shall have the value corresponding to January 1, year
    0000, 00:00:00.0, which is encoded as
    (hex)'00 00 01 01 00 00 00 00'.
 ::= { docsSecCmtsCertRevocationList 3 }

docsSecCmtsOnlineCertStatusProtocol OBJECT IDENTIFIER
 ::= { docsSecMibObjects 11 }

docsSecCmtsOnlineCertStatusProtocolUrl OBJECT-TYPE
SYNTAX      SnmpAdminString
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute contains the URL string to retrieve
    OCSP information. If the value of this attribute is
    a zero-length string, the CMTS does not attempt to request
    the status of a CM certificate.
    The CMTS persists the value of Url across
    reinitializations."
REFERENCE
    "DOCSIS 3.0 Security Specification
    CM-SP-SECv3.0-I01-060804, BPI+ X.509 Certificate Profile
    and Management Section.
    RFC 2560."
DEFVAL { "" }
 ::= { docsSecCmtsOnlineCertStatusProtocol 1 }

docsSecCmtsOnlineCertStatusProtocolSignatureBypass OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute enables or disables signature checking
    on OCSP response messages.
    The CMTS persists the value of SignatureBypass across
    reinitializations."
REFERENCE
    "DOCSIS 3.0 Security Specification
    CM-SP-SECv3.0-I01-060804, BPI+ X.509 Certificate Profile
    and Management Section.
    RFC 2560."
DEFVAL { false }
 ::= { docsSecCmtsOnlineCertStatusProtocol 2 }

docsSecCmtsCmBpi2EnforceExclusionTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsSecCmtsCmBpi2EnforceExclusionEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION

```

"This object defines a list of CMs or CM groups to exclude from BPI+ enforcement policies configured within the CMTS. This object allows overrides to the value of BPI+ enforcement control for individual CMs or group of CMs for purposes such as debugging. The CMTS supports a minimum of 30 instances of the CmtsCmBpi2EnforceExclusion object.

This object supports the creation and deletion of multiple instances."

#### REFERENCE

"DOCSIS 3.0 Operations Support System Interface Specification CM-SP-OSSIv3.0-I01-061207, MdCfg Object Section in the Media Access Control (MAC) Requirements Annex.  
DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I01-060804, BPI+ Enforce Section."  
 ::= { docssSecMibObjects 12}

**docssSecCmtsCmBpi2EnforceExclusionEntry OBJECT-TYPE**  
**SYNTAX** DocssSecCmtsCmBpi2EnforceExclusionEntry  
**MAX-ACCESS** not-accessible  
**STATUS** current  
**DESCRIPTION**  
 "The conceptual row of docssSecCmtsCmBpi2EnforceExclusion. The CMTS persists all instances of CmtsCmBpi2EnforceExclusion across reinitializations."  
**INDEX** {  
 docssSecCmtsCmBpi2EnforceExclusionId  
 }  
 ::= { docssSecCmtsCmBpi2EnforceExclusionTable 1 }

**DocssSecCmtsCmBpi2EnforceExclusionEntry ::= SEQUENCE {**  
**docssSecCmtsCmBpi2EnforceExclusionId**  
 Unsigned32,  
**docssSecCmtsCmBpi2EnforceExclusionMacAddr**  
 MacAddress,  
**docssSecCmtsCmBpi2EnforceExclusionMacAddrMask**  
 MacAddress,  
**docssSecCmtsCmBpi2EnforceExclusionRowStatus**  
 RowStatus  
**}**

**docssSecCmtsCmBpi2EnforceExclusionId OBJECT-TYPE**  
**SYNTAX** Unsigned32 (1..4294967295)  
**MAX-ACCESS** not-accessible  
**STATUS** current  
**DESCRIPTION**  
 "This key uniquely identifies the exclusion MAC address rule."  
 ::= { docssSecCmtsCmBpi2EnforceExclusionEntry 1 }

**docssSecCmtsCmBpi2EnforceExclusionMacAddr OBJECT-TYPE**  
**SYNTAX** MacAddress  
**MAX-ACCESS** read-create  
**STATUS** current  
**DESCRIPTION**  
 "This attribute identifies the CM MAC address. A match is made when a CM MAC address bitwise ANDed with the MacAddrMask attribute equals the value of this attribute."  
**DEFVAL** { '000000000000' }  
 ::= { docssSecCmtsCmBpi2EnforceExclusionEntry 2 }

**docssSecCmtsCmBpi2EnforceExclusionMacAddrMask OBJECT-TYPE**  
**SYNTAX** MacAddress

```

MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the CM MAC address mask
     and is used with the MacAddr attribute."
DEFVAL { 'FFFFFFFFFFFF'H }
 ::= { docssSecCmtsCmBpi2EnforceExclusionEntry 3 }

docssSecCmtsCmBpi2EnforceExclusionRowStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "Controls and reflects the status of rows in this
     table. There is no restriction on changing values in
     a row of this table while the row is active."
 ::= { docssSecCmtsCmBpi2EnforceExclusionEntry 4 }

-- Conformance Definitions
docssSecMibConformance OBJECT IDENTIFIER ::= { docssSecMib 2 }
docssSecMibCompliances OBJECT IDENTIFIER ::= { docssSecMibConformance 1 }
docssSecMibGroups     OBJECT IDENTIFIER ::= { docssSecMibConformance 2 }

docssSecCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for devices that implement the DOCSIS
     Security MIB."

MODULE -- this MODULE
MANDATORY-GROUPS {
    docssSecGroup
}

 ::= { docssSecMibCompliances 1 }

docssSecGroup OBJECT-GROUP
OBJECTS {
    docssSecCmtsCertRevocationListUrl,
    docssSecCmtsCertRevocationListRefreshInterval,
    docssSecCmtsCertRevocationListLastUpdate,
    docssSecCmtsOnlineCertStatusProtocolUrl,
    docssSecCmtsOnlineCertStatusProtocolSignatureBypass,
    docssSecCmtsServerCfgTftpOptions,
    docssSecCmtsServerCfgConfigFileLearningEnable,
    docssSecCmtsEncryptEncryptAlgPriority,
    docssSecCmtsSavControlCmAuthEnable,
    docssSecCmtsCmEaeExclusionMacAddr,
    docssSecCmtsCmEaeExclusionMacAddrMask,
    docssSecCmtsCmEaeExclusionRowStatus,
    docssSecSavCmAuthGrpName,
    docssSecSavCmAuthStaticPrefixListId,
    docssSecSavCfgListPrefixAddrType,
    docssSecSavCfgListPrefixAddr,
    docssSecSavCfgListPrefixLen,
    docssSecSavCfgListRowStatus,
    docssSecSavStaticListPrefixAddrType,
    docssSecSavStaticListPrefixAddr,
    docssSecSavStaticListPrefixLen,
    docssSecCmtsCmSavStatsSavDiscards,
    docssSecCmtsCertificateCertRevocationMethod,
    docssSecCmtsCmBpi2EnforceExclusionMacAddr,
    docssSecCmtsCmBpi2EnforceExclusionMacAddrMask,
}

```

```

docsSecCmtsCmBpi2EnforceExclusionRowStatus
}
STATUS      current
DESCRIPTION
    "Group of objects implemented in the CMTS."
::= { docsSecMibGroups 1 }
END

```

## Q.4 DOCS-MCAST-MIB<sup>389</sup>

```

DOCS-MCAST-MIB DEFINITIONS ::= BEGIN
IMPORTS
  MODULE-IDENTITY,
  OBJECT-TYPE,
  Unsigned32
    FROM SNMPv2-SMI          -- RFC 2578
  RowStatus,
  TruthValue,
  MacAddress
    FROM SNMPv2-TC          -- RFC 2579
  OBJECT-GROUP,
  MODULE-COMPLIANCE
    FROM SNMPv2-CONF         -- RFC 2580
  SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB -- RFC 3411
  InetAddressType,
  InetAddress,
  InetAddressPrefixLength
    FROM INET-ADDRESS-MIB   -- RFC 4001
  InterfaceIndex,
  ifIndex
    FROM IF-MIB              -- RFC 2863
  DocsBpkmDataEncryptAlg,
  DocsSAID
    FROM DOCS-IETF-BPI2-MIB -- RFC 4131
  ChSetId,
  Dsid
    FROM DOCS-IF3-MIB
  clabProjDocsis
    FROM CLAB-DEF-MIB;
  docsMcastMib MODULE-IDENTITY
    LAST-UPDATED    "201407290000Z" - July 29, 2014
    ORGANIZATION   "Cable Television Laboratories, Inc."
    CONTACT-INFO
      "Postal: Cable Television Laboratories, Inc.
       858 Coal Creek Circle
       Louisville, Colorado 80027-9750
       U.S.A.
       Phone: +1 303-661-9100
       Fax: +1 303-661-9199
       E-mail: mibs@cablelabs.com"
    DESCRIPTION
      "This MIB module contains the management objects for the
       management of Multicast over DOCSIS to support Multicast
       DSID forwarding and or bonded multicast.
       Copyright 1999-2014 Cable Television Laboratories, Inc.
       All rights reserved."
    REVISION     "201407290000Z" - July 29, 2014

```

<sup>389</sup> Section revised per OSSIV3.0-N-07.0411-3 on 5/7/07 and per OSSIV3.0-N-07.0445-3 on 5/10/07 by KN; per OSSIV3.0-N-07.0473-3 on 7/12/07 and OSSIV3.0-N-07.0499-1 on 7/17/07 by ab; per OSSIV3.0-N-07.0550-2 on 11/9/07; OSSIV3.0-N-07.0551-4 on 11/12/07 by ab; per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

```

DESCRIPTION
    "Revised Version includes ECN
    OSSIV3.0-N-14.1151-2 and published as I24"
REVISION      "200708030000Z" -- August 3, 2007
DESCRIPTION
    "Revised Version includes ECNs
    OSSIV3.0-N-07.0499-1
    OSSIV3.0-N-07.0473-3
    and is published as I04"
REVISION      "200612071700Z" -- Dec 7, 2006
DESCRIPTION
    "Initial version, published as part of the CableLabs
    OSSIV3.0 specification CM-SP-OSSIv3.0-I01-061207."
 ::= { labProjDocsis 18}

-- Textual Conventions

-- Object Definitions
docsMcastMibObjects OBJECT IDENTIFIER ::= { docsMcastMib 1 }

docsMcastCmtsGrpCfgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsMcastCmtsGrpCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object controls the QoS, PHS and encryption settings
    for downstream forwarding of IP multicast sessions.
    An IP multicast session is replicated to one
    or more Downstream Channel Sets (DCSs), where each
    DCS is either a single downstream channel or a downstream
    bonding group of multiple channels. The CMTS determines
    on which DCSs to replicate a multicast session
    based on IP multicast membership reports ('joins')
    or other vendor-specific static configuration.

The CmtsGrpCfg object allows for the configuration
of a range of sessions through the SrcPrefixAddr and
GrpPrefixAddr and SrcPrefixLen and GrpPrefixLen attributes.

The CmtsGrpCfg object allows for the configuration
of QoS, Encryption and PHS for multicast sessions. Cable
operators can specify configuration rules for
a range of multicast sessions through the tuple of
(SrcPrefixAddr,SrcPrefixLen, GrpPrefixAddr, GrpPrefixLen)
attributes in an entry. The QosConfigId attribute
identifies the QoS rule, the EncryptionConfigId
identifies the encryption rule and the PhsConfigId
identifies the PHS rule for a particular entry.
Even if an entry indicates a range of multicast sessions
the Encryption and PHS rules are applied on a per-session
basis. That is, a separate DSID is assigned
to an individual multicast session from a range of multicast
sessions identified by an entry in the CmtsGrpCfg
object and a PHS rule (indicated by the PhsCfgId)
is applied individually to each session which is
identified by the DSID assigned for that session. Similarly,
a separate SAID is assigned to individual multicast
session from range identified by the CmtsGrpCfg
object.
The CmtsGrpQosConfigQosCtrl attribute from the CmtsGrpQosCfg
object is used to determine if the traffic
for a range of multicast sessions identified by an
entry in the CmtsGrpCfg object will be transmitted in

```

an 'Aggregate-Session' Group Service Flow or will be transmitted separately for each session using 'Single-Session' Group Service Flows. Even if the range of multicast sessions are transmitted on an 'Aggregate-Session' Group Service Flow, the PHS and Encryption rules are always applied individually to a multicast session on a per-session DSID basis prior to being transmitted on an 'Aggregate-Session' Group Service Flow (GSF).

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the following attributes to be set

```
RulePriority
PrefixAddrType
SrcPrefixAddr
SrcPrefixLen
GrpPrefixAddr
GrpPrefixLen
IpDsLow
IpDsHigh
IpDsMask"
 ::= { docsMcastMibObjects 1}
```

```
docsMcastCmtsGrpCfgEntry OBJECT-TYPE
SYNTAX      DocsMcastCmtsGrpCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"The conceptual row of docsMcastCmtsGrpCfg.
The CMTS persists all instances of the CmtsGrpConfig object
across system reinitializations."
INDEX {
    docsMcastCmtsGrpCfgId
}
 ::= { docsMcastCmtsGrpCfgTable 1 }
```

```
DocsMcastCmtsGrpCfgEntry ::= SEQUENCE {
    docsMcastCmtsGrpCfgId
        Unsigned32,
    docsMcastCmtsGrpCfgRulePriority
        Unsigned32,
    docsMcastCmtsGrpCfgPrefixAddrType
        InetAddressType,
    docsMcastCmtsGrpCfgSrcPrefixAddr
        InetAddress,
    docsMcastCmtsGrpCfgSrcPrefixLen
        InetAddressPrefixLength,
    docsMcastCmtsGrpCfgGrpPrefixAddr
        InetAddress,
    docsMcastCmtsGrpCfgGrpPrefixLen
        InetAddressPrefixLength,
    docsMcastCmtsGrpCfgTosLow
        OCTET STRING,
    docsMcastCmtsGrpCfgTosHigh
        OCTET STRING,
    docsMcastCmtsGrpCfgTosMask
        OCTET STRING,
    docsMcastCmtsGrpCfgQosConfigId
        Unsigned32,
    docsMcastCmtsGrpCfgEncryptConfigId
        Unsigned32,
```

```

docsMcastCmtsGrpCfgPhsConfigId
    Unsigned32,
docsMcastCmtsGrpCfgRowStatus
    RowStatus
}

docsMcastCmtsGrpCfgId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute represents the unique identifier
     of instances of this object. This attribute is
     the key that identifies unique instances of the CmtsGrpConfig
     object."
::= { docsMcastCmtsGrpCfgEntry 1 }

docsMcastCmtsGrpCfgRulePriority OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute indicates the priority of this entry
     used to resolve which instance of this object apply
     when a newly replicated multicast session matches
     multiple entries. Higher values indicate a higher
     priority. Valid values for this attribute are 0..63
     and 192..255 in order to not conflict with CMTS
     internally-created instances that use the range
     64..191."
::= { docsMcastCmtsGrpCfgEntry 2 }

docsMcastCmtsGrpCfgPrefixAddrType OBJECT-TYPE
SYNTAX      InetAddressType
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the address family for
     the multicast session (S,G) of the GC which corresponds
     to the SrcPrefixAddr and GrpPrefixAddr attributes
     respectively."
::= { docsMcastCmtsGrpCfgEntry 3 }

docsMcastCmtsGrpCfgSrcPrefixAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute defines the IP source address prefix
     of the IP multicast session.
     Source prefix addresses are unicast host addresses."
REFERENCE
    "RFC 3569.
     RFC 3306."
::= { docsMcastCmtsGrpCfgEntry 4 }

docsMcastCmtsGrpCfgSrcPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
     Source (S) IP multicast group addresses. For Group or

```

```

        ASM based sessions this attribute is set to 0."
DEFVAL { 0 }
 ::= { docsMcastCmtsGrpCfgEntry 5 }

docsMcastCmtsGrpCfgGrpPrefixAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
    destination IP multicast group addresses."
 ::= { docsMcastCmtsGrpCfgEntry 6 }

docsMcastCmtsGrpCfgGrpPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
    IP multicast group addresses."
REFERENCE
    "DOCSIS 3.0 Operation and Support System Interface
     Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS
     Configuration Object Model section."
DEFVAL { 0 }
 ::= { docsMcastCmtsGrpCfgEntry 7 }

docsMcastCmtsGrpCfgTosLow OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (1))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the low value of a range
    of the TOS byte value to be defined in a packet classifier
    this GC instantiates in the GCR in order to limit the
    GCR-matched traffic to a particular set of DSCPs.
    This applies to the IPv4 TOS byte and the IPv6 Traffic
    Class byte.
    The IP TOS octet, as originally defined in RFC 791, has
    been superseded by the 6-bit Differentiated Services
    Field and the 2-bit Explicit Congestion Notification
    Field."
REFERENCE
    "RFC 791.
     RFC 3260.
     RFC3168."
 ::= { docsMcastCmtsGrpCfgEntry 8 }

docsMcastCmtsGrpCfgTosHigh OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(1))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the high value of a range
    of the TOS byte value to be defined in a packet classifier
    this GC instantiates in the GCR in order to limit
    the GCR-matched traffic to a particular set of DSCPs.
    This applies to the IPv4 TOS byte and the IPv6 Traffic
    Class byte.
    The IP TOS octet, as originally defined in RFC 791, has
    been superseded by the 6-bit Differentiated Services
    Field (DSField, RFC 3260) and the 2-bit Explicit

```

```

Congestion Notification Field (ECN field, RFC 3168)."
REFERENCE
  "RFC 791.
  RFC 3260.
  RFC 3168."
 ::= { docsMcastCmtsGrpCfgEntry 9 }

docsMcastCmtsGrpCfgTosMask OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE(1))
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute identifies the mask value bitwise
     ANDed with a TOS byte value to be defined in a packet classifier
     this GC instantiates in the GCR in order to limit
     the GCR-matched traffic to a particular set of DSCPs.
     This applies to the IPv4 TOS byte and the IPv6 Traffic
     Class byte.
    The IP TOS octet, as originally defined in RFC 791, has
    been superseded by the 6-bit Differentiated Services
    Field (DSField, RFC 3260) and the 2-bit Explicit
    Congestion Notification Field (ECN field, RFC 3168)."
REFERENCE
  "RFC 791.
  RFC 3260.
  RFC 3168."
 ::= { docsMcastCmtsGrpCfgEntry 10 }

docsMcastCmtsGrpCfgQosConfigId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute identifies an instance in CmtsGrpQosCfg
     for configuring the QoS for the replication
     of the sessions matching this CmtsGrpCfg instance.
    The value 0 indicates that all replications referenced
     by this CmtsGrpCfg instance will be forwarded to the
     default GSF."
REFERENCE
  "DOCSIS 3.0 Operation and Support System Interface
   Specification CM-SP-OSSIv3.0-I04-070803, Multicast QoS
   Configuration Object Model section."
DEFVAL { 0 }
 ::= { docsMcastCmtsGrpCfgEntry 11 }

docsMcastCmtsGrpCfgEncryptConfigId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute identifies an instance in CmtsGrpEncryptionCfg
     for configuring the encryption of replications derived
     from this GC.
    The value 0 indicates no encryption for all replications
     derived from this GC."
REFERENCE
  "DOCSIS 3.0 Operation and Support System Interface
   Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS
   Configuration Object Model section."
DEFVAL { 0 }

```

```

 ::= { docsMcastCmtsGrpCfgEntry 12 }

docsMcastCmtsGrpCfgPhsConfigId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute identifies an instance in CmtsGrpPhsCfg
         that configures DSID-indexed PHS compression
         for all replications derived from this GC.
         The value 0 indicates no PHS compression for all replications
         derived from this GC."
    REFERENCE
        "DOCSIS 3.0 Operation and Support System Interface
         Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS
         Configuration Object Model section."
    DEFVAL { 0 }
 ::= { docsMcastCmtsGrpCfgEntry 13 }

docsMcastCmtsGrpCfgRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this instance."
 ::= { docsMcastCmtsGrpCfgEntry 14 }

docsMcastCmtsGrpEncryptCfgTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsMcastCmtsGrpEncryptCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object controls the configuration of the Security
         Association (SA) and the encryption algorithm
         used for multicast sessions.
         This object supports the creation and deletion of instances."
 ::= { docsMcastMibObjects 2}

docsMcastCmtsGrpEncryptCfgEntry OBJECT-TYPE
    SYNTAX      DocsMcastCmtsGrpEncryptCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsMcastCmtsGrpEncryptCfg.
         The CMTS persists all instances of the CmtsGrpEncryptionConfig
         object across system reinitializations."
    INDEX {
        docsMcastCmtsGrpEncryptCfgId
    }
 ::= { docsMcastCmtsGrpEncryptCfgTable 1 }

DocsMcastCmtsGrpEncryptCfgEntry ::= SEQUENCE {
    docsMcastCmtsGrpEncryptCfgId
        Unsigned32,
    docsMcastCmtsGrpEncryptCfgCtrl
        INTEGER,
    docsMcastCmtsGrpEncryptCfgAlg
        DocsBpkmDataEncryptAlg,
    docsMcastCmtsGrpEncryptCfgRowStatus
        RowStatus
}

```

```

docsMcastCmtsGrpEncryptCfgId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute specifies the unique identifier of
         instances of this object"
    ::= { docsMcastCmtsGrpEncryptCfgEntry 1 }

docsMcastCmtsGrpEncryptCfgCtrl OBJECT-TYPE
    SYNTAX      INTEGER {
                    cmts(1),
                    mgmt(2)
                }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute controls whether the CMTS can select
         the encryption algorithm or if this can be set manually
         using the Alg attribute. If this attribute is set
         to 'cmts', the CMTS can select the encryption algorithm
         for the Security Association (SA). If this attribute
         is set to 'mgmt', the Alg attribute is used to define
         the encryption algorithm for this SA."
    DEFVAL { mgmt }
    ::= { docsMcastCmtsGrpEncryptCfgEntry 2 }

docsMcastCmtsGrpEncryptCfgAlg OBJECT-TYPE
    SYNTAX      DocsBpkmDataEncryptAlg
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute defines which encryption algorithm
         will be used for an SA referenced by this object when
         the Ctrl is set to 'mgmt'."
    REFERENCE
        "DOCSIS 3.0 Security Specification
         CM-SP-SECv3.0-I01-060804, Security-Capabilities
         section."
    DEFVAL { des56CbcMode }
    ::= { docsMcastCmtsGrpEncryptCfgEntry 3 }

docsMcastCmtsGrpEncryptCfgRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this instance."
    ::= { docsMcastCmtsGrpEncryptCfgEntry 4 }

docsMcastCmtsGrpPhsCfgTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsMcastCmtsGrpPhsCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object controls the configuration of DSID-indexed
         PHS for multicast sessions. Configuration of
         PHS Rules via this table must not be based on the configuration
         of a range of sessions, but must be configured
         on a single multicast session.
         Creation of multiple instances of this object require
         the following attributes to be set:
         PhsField"

```

```

PhsMask
PhsSize"
 ::= { docsMcastMibObjects 3}

docsMcastCmtsGrpPhsCfgEntry OBJECT-TYPE
 SYNTAX      DocsMcastCmtsGrpPhsCfgEntry
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
   "The conceptual row of docsMcastCmtsGrpPhsCfg.
    The CMTS persists all instances of the CmtsGrpPhsConfig
    object across system reinitializations."
INDEX {
  docsMcastCmtsGrpPhsCfgId
}
 ::= { docsMcastCmtsGrpPhsCfgTable 1 }

DocsMcastCmtsGrpPhsCfgEntry ::= SEQUENCE {
  docsMcastCmtsGrpPhsCfgId
    Unsigned32,
  docsMcastCmtsGrpPhsCfgPhsField
    OCTET STRING,
  docsMcastCmtsGrpPhsCfgPhsMask
    OCTET STRING,
  docsMcastCmtsGrpPhsCfgPhsSize
    Unsigned32,
  docsMcastCmtsGrpPhsCfgPhsVerify
    TruthValue,
  docsMcastCmtsGrpPhsCfgRowStatus
    RowStatus
}

docsMcastCmtsGrpPhsCfgId OBJECT-TYPE
 SYNTAX      Unsigned32 (0..65535)
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
   "This attribute identifies the unique identifier
    of a PHS rule that is referenced by the GrpConfig object."
 ::= { docsMcastCmtsGrpPhsCfgEntry 1 }

docsMcastCmtsGrpPhsCfgPhsField OBJECT-TYPE
 SYNTAX      OCTET STRING (SIZE (0..255))
 MAX-ACCESS  read-create
 STATUS      current
 DESCRIPTION
   "This attribute defines the bytes of the DOCSIS header
    which must be suppressed/restored by the sending/receiving
    device."
 ::= { docsMcastCmtsGrpPhsCfgEntry 2 }

docsMcastCmtsGrpPhsCfgPhsMask OBJECT-TYPE
 SYNTAX      OCTET STRING (SIZE (0..32))
 MAX-ACCESS  read-create
 STATUS      current
 DESCRIPTION
   "This attribute defines the bit mask which is used in
    combination with the PhsField to define which bytes
    in header must be suppressed/restored by the sending
    or receiving device.
    Each bit of this bit mask corresponds to a byte in the
    PhsField, with the least significant bit corresponding
    to the first byte of the PhsField.

```

Each bit of the bit mask specifies whether or not the corresponding byte should be suppressed in the packet. A bit value of '1' indicates that the byte should be suppressed by the sending device and restored by the receiving device. A bit value of '0' indicates that the byte should not be suppressed by the sending device or restored by the receiving device. If the bit mask does not contain a bit for each byte in the PhsField then the bit mask is extended with bit values of '1' to be the necessary length."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, Payload Header Suppression Encodings section and Payload Header Suppression Mask (PHSM) in the Common Radio Frequency Interface Encodings Annex."

**::= { docsMcastCmtsGrpPhsCfgEntry 3 }**

**docsMcastCmtsGrpPhsCfgPhsSize OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..255)

**UNITS** "Bytes"

**MAX-ACCESS** read-create

**STATUS** current

**DESCRIPTION**

"This attribute specifies the number of bytes in the header to be suppressed and restored. The value of this object matches the number of bytes the bits indicated in the PhsField attribute."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, Payload Header Suppression Encodings section and Payload Header Suppression Size (PHSS) section in the Common Radio Frequency Interface Encodings Annex."

**::= { docsMcastCmtsGrpPhsCfgEntry 4 }**

**docsMcastCmtsGrpPhsCfgPhsVerify OBJECT-TYPE**

**SYNTAX** TruthValue

**MAX-ACCESS** read-create

**STATUS** current

**DESCRIPTION**

"This attribute specifies the Payload Header Suppression verification value of 'true' the sender must verify PhsField is the same as what is contained in the packet to be suppressed."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, Payload Header Suppression Encodings section and Payload Header Suppression Size (PHSS) section in the Common Radio Frequency Interface Encodings Annex."

**DEFVAL { false }**

**::= { docsMcastCmtsGrpPhsCfgEntry 5 }**

**docsMcastCmtsGrpPhsCfgRowStatus OBJECT-TYPE**

**SYNTAX** RowStatus

**MAX-ACCESS** read-create

**STATUS** current

**DESCRIPTION**

"The status of this instance."

**::= { docsMcastCmtsGrpPhsCfgEntry 6 }**

```

docsMcastCmtsGrpQosCfgTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsMcastCmtsGrpQosCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object configures the QoS configured for Multicast
     sessions replicated to any Downstream Channel
     Set. It does not control which particular DCSs to which
     the CMTS replicates a multicast session.
     An instance in this object is called a GQC entry. A GQC
     entry controls how the CMTS instantiates a Group Classifier
     Rule (GCR) on the DCS to match packets of the multicast
     session. A Group Classifier Rule (GCR) uses
     source and destination IP address and ToS criteria.

    A GQC entry controls how and with what QoS parameters
    a Group Service Flow (GSF) is created on a DCS. All downstream
    multicast packets are scheduled on a GSF. The
    QoS Type attribute of the GQC entry controls whether
    the CMTS creates one GSF for each single IP multicast
    session or whether the CMTS creates one GSF for the aggregate
    of all sessions that match the GQC criteria.

    The GQC instance contains a reference to a Service Class
    from docsIetfQosServiceClassTable. The Service
    Class defines the list of QoS parameters for the GSF(s)
    instantiated for the GQC entry.

    A CMTS identifies one Service Class as the Default Group
    QoS Service Class. The CMTS instantiates a Default
    Group Service Flow on each single-channel DCS based
    on the parameters of the Default Group QoS Service
    Class.

    The set of GCRs and GSFs instantiated on a DCS control
    how QoS is provided to multicast packets replicated
    to the DCS. For each multicast packet, the CMTS classifies
    the packet to the highest priority matching GCR
    on that DCS. The GCR refers to a single GSF, which controls
    the scheduling of the packets on the DCS. If the
    multicast packet does not match any GCR on the DCS, the
    packet is scheduled on the Default Group Service Flow
    of the DCS. The CMTS replicates unclassified multicast
    traffic to only DCSs consisting of a single downstream
    channel. Thus, the Maximum Sustained Traffic
    Rate QoS parameter of the Default Group Service Class
    limits the aggregate rate of unclassified multicast
    traffic on each downstream channel.

    The CMTS is expected to instantiate GCRs and GSFs controlled
    by the entries in this table only for the duration
    of replication of the multicast sessions matching
    the entry.

    This object supports the creation of multiple instances.

    Creation of new instances of this object require the
    following objects to be set:
    ServiceClassName
    QosCtrl
    AggSessLimit"
    ::= { docsMcastMibObjects 4}

docsMcastCmtsGrpQosCfgEntry OBJECT-TYPE
  SYNTAX      DocsMcastCmtsGrpQosCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION

```

```

"The conceptual row of docsMcastCmtsGrpQosCfg.
The CMTS persists all instances of the CmtsGrpQosConfig
object across system reinitialization."
INDEX {
    docsMcastCmtsGrpQosCfgId
}
 ::= { docsMcastCmtsGrpQosCfgTable 1 }

DocsMcastCmtsGrpQosCfgEntry ::= SEQUENCE {
    docsMcastCmtsGrpQosCfgId
        Unsigned32,
    docsMcastCmtsGrpQosCfgServiceClassName
        SnmpAdminString,
    docsMcastCmtsGrpQosCfgQosCtrl
        INTEGER,
    docsMcastCmtsGrpQosCfgAggSessLimit
        Unsigned32,
    docsMcastCmtsGrpQosCfgAppId
        Unsigned32,
    docsMcastCmtsGrpQosCfgRowStatus
        RowStatus
}

docsMcastCmtsGrpQosCfgId OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute identifies a unique Group QoS Configuration
     object instance."
 ::= { docsMcastCmtsGrpQosCfgEntry 1 }

docsMcastCmtsGrpQosCfgServiceClassName OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE (1..15))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the Service Class Name
     reference for the set of QoS parameters for this GQC."
REFERENCE
    "DOCSIS 3.0 Operation and Support System Interface
     Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS
     Configuration Object Model section."

DEFVAL { ''H }
 ::= { docsMcastCmtsGrpQosCfgEntry 2 }

docsMcastCmtsGrpQosCfgQosCtrl OBJECT-TYPE
SYNTAX      INTEGER {
                singleSession(1),
                aggregateSession(2)
            }
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies how Group Classifier Rules
     (GCRs) and Group Service Flows (GSFs) are instantiated
     when multiple sessions match the (S,G) criteria
     of this entry. If 'singleSession', the CMTS creates
     a unique GCR and a unique GSF for the session. If this
     object's value is 'aggregateSession', all sessions
     matching this criterion are aggregated into the
     same GSF."

```

**REFERENCE**

"DOCSIS 3.0 Operation and Support System Interface Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS Configuration Object Model section."  
 ::= { docsMcastCmtsGrpQosCfgEntry 3 }

**docsMcastCmtsGrpQosCfgAggSessLimit OBJECT-TYPE**

**SYNTAX** Unsigned32 (1..65535)  
**MAX-ACCESS** read-create  
**STATUS** current

**DESCRIPTION**

"This attribute identifies the maximum number of sessions that may be aggregated in an aggregated Service Flow. This value is ignored in case of a GQC entry with QosCtrl set to 'singleSession'."

**REFERENCE**

"DOCSIS 3.0 Operation and Support System Interface Specification CM-SP-OSSIv3.0-I01-061207, Multicast QoS Configuration Object Model section."  
 ::= { docsMcastCmtsGrpQosCfgEntry 4 }

**docsMcastCmtsGrpQosCfgAppId OBJECT-TYPE**

**SYNTAX** Unsigned32  
**MAX-ACCESS** read-create  
**STATUS** current

**DESCRIPTION**

"This attribute allows the operator to configure a Cable Operator defined Application Identifier for multicast sessions, e.g., an Application Manager ID and Application Type.  
 This Application Identifier can be used to influence admission control or other policies in the CMTS that are outside of the scope of this specification.  
 This parameter is optional in defining QoS for multicast sessions.  
 If the value of this attribute is different from the value of the AppId in the referenced SCN for this GQC instance, the value of this attribute is used."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I04-070518, Application Identifier section in the Common TLV Encodings Annex; PacketCable Multimedia Specification PKT-SP-MM-I03-051221, Policy Server and CMTS Interface section."

**DEFVAL** { 0 }

::= { docsMcastCmtsGrpQosCfgEntry 5 }

**docsMcastCmtsGrpQosCfgRowStatus OBJECT-TYPE**

**SYNTAX** RowStatus  
**MAX-ACCESS** read-create  
**STATUS** current

**DESCRIPTION**

"The status of this instance."  
 ::= { docsMcastCmtsGrpQosCfgEntry 6 }

**docsMcastCmtsReplSessTable OBJECT-TYPE**

**SYNTAX** SEQUENCE OF DocsMcastCmtsReplSessEntry  
**MAX-ACCESS** not-accessible  
**STATUS** current

**DESCRIPTION**

"This object describes the replication of IP Multicast sessions onto the different Downstream Channel Sets of a CMTS. Each DCS may be either a single downstream

channel or a bonding group of multiple downstream channels. Each IP Multicast session is identified by a combination of IP source and IP Destination group address '(S,G). The CMTS replicates each IP packet in an (S,G) session onto one or more Downstream Channel Sets (DCSs), each of which is implemented in a MAC Domain. The CMTS assigns each replication a Downstream Service ID (DSID) that is unique per MAC Domain."

```

 ::= { docsMcastMibObjects 5}

docsMcastCmtsReplSessEntry OBJECT-TYPE
  SYNTAX      DocsMcastCmtsReplSessEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsMcastCmtsReplSess."
  INDEX {
    docsMcastCmtsReplSessPrefixAddrType,
    docsMcastCmtsReplSessGrpPrefix,
    docsMcastCmtsReplSessSrcPrefix,
    docsMcastCmtsReplSessMdIfIndex,
    docsMcastCmtsReplSessDcsId,
    docsMcastCmtsReplSessServiceFlowId
  }
 ::= { docsMcastCmtsReplSessTable 1 }

DocsMcastCmtsReplSessEntry ::= SEQUENCE {
  docsMcastCmtsReplSessPrefixAddrType
    InetAddressType,
  docsMcastCmtsReplSessGrpPrefix
    InetAddress,
  docsMcastCmtsReplSessSrcPrefix
    InetAddress,
  docsMcastCmtsReplSessMdIfIndex
    InterfaceIndex,
  docsMcastCmtsReplSessDcsId
    ChSetId,
  docsMcastCmtsReplSessServiceFlowId
    Unsigned32,
  docsMcastCmtsReplSessDsid
    Dsid,
  docsMcastCmtsReplSessSaid
    DocssSAId
}

docsMcastCmtsReplSessPrefixAddrType OBJECT-TYPE
  SYNTAX      InetAddressType
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute defines the address type for the GrpPrefix
     and SrcPrefix addresses."
 ::= { docsMcastCmtsReplSessEntry 1 }

docsMcastCmtsReplSessGrpPrefix OBJECT-TYPE
  SYNTAX      InetAddress
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute defines the group G of a particular
     (S,G) IP multicast session."
 ::= { docsMcastCmtsReplSessEntry 2 }

```

```

docsMcastCmtsReplSessSrcPrefix OBJECT-TYPE
  SYNTAX      InetAddress
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute identifies a specific Multicast Source
     Address. A Source Address that is all zeros is defined
     as 'all source addresses  (*, G)'."
  REFERENCE
    "RFC 3569.
     RFC 3306."
  ::= { docsMcastCmtsReplSessEntry 3 }

docsMcastCmtsReplSessMdIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute defines the MAC Domain Interface index
     of the channel to which the (S,G) session is replicated."
  ::= { docsMcastCmtsReplSessEntry 4 }

docsMcastCmtsReplSessDcsId OBJECT-TYPE
  SYNTAX      ChSetId
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute provides the reference for the Downstream
     Channel Set within a MAC Domain that the multicast
     session (S,G) is replicated to."
  ::= { docsMcastCmtsReplSessEntry 5 }

docsMcastCmtsReplSessServiceFlowId OBJECT-TYPE
  SYNTAX      Unsigned32 (1..4294967295)
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute indicates the service flow into which
     packets are classified for this replication of the
     multicast session (S,G)."
  ::= { docsMcastCmtsReplSessEntry 6 }

docsMcastCmtsReplSessDsid OBJECT-TYPE
  SYNTAX      Dsid
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute defines the Downstream Service ID
     (DSID) label with which the CMTS labels all packets of
     the (S,G) session on the DCS of a MAC Domain. The DSID
     value is unique per MAC domain."
  ::= { docsMcastCmtsReplSessEntry 7 }

docsMcastCmtsReplSessSaid OBJECT-TYPE
  SYNTAX      DocsSAId
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute defines the Security Association
     ID (SAID) of this multicast replication session. The
     value 0 indicates no SAID associated with this session."
  ::= { docsMcastCmtsReplSessEntry 8 }

```

```

docsMcastDefGrpSvcClass OBJECT IDENTIFIER ::= { docsMcastMibObjects 6 }

docsMcastDefGrpSvcClassDef OBJECT-TYPE
  SYNTAX      SnmpAdminString (SIZE (0..15))
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute references an instance of the SNMP
     table docsIetfQosServiceClassName object. This attribute
     is used to expand the QoS parameter Set of QoS
     for multicast sessions that uses a default QoS policy.
     The CMTS persists all instances of this attribute across
     reinitializations."
  REFERENCE
    "RFC 4323."
  DEFVAL { ''H }
  ::= { docsMcastDefGrpSvcClass 1 }

docsMcastDsidPhsTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsMcastDsidPhsEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object reports the set of DSID-Indexed PHS rules
     that are signaled between the CMTS and CMs as part
     of the Multicast Sessions setup. The attributes PhsMask,
     PhsSize and PhsVerify comes from the configuration
     object CmtsGrpPhsCfg. The value of the PhsField
     attribute is derived by the CMTS from the CmtsGrpCfg
     object parameters, and possibly other IP header information
     of the multicast session that the CMTS is capable
     of knowing prior to the multicast session setup.
     In cases where the PhsSize is longer than the CMTS
     knowledge of IP/TCP header fields, the CMTS extends
     the PhsMask with bits set to 0 until reaching the equivalent
     PhsSize value."
  ::= { docsMcastMibObjects 7}

docsMcastDsidPhsEntry OBJECT-TYPE
  SYNTAX      DocsMcastDsidPhsEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsMcastDsidPhs.
     The ifIndex key corresponds to the MAC Domain interface
     where the PHSI-Indexed DSID is configured."
  INDEX {
    ifIndex,
    docsMcastDsidPhsDsid
  }
  ::= { docsMcastDsidPhsTable 1 }

DocsMcastDsidPhsEntry ::= SEQUENCE {
  docsMcastDsidPhsDsid
  Dsid,
  docsMcastDsidPhsPhsField
    OCTET STRING,
  docsMcastDsidPhsPhsMask
    OCTET STRING,
  docsMcastDsidPhsPhsSize
    Unsigned32,
  docsMcastDsidPhsPhsVerify
    TruthValue
}

```

```

}

docsMcastDsidPhsDsid OBJECT-TYPE
  SYNTAX      Dsid
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute represents the 20-bit DSID associated
     with this PHS rule."
 ::= { docsMcastDsidPhsEntry 1 }

docsMcastDsidPhsPhsField OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE (0..255))
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute defines the bytes of the header which
     must be suppressed/restored by the sending/receiving
     device."
 ::= { docsMcastDsidPhsEntry 2 }

docsMcastDsidPhsPhsMask OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE (0..32))
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute defines the Payload Header Suppression
     mask in the header to be suppressed and restored."
 ::= { docsMcastDsidPhsEntry 3 }

docsMcastDsidPhsPhsSize OBJECT-TYPE
  SYNTAX      Unsigned32 (0..255)
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute defines the number of bytes in the
     header to be suppressed and restored."
 ::= { docsMcastDsidPhsEntry 4 }

docsMcastDsidPhsPhsVerify OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute, when set to 'true', indicates that
     the sender must verify that the PHS Field attribute
     value is the same as what is contained in the
     packet to be suppressed."
 ::= { docsMcastDsidPhsEntry 5 }

docsMcastStatsTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsMcastStatsEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The table contains statistics for the IP multicast session
     identified by the combination of IP source and IP destination
     group address (S,G)."
 ::= { docsMcastMibObjects 8 }

docsMcastStatsEntry OBJECT-TYPE
  SYNTAX      DocsMcastStatsEntry
  MAX-ACCESS  not-accessible

```

```

STATUS      current
DESCRIPTION
    "The conceptual row of docsMcastStatsTable.
    The ifIndex key corresponds to the Ethernet interface
    where the IP Multicast session is configured."
INDEX {
    ifIndex,
    docsMcastStatsGrpAddrType,
    docsMcastStatsGrpAddr,
    docsMcastStatsGrpPrefixLen,
    docsMcastStatsSrcAddrType,
    docsMcastStatsSrcAddr,
    docsMcastStatsSrcPrefixLen
}
 ::= { docsMcastStatsTable 1 }

DocsMcastStatsEntry ::= SEQUENCE {
    docsMcastStatsGrpAddrType
        InetAddressType,
    docsMcastStatsGrpAddr
        InetAddress,
    docsMcastStatsGrpPrefixLen
        InetAddressPrefixLength,
    docsMcastStatsSrcAddrType
        InetAddressType,
    docsMcastStatsSrcAddr
        InetAddress,
    docsMcastStatsSrcPrefixLen
        InetAddressPrefixLength,
    docsMcastStatsDroppedPkts
        Counter32,
    docsMcastStatsDroppedOctets
        Counter32
}

docsMcastStatsGrpAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute indicates the address family of the address
         contained in docsMcastStatsGrpAddr."
    ::= { docsMcastStatsEntry 1 }

docsMcastStatsGrpAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines 'G' as the group address for a
         particular (S,G) IP multicast session."
    ::= { docsMcastStatsEntry 2 }

docsMcastStatsGrpPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines the group address prefix length
         of a particular (S,G) IP multicast session."
    ::= { docsMcastStatsEntry 3 }

docsMcastStatsSrcAddrType OBJECT-TYPE

```

```

SYNTAX      InetAddressType
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute indicates the address family of the address
     contained in docsMcastStatsSrcAddr."
 ::= { docsMcastStatsEntry 4 }

docsMcastStatsSrcAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute defines 'S' as the source address for a
     particular (S,G) IP multicast session. For the case of
     Any Source Multicast (ASM), this attribute uses a value
     of 0.0.0.0 for IPv4 or 0::0 for IPv6."
 ::= { docsMcastStatsEntry 5 }

docsMcastStatsSrcPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute defines the source address prefix length
     of a particular (S,G) IP multicast session."
 ::= { docsMcastStatsEntry 6 }

docsMcastStatsDroppedPkts OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute returns a count of the packets dropped by the
     CMTS Forwarder process for a particular IP multicast session
     prior to replication to the outbound interface(s) (e.g., MAC
     domain interfaces). These packet drops can occur whenever there
     are no replications for this IP multicast session, or where an
     IP multicast packet for the specific S,G is not forwarded to
     the outbound interface(s)."
 ::= { docsMcastStatsEntry 7 }

docsMcastStatsDroppedOctets OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute returns a count of the octets for packets
     dropped by the CMTS Forwarder process for a particular IP
     multicast session prior to replication to the outbound
     interface(s).."
 ::= { docsMcastStatsEntry 8 }

docsMcastCpeListTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsMcastCpeListEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The table contains CPE information for the IP multicast session
     identified by the combination of IP source and IP destination
     group address (S,G), MAC Domain interface and CM MAC address."
 ::= { docsMcastMibObjects 9}

```

```

docsMcastCpeListEntry OBJECT-TYPE
  SYNTAX      DocsMcastCpeListEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsMcastCpeListTable.
     The ifIndex key corresponds to the MAC Domain interface
     where the IP Multicast session is configured."
  INDEX {
    ifIndex,
    docsMcastCpeListGrpAddrType,
    docsMcastCpeListGrpAddr,
    docsMcastCpeListGrpPrefixLen,
    docsMcastCpeListSrcAddrType,
    docsMcastCpeListSrcAddr,
    docsMcastCpeListSrcPrefixLen,
    docsMcastCpeListCmMacAddr
  }
 ::= { docsMcastCpeListTable 1 }

DocsMcastCpeListEntry ::= SEQUENCE {
  docsMcastCpeListGrpAddrType
    InetAddressType,
  docsMcastCpeListGrpAddr
    InetAddress,
  docsMcastCpeListGrpPrefixLen
    InetAddressPrefixLength,
  docsMcastCpeListSrcAddrType
    InetAddressType,
  docsMcastCpeListSrcAddr
    InetAddress,
  docsMcastCpeListSrcPrefixLen
    InetAddressPrefixLength,
  docsMcastCpeListCmMacAddr
    MacAddress,
  docsMcastCpeListDsid
    Dsid,
  docsMcastCpeListCpeMacAddr
    MacAddress,
  docsMcastCpeListCpeIpAddrType
    InetAddressType,
  docsMcastCpeListCpeIpAddr
    InetAddress
}

docsMcastCpeListGrpAddrType OBJECT-TYPE
  SYNTAX      InetAddressType
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute indicates the address family of the address
     contained in docsMcastCpeListGrpAddr."
  ::= { docsMcastCpeListEntry 1 }

docsMcastCpeListGrpAddr OBJECT-TYPE
  SYNTAX      InetAddress
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute defines 'G' as the group address for a
     particular (S,G) IP multicast session."
  ::= { docsMcastCpeListEntry 2 }

```

```

docsMcastCpeListGrpPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines the group address prefix length
         of a particular (S,G) IP multicast session."
    ::= { docsMcastCpeListEntry 3 }

docsMcastCpeListSrcAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute indicates the address family of the address
         contained in docsMcastCpeListSrcAddr."
    ::= { docsMcastCpeListEntry 4 }

docsMcastCpeListSrcAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines 'S' as the source address for a
         particular (S,G) IP multicast session. For the case of
         Any Source Multicast (ASM), this attribute uses a value
         of 0.0.0.0 for IPv4 or ::/0 for IPv6. "
    ::= { docsMcastCpeListEntry 5 }

docsMcastCpeListSrcPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines the source address prefix length
         of a particular (S,G) IP multicast session."
    ::= { docsMcastCpeListEntry 6 }

docsMcastCpeListCmMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines the CM MAC address of a particular
         (S,G) IP multicast session."
    ::= { docsMcastCpeListEntry 7 }

docsMcastCpeListDsid OBJECT-TYPE
    SYNTAX      Dsid
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute defines the Downstream Service ID (DSID) label
         with which the CMTS labels all packets of a particular (S,G)
         IP multicast session."
    ::= { docsMcastCpeListEntry 8 }

docsMcastCpeListCpeMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute returns the CPE MAC address for the (S,G)

```

```

    IP multicast session."
 ::= { docsMcastCpeListEntry 9 }

docsMcastCpeListCpeIpAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the address family of the address
         contained in docsMcastCpeListCpeIpAddr."
 ::= { docsMcastCpeListEntry 10 }

docsMcastCpeListCpeIpAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute returns the CPE IP address for the (S,G)
         IP multicast session."
 ::= { docsMcastCpeListEntry 11 }

-- Conformance Definitions
docsMcastMibConformance OBJECT IDENTIFIER ::= { docsMcastMib 2 }
docsMcastMibCompliances OBJECT IDENTIFIER
    ::= { docsMcastMibConformance 1 }
docsMcastMibGroups     OBJECT IDENTIFIER
    ::= { docsMcastMibConformance 2 }

docsMcastCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for devices that implement the DOCSIS
     Multicast MIB."

MODULE -- this MODULE
MANDATORY-GROUPS {
    docsMcastGroup
}
 ::= { docsMcastMibCompliances 1 }
docsMcastGroup OBJECT-GROUP
    OBJECTS {
        docsMcastCmtsReplSessDsid,
        docsMcastCmtsReplSessSaid,
        docsMcastDefGrpSvcClassDef,
        docsMcastDsidPhsPhsField,
        docsMcastDsidPhsPhsMask,
        docsMcastDsidPhsPhsSize,
        docsMcastDsidPhsPhsVerify,
        docsMcastCmtsGrpCfgRulePriority,
        docsMcastCmtsGrpCfgPrefixAddrType,
        docsMcastCmtsGrpCfgSrcPrefixAddr,
        docsMcastCmtsGrpCfgSrcPrefixLen,
        docsMcastCmtsGrpCfgGrpPrefixAddr,
        docsMcastCmtsGrpCfgGrpPrefixLen,
        docsMcastCmtsGrpCfgTosLow,
        docsMcastCmtsGrpCfgTosHigh,
        docsMcastCmtsGrpCfgTosMask,
        docsMcastCmtsGrpCfgQosConfigId,
        docsMcastCmtsGrpCfgEncryptConfigId,
        docsMcastCmtsGrpCfgPhsConfigId,
        docsMcastCmtsGrpCfgRowStatus,
        docsMcastCmtsGrpQosCfgServiceClassName,

```

```

docsMcastCmtsGrpQosCfgQosCtrl,
docsMcastCmtsGrpQosCfgAggSessLimit,
docsMcastCmtsGrpQosCfgAppId,
docsMcastCmtsGrpQosCfgRowStatus,
docsMcastCmtsGrpEncryptCfgCtrl,
docsMcastCmtsGrpEncryptCfgAlg,
docsMcastCmtsGrpEncryptCfgRowStatus,
docsMcastCmtsGrpPhsCfgPhsField,
docsMcastCmtsGrpPhsCfgPhsMask,
docsMcastCmtsGrpPhsCfgPhsSize,
docsMcastCmtsGrpPhsCfgPhsVerify,
docsMcastCmtsGrpPhsCfgRowStatus,
docsMcastStatsDroppedPkts,
docsMcastStatsDroppedOctets,
docsMcastCpeListDsid,
docsMcastCpeListCpeMacAddr,
docsMcastCpeListCpeIpAddrType,
docsMcastCpeListCpeIpAddr
}
STATUS      current
DESCRIPTION
    "Group of objects implemented in the CMTS."
::= { docsMcastMibGroups 1 }
END

```

## Q.5 DOCS-MCAST-AUTH-MIB<sup>390</sup>

```

DOCS-MCAST-AUTH-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32
        FROM SNMPv2-SMI          -- RFC 2578
    RowStatus
        FROM SNMPv2-TC          -- RFC 2579
    OBJECT-GROUP,
    MODULE-COMPLIANCE
        FROM SNMPv2-CONF         -- RFC 2580
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB -- RFC 3411
    InetAddressType,
    InetAddress,
    InetAddressPrefixLength
        FROM INET-ADDRESS-MIB   -- RFC 4001
    SnmpTagList
        FROM SNMP-TARGET-MIB   -- RFC 3411
    docsIf3CmtsCmRegStatusId
        FROM DOCS-IF3-MIB
    clabProjDocsis
        FROM CLAB-DEF-MIB;

docsMcastAuthMib MODULE-IDENTITY
LAST-UPDATED      "200712060000Z" -- December 6, 2007
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
"
Postal: Cable Television Laboratories, Inc.
858 Coal Creek Circle
Louisville, Colorado 80027-9750
U.S.A.

```

<sup>390</sup> Section modified per OSSIV3.0-N-07.0602-1 on 1/29/08 by KN.

```

Phone: +1 303-661-9100
Fax: +1 303-661-9199
E-mail: mibs@cablelabs.com"

DESCRIPTION
"This MIB module contains the management objects for the
management of the CMTS Multicast Authorization Module.
Copyright 1999-2007 Cable Television Laboratories, Inc.
All rights reserved."
REVISION "200712060000Z" -- December 6, 2007
DESCRIPTION
"Revised version includes ECN
OSSIv3.0-N-07.0551-4 and published as I05."
REVISION "200612071700Z" -- Dec 7, 2006
DESCRIPTION
"Initial version, published as part of the CableLabs
OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207."
 ::= { labProjDocsis 19}

-- Textual Conventions

-- Object Definitions
docsMcastAuthMibObjects OBJECT IDENTIFIER ::= { docsMcastAuthMib 1 }

docsMcastAuthCtrl OBJECT IDENTIFIER ::= { docsMcastAuthMibObjects 1 }

docsMcastAuthCtrlEnable OBJECT-TYPE
SYNTAX      INTEGER {
                enable(1),
                disable(2)
            }
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"This attribute enables the enforcement of Multicast
Authorization feature. When this attribute is set
to 'enable' Multicast Authorization is enforced;
otherwise clients are permitted to join any IP multicast
session. The factory default value of this attribute
is 'disable'."
REFERENCE
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I01-060804, IP Multicast
Join Authorization section."
DEFVAL { disable }
 ::= { docsMcastAuthCtrl 1 }

docsMcastAuthCtrlDefProfileNameList OBJECT-TYPE
SYNTAX      SnmpTagList
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"When IP Multicast Authorization is enforced, this
attribute provides the default set of Multicast Authorization
Profiles the CMTS enforces for a CM in the
case that this CM didn't signal a set of profiles during
the registration process. If the Default Multicast
Authorization Group Name is zero length string,
the DefAction attribute determines whether a join request
is authorized when a CM registers without a Multicast
Authorization Profile Set or a list of config
File Session Rules. If the CMTS supports more than 1
profile name as a default, the CMTS enforces each of the
profiles in order until the maximum number of profiles"

```

is reached. This attribute indicates one or more Multicast Authorization Profiles."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, IP Multicast Profile Name Subtype section."

**DEFVAL** { ''H }

::= { docsMcastAuthCtrl 2 }

**docsMcastAuthCtrlDefAction** OBJECT-TYPE

**SYNTAX** INTEGER {  
    permit(1),  
    deny(2)  
}

**MAX-ACCESS** read-write

**STATUS** current

**DESCRIPTION**

"This attribute defines the default authorization action when no IP Multicast Session Rule is determined to match a client's IP multicast join request."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, Session Rules section."

**DEFVAL** { deny }

::= { docsMcastAuthCtrl 3 }

**docsMcastAuthCtrlDefMaxNumSess** OBJECT-TYPE

**SYNTAX** Unsigned32 (0..65535)

**MAX-ACCESS** read-write

**STATUS** current

**DESCRIPTION**

"This attribute indicates the default maximum number of multicast sessions that clients reached through a CM are allowed to join. If set to zero, the maximum number of sessions is not limited by the CMTS. A DefMaxNumSess value of 0 indicates that no dynamic joins are permitted."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I01-060804, Maximum Multicast Sessions section."

**DEFVAL** { 0 }

::= { docsMcastAuthCtrl 4 }

**docsMcastAuthCmtsCmStatusTable** OBJECT-TYPE

**SYNTAX** SEQUENCE OF DocsMcastAuthCmtsCmStatusEntry

**MAX-ACCESS** not-accessible

**STATUS** current

**DESCRIPTION**

"This object maintains per-CM status of Multicast Authorization policies to be applied to this CM. The CM acquires these policy parameters through the CM registration process, or in the absence of some or all of those parameters, from the Ctrl Object.

This object is meaningful when the Control Enable attribute is set to 'enable'.

In the process of authorizing a CM client's session request the CMTS must check rules defined in StaticSessRule object and then rules defined in ProfileSessRule object. In the case of multiple multicast session matches, the rule priority attribute defines the final selected session rule. The selection of a session

```

rules when multiple matches have the same priority
is vendor specific.
The CMTS MAY report in the CmtsCmStatus object CMs that
do not signal any IP Multicast Authorization Encodings
in the registration process. "
 ::= { docsMcastAuthMibObjects 2}

docsMcastAuthCmtsCmStatusEntry OBJECT-TYPE
SYNTAX      DocsMcastAuthCmtsCmStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsMcastAuthCmtsCmStatus."
INDEX {
    docsIf3CmtsCmRegStatusId
}
 ::= { docsMcastAuthCmtsCmStatusTable 1 }

DocsMcastAuthCmtsCmStatusEntry ::= SEQUENCE {
    docsMcastAuthCmtsCmStatusCfgProfileNameList
        SnmpTagList,
    docsMcastAuthCmtsCmStatusCfgListId
        Unsigned32,
    docsMcastAuthCmtsCmStatusMaxNumSess
        Unsigned32,
    docsMcastAuthCmtsCmStatusCfgParamFlag
        BITS
}

docsMcastAuthCmtsCmStatusCfgProfileNameList OBJECT-TYPE
SYNTAX      SnmpTagList
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the set of Profile Names
associated with the CM.
    This attribute indicates the CM signaled 'IP Multicast
Authorization Profile Name' encodings during the
CM registration process, or in the absence of instances
of that config file parameter, the DefProfileNameList
attribute from the Ctrl object."
 ::= { docsMcastAuthCmtsCmStatusEntry 1 }

docsMcastAuthCmtsCmStatusCfgListId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute identifies the reference to a CMTS
created Session Rule List based on the CM signaled 'IP
Multicast Authorization Static Session Rule' encodings.
The CMTS may reuse this attribute value to reference
more than one CM that have signaled the same list
of Session Rules to the CMTS.
The value zero indicates that the CM did not signal Multicast
Session Rules to the CMTS or the CMTS does not
support the StaticSessRule, in which case, the CMTS
ignores any CM signalled Session Rule encodings during
registration."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I01-060804, IP Multicast Join
Authorization Static Session Rule Subtype section in the

```

```

Common Radio Frequency Interface Encodings Annex."
 ::= { docsMcastAuthCmtsCmStatusEntry 2 }

docsMcastAuthCmtsCmStatusMaxNumSess OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    UNITS      "sessions"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the CM signaled value in
        Maximum Multicast Sessions Encoding during the CM registration
        process. If this value is missing the DefMaxNumSess
        attribute of the Ctrl object is used to determine
        the maximum number of multicast sessions this
        client may forward. The value 0 indicates that no
        dynamic joins are permitted. The value 65535 (the largest
        valid value) indicates that the CMTS permits any
        number of sessions to be joined by clients reached
        through the CM."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I01-060804, Maximum Multicast
        Sessions Encoding section in the Common Radio Frequency
        Interface Encodings Annex."
 ::= { docsMcastAuthCmtsCmStatusEntry 3 }

docsMcastAuthCmtsCmStatusCfgParamFlag OBJECT-TYPE
    SYNTAX      BITS {
        profile(0),
        staticMulticast(1),
        maxNumSessions(2)
    }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the functions that are
        activated through the registration process.
        The bit 'profile' indicates whether the CM signaled
        'IP Multicast Authorization Profile Name Subtype'
        encodings.
        The bit 'staticMulticast' indicates whether the CM
        signaled 'IP Multicast Authorization Static Session
        Rule Subtype' encodings.
        The bit 'maxNumSess' indicates whether the CM signaled
        the 'Maximum Multicast Sessions' encoding."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I01-060804"
 ::= { docsMcastAuthCmtsCmStatusEntry 4 }

docsMcastAuthProfileSessRuleTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsMcastAuthProfileSessRuleEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object defines Operator configured profiles
        to be matched during the authorization process.
        This object supports the creation and deletion of multiple
        instances.
        Creation of a new instance of this object requires the
        following attributes to be set:
        PrefixAddrType
        SrcPrefixAddr

```

```

    SrcPrefixLen
    GrpPrefixAddr
    GrpPrefixLen."
 ::= { docsMcastAuthMibObjects 3}

docsMcastAuthProfileSessRuleEntry OBJECT-TYPE
SYNTAX      DocsMcastAuthProfileSessRuleEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsMcastAuthProfileSessRule.
    The CMTS persists all instances of the ProfileSessRule
    object across reinitializations."
INDEX {
    docsMcastAuthProfilesName,
    docsMcastAuthProfileSessRuleId
}
 ::= { docsMcastAuthProfileSessRuleTable 1 }

DocsMcastAuthProfileSessRuleEntry ::= SEQUENCE {
    docsMcastAuthProfileSessRuleId
        Unsigned32,
    docsMcastAuthProfileSessRulePriority
        Unsigned32,
    docsMcastAuthProfileSessRulePrefixAddrType
        InetAddressType,
    docsMcastAuthProfileSessRuleSrcPrefixAddr
        InetAddress,
    docsMcastAuthProfileSessRuleSrcPrefixLen
        InetAddressPrefixLength,
    docsMcastAuthProfileSessRuleGrpPrefixAddr
        InetAddress,
    docsMcastAuthProfileSessRuleGrpPrefixLen
        InetAddressPrefixLength,
    docsMcastAuthProfileSessRuleAction
        INTEGER,
    docsMcastAuthProfileSessRuleRowStatus
        RowStatus
}

docsMcastAuthProfileSessRuleId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute provides a unique identifier for each
    CMTS configured Multicast Authorization Profile
    Session rule within a Multicast Authorization Profile
    Name."
 ::= { docsMcastAuthProfileSessRuleEntry 1 }

docsMcastAuthProfileSessRulePriority OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute configures the rule priority for the
    static session rule. Permitted values for this attribute
    range from 0..255. Higher values indicate a
    higher priority. If more than one session rule matches
    a joined session, the session rule with the highest
    rule priority determines the authorization action."
REFERENCE

```

```

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I01-060804, Session Rules
section."
 ::= { docsMcastAuthProfileSessRuleEntry 2 }

docsMcastAuthProfileSessRulePrefixAddrType OBJECT-TYPE
SYNTAX      InetAddressType
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the address family for
    the multicast session (S,G) which corresponds to the
    SrcPrefixAddr and GrpPrefixAddr attributes respectively."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I01-060804, Session Rules
    section."
 ::= { docsMcastAuthProfileSessRuleEntry 3 }

docsMcastAuthProfileSessRuleSrcPrefixAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies a specific Multicast Source
    Address defined for this rule. A Source Address
    that is all zeros is defined as 'all source addresses'
    (*, G). Source prefix addresses are unicast addresses."
REFERENCE
    "RFC 3569.
    RFC 3306"
 ::= { docsMcastAuthProfileSessRuleEntry 4 }

docsMcastAuthProfileSessRuleSrcPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
    Source (S) IP multicast group addresses. For Group or
    ASM based sessions this attribute is set to 0."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I01-060804, Session Rules
    section."
 ::= { docsMcastAuthProfileSessRuleEntry 5 }

docsMcastAuthProfileSessRuleGrpPrefixAddr OBJECT-TYPE
SYNTAX      InetAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
    destination IP multicast group addresses."
 ::= { docsMcastAuthProfileSessRuleEntry 6 }

docsMcastAuthProfileSessRuleGrpPrefixLen OBJECT-TYPE
SYNTAX      InetAddressPrefixLength
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute identifies the prefix of a range of
    IP multicast group addresses."

```

```

 ::= { docsMcastAuthProfileSessRuleEntry 7 }

docsMcastAuthProfileSessRuleAction OBJECT-TYPE
    SYNTAX      INTEGER {
                    accept(1),
                    deny(2)
                }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the authorization action
         for a session join attempt that matches the session
         rule.
         The value 'accept' indicates that the rule permits a
         matching multicast join request is allowed. The value
         'deny' indicates that a matching multicast join request
         is denied."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I01-060804, Session Rules
         section."
    DEFVAL { deny }
 ::= { docsMcastAuthProfileSessRuleEntry 8 }

docsMcastAuthProfileSessRuleRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this instance."
 ::= { docsMcastAuthProfileSessRuleEntry 9 }

docsMcastAuthStaticSessRuleTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsMcastAuthStaticSessRuleEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object defines the Session authorization Rules
         based on the CM or group of CMs signaled in IP Multicast
         Join Authorization Static Session Subtype encoding
         This object reflects the Static Session rules
         that were included in the CM registration request message."
 ::= { docsMcastAuthMibObjects 4}

docsMcastAuthStaticSessRuleEntry OBJECT-TYPE
    SYNTAX      DocsMcastAuthStaticSessRuleEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsMcastAuthStaticSessRule.
         The CMTS may persist all instances of the StaticSessRule
         object across reinitializations."
    INDEX {
        docsMcastAuthStaticSessRuleCfgListId,
        docsMcastAuthStaticSessRuleId
    }
 ::= { docsMcastAuthStaticSessRuleTable 1 }

DocsMcastAuthStaticSessRuleEntry ::= SEQUENCE {
    docsMcastAuthStaticSessRuleCfgListId
        Unsigned32,
    docsMcastAuthStaticSessRuleId
        Unsigned32,
}

```

```

docsMcastAuthStaticSessRulePriority
    Unsigned32,
docsMcastAuthStaticSessRulePrefixAddrType
    InetAddressType,
docsMcastAuthStaticSessRuleSrcPrefixAddr
    InetAddress,
docsMcastAuthStaticSessRuleSrcPrefixLen
    InetAddressPrefixLength,
docsMcastAuthStaticSessRuleGrpPrefixAddr
    InetAddress,
docsMcastAuthStaticSessRuleGrpPrefixLen
    InetAddressPrefixLength,
docsMcastAuthStaticSessRuleAction
    INTEGER
}

docsMcastAuthStaticSessRuleCfgListId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute contains a CMTS-derived value for
    a set of multicast static session rules associated to
    one or more CMs."
::= { docsMcastAuthStaticSessRuleEntry 1 }

docsMcastAuthStaticSessRuleId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This attribute provides an identifier for each Multicast
    Authorization Static Session rule in the IP
    Multicast Join Authorization Static Session SubType
    communicated by a CM or group of CMs during registration."
::= { docsMcastAuthStaticSessRuleEntry 2 }

docsMcastAuthStaticSessRulePriority OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute defines the rule priority for the static
    session rule. Higher values indicate a higher
    priority. If more than one session rule matches a joined
    session, the session rule with the highest rule priority
    determines the authorization action."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I01-060804, RulePriority
    section in the Common Radio Frequency Interface Encodings
    Annex."
::= { docsMcastAuthStaticSessRuleEntry 3 }

docsMcastAuthStaticSessRulePrefixAddrType OBJECT-TYPE
SYNTAX      InetAddressType
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute identifies the address family for
    the multicast session (S,G) which corresponds to the
    SrcPrefixAddr and GrpPrefixAddr attributes respectively."
::= { docsMcastAuthStaticSessRuleEntry 4 }

```

```

docsMcastAuthStaticSessRuleSrcPrefixAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute identifies a specific Multicast Source
         Address defined for this rule. A Source Address
         that is all zeros is defined as 'all source addresses
         (*, G)'. Source Prefix Addresses are unicast host addresses."
    REFERENCE
        "RFC 3569.
         RFC 3306."
    ::= { docsMcastAuthStaticSessRuleEntry 5 }

docsMcastAuthStaticSessRuleSrcPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute identifies the prefix of a range of
         Source (S) IP multicast group addresses. For ASM-based
         sessions, this attribute is set to 0."
    ::= { docsMcastAuthStaticSessRuleEntry 6 }

docsMcastAuthStaticSessRuleGrpPrefixAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute identifies the prefix of a range of
         destination IP multicast group addresses."
    ::= { docsMcastAuthStaticSessRuleEntry 7 }

docsMcastAuthStaticSessRuleGrpPrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute identifies the prefix of a range of
         IP multicast group addresses."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I01-060804, Group Prefix
         Length Subtype section in the Common Radio Frequency
         Interface Encodings Annex."
    ::= { docsMcastAuthStaticSessRuleEntry 8 }

docsMcastAuthStaticSessRuleAction OBJECT-TYPE
    SYNTAX      INTEGER {
                    permit(1),
                    deny(2)
                }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute specifies the authorization action
         for a session join attempt that matches the session
         rule.
         The value 'accept' indicates that the rule permits a
         matching multicast join request is allowed. The value
         'deny' indicates that a matching multicast join request
         is denied."

```

```

REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I01-060804, Authorization
  Action section in the Common Radio Frequency Interface
  Encodings Annex."
 ::= { docsMcastAuthStaticSessRuleEntry 9 }

docsMcastAuthProfilesTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsMcastAuthProfilesEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object contains the description of the Multicast
     Authorization profiles for administrative purposes.

    This object supports the creation and deletion of multiple
    instances.
    Creation of a new instance of this object requires the
    Description attribute to be set."
 ::= { docsMcastAuthMibObjects 5}

docsMcastAuthProfilesEntry OBJECT-TYPE
  SYNTAX      DocsMcastAuthProfilesEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsMcastAuthProfiles.
     The CMTS persists all instances of the Profiles
     object across reinitializations"
  INDEX {
    docsMcastAuthProfilesName
  }
 ::= { docsMcastAuthProfilesTable 1 }

DocsMcastAuthProfilesEntry ::= SEQUENCE {
  docsMcastAuthProfilesName
    SnmpAdminString,
  docsMcastAuthProfilesDescription
    SnmpAdminString,
  docsMcastAuthProfilesRowStatus
    RowStatus
}

docsMcastAuthProfilesName OBJECT-TYPE
  SYNTAX      SnmpAdminString (SIZE (1..15))
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This attribute is a unique name or identifier for a
     Multicast Authorization Profile."
 ::= { docsMcastAuthProfilesEntry 1 }

docsMcastAuthProfilesDescription OBJECT-TYPE
  SYNTAX      SnmpAdminString
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute is a human readable description of
     the Multicast Authorization Profile."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I01-060804, IP Multicast
     Profile Name Subtype section."

```

```

 ::= { docsMcastAuthProfilesEntry 2 }

docsMcastAuthProfilesRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this instance."
    ::= { docsMcastAuthProfilesEntry 3 }

-- Conformance Definitions
docsMcastAuthMibConformance OBJECT IDENTIFIER ::= { docsMcastAuthMib 2 }
docsMcastAuthMibCompliances OBJECT IDENTIFIER
    ::= { docsMcastAuthMibConformance 1 }
docsMcastAuthMibGroups     OBJECT IDENTIFIER
    ::= { docsMcastAuthMibConformance 2 }

docsMcastAuthCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for devices that implement the DOCSIS
     Multicast Authorization MIB.

    MODULE -- this MODULE
MANDATORY-GROUPS {
    docsMcastAuthGroup
}
 ::= { docsMcastAuthMibCompliances 1 }
docsMcastAuthGroup OBJECT-GROUP
    OBJECTS {
        docsMcastAuthCtrlEnable,
        docsMcastAuthCtrlDefProfileNameList,
        docsMcastAuthCtrlDefAction,
        docsMcastAuthCtrlDefMaxNumSess,
        docsMcastAuthCmtsCmStatusCfgProfileNameList,
        docsMcastAuthCmtsCmStatusCfgListId,
        docsMcastAuthCmtsCmStatusMaxNumSess,
        docsMcastAuthCmtsCmStatusCfgParamFlag,
        docsMcastAuthProfileSessRulePriority,
        docsMcastAuthProfileSessRulePrefixAddrType,
        docsMcastAuthProfileSessRuleSrcPrefixAddr,
        docsMcastAuthProfileSessRuleSrcPrefixLen,
        docsMcastAuthProfileSessRuleGrpPrefixAddr,
        docsMcastAuthProfileSessRuleGrpPrefixLen,
        docsMcastAuthProfileSessRuleAction,
        docsMcastAuthProfileSessRowStatus,
        docsMcastAuthStaticSessRulePriority,
        docsMcastAuthStaticSessRulePrefixAddrType,
        docsMcastAuthStaticSessRuleSrcPrefixAddr,
        docsMcastAuthStaticSessRuleSrcPrefixLen,
        docsMcastAuthStaticSessRuleGrpPrefixAddr,
        docsMcastAuthStaticSessRuleGrpPrefixLen,
        docsMcastAuthStaticSessRuleAction,
        docsMcastAuthProfilesDescription,
        docsMcastAuthProfilesRowStatus
}
STATUS      current
DESCRIPTION
    "Group of objects implemented in the CMTS."
 ::= { docsMcastAuthMibGroups 1 }
END

```

## Q.6 DOCS-IF3-MIB<sup>391</sup>

```

DOCS-IF3-MIB DEFINITIONS ::= BEGIN
  IMPORTS
    NOTIFICATION-TYPE,
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Integer32,
    Unsigned32,
    Counter32
      FROM SNMPv2-SMI          -- RFC 2578
  sysName
      FROM SNMPv2-MIB          -- RFC 3418
  TEXTUAL-CONVENTION,
  RowStatus,
  TruthValue,
  MacAddress,
  DateAndTime,
  StorageType
      FROM SNMPv2-TC          -- RFC 2579
  OBJECT-GROUP,
  NOTIFICATION-GROUP,
  MODULE-COMPLIANCE
      FROM SNMPv2-CONF         -- RFC 2580
  SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB -- RFC 3411
  SnmpTagList
      FROM SNMP-TARGET-MIB     -- RFC 3413
  InetAddressIPv6,
  InetAddressIPv4
      FROM INET-ADDRESS-MIB    -- RFC 4001
  ifIndex,
  InterfaceIndex,
  InterfaceIndexOrZero
      FROM IF-MIB               -- RFC 2863
  TenthdB,
  TenthdBmV,
  DocsisUpstreamType,
  DocsEqualizerData,
  DocsisQosVersion
      FROM DOCS-IF-MIB         -- RFC 4546
  NodeName
      FROM CLAB-TOPO-MIB

  docsDevEvLevel,
  docsDevEvId,
  docsDevEvText,
  docsDevEvLastTime
      FROM DOCS-CABLE-DEVICE-MIB -- RFC 4639
  clabProjDocsis

```

<sup>391</sup> Changed by KN per OSSIV3.0-N-06.0357-1 on 2/7/07, per OSSIV3.0-N-07.0384-1 and OSSIV3.0-N-07.0392-1 by ab on 5/3/07, per OSSIV3.0-N-07.0410-4 on 5/8/07 and OSSIV3.0-N-07.0441-4 on 5/9/07, per OSSIV3.0-N-07.0446-4, per OSSIV3.0-N-07.0445-3, per OSSIV3.0-N-07.0447-2 on 5/10/07, per OSSIV3.0-N-07.0422-3 and per OSSIV3.0-N-07.0413-3 on 5/11/07 by KN, per OSSIV3.0-N-07.0480-3 on 7/16/07 and OSSIV3.0-N-07.0481-2 on 7/17/07 by ab. Again per OSSIV3.0-N-07.0531-1 on 10/19/07, per OSSIV3.0-N-07.0539-1 on 11/6/07, per OSSIV3.0-N-07.0550-2 on 11/9/07, and per OSSIV3.0-N-07.0551-4 on 11/12/07 by ab. Replaced entirely per OSSIV3.0-N-07.0554-4 by ab on 11/13/07. Modified per OSSIV3.0-N-07.0532-4 on 1/29/08, OSSIV3.0-N-07.0589-3, OSSIV3.0-N-07.0605-1 on 1/30/08, OSSIV3.0-N-08.0616-2 on 4/10/08, OSSIV3.0-N-08.0645-4 on 5/1/08 by KN; revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09. Revised further per OSSIV3.0-N-09-0773-1 on 5/8/09 by JB; per OSSIV3.0-N-09.0871-4 and per OSSIV3.0-N-09.0872-4 on 1/5/10 and per OSSIV3.0-N-10.0906-2 on 5/20/10 by JB. Revised per OSSIV3.0-N-10.0962-5 on 1/23/11, OSSIV3.0-N-10.0984-1 on 1/26/11, per OSSIV3.0-N-11.0996-1 on 6/2/11 by JB, and per OSSIV3.0-N-12.1064-3 on 7/27/12 by JS, by OSSIV3.0-N-12.1079-4 on 10/29/12 by PO, updated per OSSIV3.0-N-12.1083-5 on 3/21/13 by PO, updated per OSSIV3.0-N-13.1119-3 on 11/8/13 by PO.

```
FROM CLAB-DEF-MIB;

docsIf3Mib MODULE-IDENTITY
LAST-UPDATED      "201311200000Z" -- November 20, 2013
ORGANIZATION      "Cable Television Laboratories, Inc."
CONTACT-INFO
"
Postal: Cable Television Laboratories, Inc.
858 Coal Creek Circle
Louisville, Colorado 80027-9750
U.S.A.
Phone: +1 303-661-9100
Fax:   +1 303-661-9199
E-mail: mibs@cablelabs.com"
DESCRIPTION
"This MIB module contains the management objects for the
management of DOCSIS 3.0 features, primarily channel bonding,
interface topology and enhanced signal quality monitoring.
Copyright 1999-2013 Cable Television Laboratories, Inc.
All rights reserved."
REVISION      "201311190000Z" -- November 20, 2013
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-13.1119-3 and published as I22"
REVISION      "201304040000Z" -- April 4, 2013
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-12.1083 and OSSIv3.0-N-13.1093
and published as I21"
REVISION      "201211130000Z" -- November 13, 2012
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-12.1079-4 and published as I20"
REVISION      "201208090000Z" -- August 9, 2012
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-12.1064-3 and published as I19"
REVISION      "201102100000Z" -- February 10, 2011
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-10.0962-5 and OSSIv3.0-N-10.0984-1
and published as I14"
REVISION      "201006110000Z" -- June 11, 2010
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-10.0906-2
and published as I12"
REVISION      "201001150000Z" -- January 15, 2010
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-09.0871-4
OSSIv3.0-N-09.0872-4
OSSIv3.0-N-09.0881-3
and published as I11"
REVISION      "200905290000Z" -- May 29, 2009
DESCRIPTION
"Revised Version includes ECN
OSSIv3.0-N-09.0775-3
and published as I09"
REVISION      "200901210000Z" -- January 21, 2009
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-08.0651-3
```

```

OSSIv3.0-N-08.0700-4
and published as I08"
REVISION      "200805220000Z" -- May 22, 2008
DESCRIPTION
    "Revised Version includes ECN OSSIv3.0-N-08.0645-4
     and published as I07"
REVISION "200802150000Z"
DESCRIPTION
    "Revised Version includes ECN OSSIv3.0-N-07.0605-1
     and published as I06"
REVISION "200712060000Z" -- December 6, 2007
DESCRIPTION
    "Revised Version includes ECNs
     OSSIV3.0-N-07.0522-6
     OSSIV3.0-N-07.0554-4
     and published as I05"
REVISION "200708030000Z" -- August 3, 2007
DESCRIPTION
    "Revised Version includes ECNs
     OSSIV3.0-N-07.0481-2
     OSSIV3.0-N-07.0480-3
     and published as I04"
REVISION "200705180000Z" -- May 18, 2007
DESCRIPTION
    "Revised Version includes ECNs
     OSSIV3.0-N-07.0447-2
     OSSIV3.0-N-07.0446-4
     OSSIV3.0-N-07.0445-3
     OSSIV3.0-N-07.0441-4
     OSSIV3.0-N-07.0422-5
     OSSIV3.0-N-07.0413-3
     OSSIV3.0-N-07.0410-4
     OSSIV3.0-N-07.0392-1
     OSSIV3.0-N-07.0384-1
     OSSIV3.0-N-06.0357-1
     and published as I03"
REVISION "200702230000Z" -- February 23, 2007
DESCRIPTION
    "Revised Version includes ECN OSSIv3.0-N-06.0357-1
     and published as I02"
REVISION "200612071700Z" -- December 7, 2006
DESCRIPTION
    "Initial version, published as part of the CableLabs
     OSSIV3.0 specification CM-SP-OSSIv3.0-I01-061207"
::= { labProjDocsis 20 }

```

#### -- Textual Conventions

```

CmRegState ::= TEXTUAL-CONVENTION
  STATUS      current
  DESCRIPTION
    "This data type defines the CM connectivity state as reported
     by the CM.
    The enumerated values associated with the CmRegState are:
    'other'
    indicates any state not described below.
    'notReady'
    indicates that the CM has not started the registration process
     yet.
    'notSynchronized'
    indicates that the CM has not initiated or completed the
     synchronization of the downstream physical layer
    'phySynchronized'

```

indicates that the CM has completed the synchronization of the downstream physical layer

'dsTopologyResolutionInProgress'

indicates that the CM is attempting to determine its MD-DS-SG

'usParametersAcquired'

indicates that the CM has completed the upstream parameters acquisition or have completed the downstream and upstream service groups resolution, whether the CM is registering in a pre-3.0 or a 3.0 CMTS.

'rangingInProgress'

indicates that the CM has initiated the ranging process.

'rangingComplete'

indicates that the CM has completed initial ranging and received a Ranging Status of success from the CMTS in the RNG-RSP message.

'eaeInProgress'

indicates that the CM has sent an Auth Info message for EAE.

'dhcpv4InProgress'

indicates that the CM has sent a DHCPv4 DISCOVER to gain IP connectivity.

'dhcpv6InProgress'

indicates that the CM has sent an DHCPv6 Solicit message.

'dhcpv4Complete'

indicates that the CM has received a DHCPv4 ACK message from the CMTS.

'dhcpv6Complete'

indicates that the CM has received a DHCPv6 Reply message from the CMTS.

'todEstablished'

indicates that the CM has successfully acquired time of day. If the ToD is acquired after the CM is operational, this value should not be reported.

'securityEstablished'

indicates that the CM has successfully completed the BPI initialization process.

'configFileDownloadComplete'

indicates that the CM has completed the config file download process.

'registrationInProgress'

indicates that the CM has sent a Registration Request (REG-REQ or REG-REQ-MP)

'registrationComplete'

indicates that the CM has successfully completed the Registration process with the CMTS.

'accessDenied'

indicates that the CM has received a registration aborted notification from the CMTS

'operational'

indicates that the CM has completed all necessary initialization steps and is operational.

'bpiInit'

indicates that the CM has started the BPI initialization process as indicated in the CM config file. If the CM already performed EAE, this state is skipped by the CM.

'forwardingDisabled'

indicates that the registration process was completed, but the network access option in the received configuration file prohibits forwarding.

'rfMuteAll'

indicates that the CM is instructed to mute all channels in the CM-CTRL-REQ message from CMTS."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface

```

Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem -
CMTS Interaction section."
SYNTAX      INTEGER {other(1),
                  notReady(2),
                  notSynchronized(3),
                  phySynchronized(4),
                  dsTopologyResolutionInProgress(21),
                  usParametersAcquired(5),
                  rangingInProgress(22),
                  rangingComplete(6),
                  eaeInProgress(14),
                  dhcpv4InProgress(15),
                  dhcpv6InProgress(16),
                  dhcpv4Complete(7),
                  dhcpv6Complete(17),
                  todEstablished(8),
                  securityEstablished(9),
                  configFileDownloadComplete(10),
                  registrationInProgress(18),
                  registrationComplete(11),
                  accessDenied(13),
                  operational(12),
                  bpiInit (19),
                  forwardingDisabled(20),
                  rfMuteAll(23)
}
CmtsCmRegState ::= TEXTUAL-CONVENTION
STATUS      current
DESCRIPTION
"This data type defines the CM connectivity states as reported
by the CMTS.
The enumerated values associated with the CmtsCmRegState are:
'other'
indicates any state not described below.
'initialRanging'
indicates that the CMTS has received an Initial Ranging
Request message from the CM, and the ranging process is not yet
complete.
'rangingAutoAdjComplete'
indicates that the CM has completed initial ranging and the
CMTS sends a Ranging Status of success in the RNG-RSP.
'startEae'
indicates that the CMTS has received an Auth Info message for
EAE from the CM.
'startDhcpv4'
indicates that the CMTS has received a DHCPv4 DISCOVER message
from the CM.
'startDhcpv6'
indicates that the CMTS has received a DHCPv6 Solicit message
from the CM.
'dhcpv4Complete'
indicates that the CMTS has sent a DHCPv4 ACK message to the
CM.
'dhcpv6Complete'
indicates that the CMTS has sent a DHCPv6 Reply message to the
CM.
'startConfigFileDownload'
indicates that the CM has started the config file download.
If the TFTP Proxy feature is not enabled, the CMTS may not
report this state.
'configFileDownloadComplete'
```

indicates that the CM has completed the config file download process. If the TFTP Proxy feature is not enabled, the CMTS is not required to report this state.

'startRegistration'  
 indicates that the CMTS has received a Registration Request (REG-REQ or REG-REQ-MP) from the CM.

'registrationComplete'  
 indicates that the CMTS has received a Registration Acknowledge (REG-ACK) with a confirmation code of okay/success.

'operational'  
 indicates that the CM has completed all necessary initialization steps and is operational.

'bpiInit'  
 indicates that the CMTS has received an Auth Info or Auth Request message as part of BPI Initialization.

'forwardingDisabled'  
 indicates that the registration process was completed, but the network access option in the received configuration file prohibits forwarding.

'rfMuteAll'  
 indicates that the CM is instructed to mute all channels in the CM-CTRL-REQ message from CMTS."

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem - CMTS Interaction section."

**SYNTAX**      INTEGER {other (1),  
                   initialRanging(2),  
                   rangingAutoAdjComplete(4),  
                   startEae(10),  
                   startDhcpv4 (11),  
                   startDhcpv6(12),  
                   dhcpv4Complete(5),  
                   dhcpv6Complete(13),  
                   startConfigFileDownload(14),  
                   configFileDownloadComplete(15),  
                   startRegistration(16),  
                   registrationComplete(6),  
                   operational (8),  
                   bpiInit(9),  
                   forwardingDisabled(17),  
                   rfMuteAll(18)  
 }

**ScdmaSelectionString ::= TEXTUAL-CONVENTION**

**STATUS**        current

**DESCRIPTION**  
 "This data type represents the S-CDMA selection string for active codes used with Selectable Active Codes Mode 2. A 128-bit string indicating which codes are active. The first element in the string corresponds to code 0 (the all-ones code), and the last element in the string corresponds to code 127. A '1' element in the string indicates an active code, and a '0' indicates an unused code. A zero-length string is returned for an unknown or non-applicable value."

**REFERENCE**  
 "DOCSIS 3.0 Physical Layer Specification CM-SP-PHYv3.0-I05-070803, Mini-slot Numbering Parameters in UCD section."

**SYNTAX**        OCTET STRING (SIZE(0 | 16))

**AmplitudeData ::= TEXTUAL-CONVENTION**

**STATUS** current

**DESCRIPTION**

"This data type represents a sequence of spectral amplitudes. Each spectral amplitude value corresponds to a bin. The format of the bin measurement is as follows.

Sequence of:

- 4 bytes: ChCenterFreq  
The center frequency of the upstream channel.
- 4 bytes: FreqSpan  
The width in Hz of the band across which the spectral amplitudes characterizing the channel are measured.
- 4 bytes: NumberOfBins  
The number of data points or bins that compose the spectral data. The leftmost bin corresponds to the lower band edge, the rightmost bin corresponds to the upper band edge, and the middle bin center is aligned with the center frequency of the analysis span.
- 4 bytes: BinSpacing  
The frequency separation between adjacent bin centers. It is derived from the frequency span and the number of bins or data points.  
The bin spacing is computed as:

$$\text{BinSpacing} = \text{FrequencySpan}/(\text{NumberOfBins} - 1)$$

The larger the number of bins the finer the resolution.

- 4 bytes: ResolutionBW  
The resolution bandwidth or equivalent noise bandwidth of each bin. If spectral windowing is used (based on vendor implementation), the bin spacing and resolution bandwidth would not generally be the same.
- n bytes: Amplitude (2 bytes \* NumberOfBins)  
A sequence of two byte elements. Each element represents the spectral amplitudes in relation to the expected received signal power of a bin, in units of 0.01dB. That is, a test CMTS input signal with square-root raised-cosine spectrum, bandwidth equal to the expected received signal bandwidth, and power equal to the expected received signal power, which is present for the entire spectrum sampling period, will exhibit a spectrum measurement of 0 dB average power in each bin of the signal passband.  
Each bin element amplitude value format is 2's complement which provides a range of -327.68 dB to 327.67 dB amplitude value for the bin measurement."

**SYNTAX** OCTET STRING (SIZE(0 | 2..4116))

SpectrumAnalysisWindowFunction ::= TEXTUAL-CONVENTION

**STATUS** current

**DESCRIPTION**

"This object controls the windowing function which will be used when performing the discrete fourier transform for the analysis. Note that all window functions may not be supported by all devices. If an attempt is made to set the object to an unsupported window function, an error of inconsistentValue will be returned."

**REFERENCE**

"Harris, Fredric J. (Jan 1978). 'On the use of Windows for Harmonic Analysis with the Discrete Fourier Transform'. Proceedings of the IEEE, Vol 66, Issue 1, Jan 1978  
doi:10.1109/PROC.1978.10837"

**SYNTAX** INTEGER {

```

        other(0),
        hann(1),
        blackmanHarris(2),
        rectangular(3),
        hamming(4),
        flatTop(5),
        gaussian(6),
        chebyshev(7)
    }

Tlv8 ::= TEXTUAL-CONVENTION
STATUS      current
DESCRIPTION
    "This data type represents a single TLV encoding.
    This first octet represents the Type of the TLV.
    The second octet represents an unsigned 8-bit Length of the
    subsequent Value part of the TLV. The remaining octets
    represent the value. The Value could be an atomic value or a
    sequence of one or more sub-TLVs."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Common Radio
    Frequency Interface Encodings Annex."
SYNTAX      OCTET STRING (SIZE(0 | 2..255))

ChId ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS      current
DESCRIPTION
    "This data type is an 8-bit number that represents a provisioned
    Downstream Channel ID (DCID) or a provisioned Upstream Channel
    ID (UCID). A Channel Id is unique per direction within a MAC
    Domain. The value zero is reserved for use when the channel ID
    is unknown."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Upstream Channel
    Descriptor (UCD) section."
SYNTAX      Unsigned32 (0..255)

ChSetId ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS      current
DESCRIPTION
    "This data type is a CMTS-derived unique number within a MAC
    Domain used to reference a Channel Set within the CMTS.
    Values in the range of 1 to 255 define a single-channel Channel
    Set and correspond to either the Downstream Channel ID (DCID)
    or an Upstream Channel ID (UCID) of that channel.
    Values greater than 255 indicate a Channel Set consisting of two
    or more channels in the same direction within the MAC Domain.
    The value zero is reserved for use when the Channel Set is
    unknown."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Channel
    Bonding section."
SYNTAX      Unsigned32

ChannelList ::= TEXTUAL-CONVENTION
DISPLAY-HINT "1d,"
STATUS      current
DESCRIPTION

```

"This data type represents a unique set of channel IDs in either the upstream or the downstream direction. Each octet represents a UCID or DCID depending on the direction of the channels within the list. The CMTS must ensure that this combination of channels is unique per direction within the MAC Domain.

In order to facilitate Channel ID combinatorial uniqueness across all channel lists, a query to retrieve the value of an attribute of this type, returns the set of channels in the channel list in ascending order of Channel Ids."

SYNTAX OCTET STRING (SIZE (0..255))

AttributeMask ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This data type consists of a sequence of 32-bit positions used to select the bonding group or the channel to which a service flow is assigned. DOCSIS defines three types of Attribute Masks for which this type applies: The Provisioned Attribute Mask that is configured to a Bonding Group or a single-channel, whereas the Required Attribute and the Forbidden Attribute Mask are part of the Service Flow QOS Parameter Set to be matched with the Provisioned Attribute Mask of CMTS-configured Bonding Groups or single-channels. DOCSIS reserves the assignment of the meaning of the first 8 bit positions (left to right) as follows:

- Bit 0: 'bonding'
- Bit 1: 'lowLatency'
- Bit 2: 'highAvailability'
- Bit positions 3-15 are reserved.

Bit positions 16-31 are freely assigned by operators to represent their own constraints on the channel(s) selection for a particular service flow."

REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Assignment section."

SYNTAX BITS {  
                   bonding(0),  
                   lowLatency(1),  
                   highAvailability(2)  
         }

AttrAggrRuleMask ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This data type represents a sequence of 32-bit positions that defines logical (e.g., AND, OR) operations to match against the channel list Provisioned Mask and Service Flow Required Mask bit positions when the CMTS is determining the service flow for assignment to a bonding group not configured by the management system."

REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Assignment section."

SYNTAX OCTET STRING (SIZE (4))

RcpId ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This data type defines a 'Receive Channel Profile Identifier' (RCP-ID). An RCP-ID consists of 5-octet length string where the first 3-bytes (from left to right corresponds to the Organizational Unique ID (OUI) followed by a two-byte vendor-maintained identifier to represent multiple versions or models of RCP-IDs."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, RCP-ID section in the Common Radio Frequency Interface Encodings Annex."

**SYNTAX OCTET STRING (SIZE (5))**

Dsid ::= TEXTUAL-CONVENTION

DISPLAY-HINT "d"

STATUS current

**DESCRIPTION**

"This data type defines the 20-bit Downstream Service Identifier (DSID) used by the CM for downstream resequencing, filtering, and forwarding. The value zero is reserved for use when the DSID is unknown or does not apply."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, DSID Definition section."

**SYNTAX Unsigned32 (0..1048575)**

RangingState ::= TEXTUAL-CONVENTION

STATUS current

**DESCRIPTION**

"This data type defines the CM ranging state as reported by the CMTS.

The enumerated values associated with the RangingState are:

'other'

indicates any state not described below.

'aborted'

indicates that the CMTS has sent a ranging abort.

'retriesExceeded'

indicates that the CM ranging retry limit has exceeded.

'success'

indicates that the CMTS has sent a ranging success in the ranging response.

'continue'

indicates that the CMTS has sent a ranging continue in the ranging response.

'timeoutT4'

indicates that the T4 timer expired on the CM."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem - CMTS Interaction section."

**SYNTAX INTEGER {other(1),  
aborted(2),  
retriesExceeded(3),  
success(4),  
continue(5),  
timeoutT4(6)}**

}

IfDirection ::= TEXTUAL-CONVENTION

STATUS current

**DESCRIPTION**

"Indicates a direction on an RF MAC interface.

The value downstream(1) is from Cable Modem Termination System to Cable Modem.

The value upstream(2) is from Cable Modem to Cable Modem Termination System."

SYNTAX      INTEGER {  
                downstream(1),  
                upstream(2)  
}

-- Object Definitions  
docsIf3Notifications OBJECT IDENTIFIER ::= { docsIf3Mib 0 }  
docsIf3MibObjects OBJECT IDENTIFIER ::= { docsIf3Mib 1 }

-- Notifications

-- CMTS Notifications  
docsIf3CmtsEventNotif NOTIFICATION-TYPE  
OBJECTS {  
    docsDevEvLevel,  
    docsDevEvId,  
    docsDevEvText,  
    docsDevEvLastTime,  
    sysName  
}  
STATUS current  
DESCRIPTION  
    "A notification to report a DOCSIS event detected on the CMTS.  
  
This notification includes the following information:  
- docsDevEvLevel: the DOCSIS priority level associated with the event.  
- docsDevEvId: the numeric identifier of the event.  
- docsDevEvText: The text description of the event.  
- docsDevEvLastTime: The local date and time when this event was generated.  
- sysName: the administratively-assigned name of the CMTS.  
e.g., The fully-qualified domain name as indicated in RFC 3418 or in the absence of the CMTS administrative interface in dot '.' notation for IPv4 and colon ':' notation for IPv6 Address as indicated in RFC 3164"  
REFERENCE  
    "DOCSIS 3.0 Operations Support System Interface Specification CM-SP-OSSIv3.0-I07-080522, Format and Content for Event, Syslog, and SNMP Notification Annex.  
    RFC 3418, RFC 3164"  
::= { docsIf3Notifications 1 }

-- CM Notifications

docsIf3CmEventNotif NOTIFICATION-TYPE  
OBJECTS {  
    docsDevEvLevel,  
    docsDevEvId,  
    docsDevEvText,  
    docsDevEvLastTime  
}  
STATUS current  
DESCRIPTION  
    "A notification to report a DOCSIS event detected on the

CM.

This notification includes the following information:

- docsDevEvLevel: the priority level associated with the event.
- docsDevEvId: the unique identifier of the event that occurred.
- docsDevEvText: a textual description of the event.
- docsDevEvLastTime: The local date and time when this event was generated."

#### REFERENCE

"DOCSIS 3.0 Operations Support System Interface Specification CM-SP-OSSIv3.0-I07-080522, Format and Content for Event, Syslog, and SNMP Notification Annex."  
 $::= \{ \text{docsIf3Notifications} \ 2 \}$

**docsIf3CmStatusTable OBJECT-TYPE**

SYNTAX        SEQUENCE OF DocsIf3CmStatusEntry

MAX-ACCESS    not-accessible

STATUS        current

#### DESCRIPTION

"This object defines attributes of the CM connectivity status. This object provides CM connectivity status information of the CM previously available in the SNMP table docsIfCmStatusTable."

#### REFERENCE

"RFC 4546"

$::= \{ \text{docsIf3MibObjects} \ 1 \}$

**docsIf3CmStatusEntry OBJECT-TYPE**

SYNTAX        DocsIf3CmStatusEntry

MAX-ACCESS    not-accessible

STATUS        current

#### DESCRIPTION

"The conceptual row of docsIf3CmStatusTable.  
An instance exist for the CM MAC Domain Interface."

#### INDEX {

    ifIndex

}

$::= \{ \text{docsIf3CmStatusTable} \ 1 \}$

**DocsIf3CmStatusEntry ::= SEQUENCE {**

**docsIf3CmStatusValue**

        CmRegState,

**docsIf3CmStatusCode**

        OCTET STRING,

**docsIf3CmStatusResets**

        Counter32,

**docsIf3CmStatusLostSyncs**

        Counter32,

**docsIf3CmStatusInvalidMaps**

        Counter32,

**docsIf3CmStatusInvalidUcds**

        Counter32,

**docsIf3CmStatusInvalidRangingRsp**

        Counter32,

**docsIf3CmStatusInvalidRegRsp**

        Counter32,

**docsIf3CmStatusT1Timeouts**

        Counter32,

**docsIf3CmStatusT2Timeouts**

        Counter32,

**docsIf3CmStatusUCCsSuccesses**

```
        Counter32,
docsIf3CmStatusUCCFails
        Counter32,
docsIf3CmStatusEnergyMgt1x1OperStatus
        TruthValue
}

docsIf3CmStatusValue OBJECT-TYPE
SYNTAX      CmRegState
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute denotes the current CM connectivity
     state. For the case of IP acquisition related states,
     this attribute reflects states for the current CM
     provisioning mode, not the other DHCP process associated
     with dual stack operation."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Establishing
     IP Connectivity section."
::= { docsIf3CmStatusEntry 1 }

docsIf3CmStatusCode OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE( 0 | 5 | 6 | 7 ))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute denotes the status code for CM as defined
     in the OSSi Specification. The status code consists
     of a single character indicating error groups,
     followed by a two- or three-digit number indicating
     the status condition, followed by a decimal. An example
     of a returned value could be 'T101.0'. The zero-length
     hex string indicates no status code yet registered."
REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
     Specification CM-SP-OSSIv3.0-I09-090529, Format and Content
     for Event, Syslog, and SNMP Notification Annex."
::= { docsIf3CmStatusEntry 2 }

docsIf3CmStatusResets OBJECT-TYPE
SYNTAX      Counter32
UNITS       "resets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute denotes the number of times the CM reset
     or initialized this interface. Discontinuities
     in the value of this counter can occur at re-initialization
     of the managed system, and at other times as
     indicated by the value of ifCounterDiscontinuityTime
     for the CM MAC Domain interface."
REFERENCE
    "RFC 2863."
::= { docsIf3CmStatusEntry 3 }

docsIf3CmStatusLostSyncs OBJECT-TYPE
SYNTAX      Counter32
UNITS       "messages"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
```

"This attribute denotes the number of times the CM lost synchronization with the downstream channel. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."

**REFERENCE**  
 "RFC 2863."  
`::= { docsIf3CmStatusEntry 4 }`

**docsIf3CmStatusInvalidMaps OBJECT-TYPE**  
**SYNTAX** Counter32  
**UNITS** "maps"  
**MAX-ACCESS** read-only  
**STATUS** current  
**DESCRIPTION**  
 "This attribute denotes the number of times the CM received invalid MAP messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  

**REFERENCE**  
 "RFC 2863."  
`::= { docsIf3CmStatusEntry 5 }`

**docsIf3CmStatusInvalidUcds OBJECT-TYPE**  
**SYNTAX** Counter32  
**UNITS** "messages"  
**MAX-ACCESS** read-only  
**STATUS** current  
**DESCRIPTION**  
 "This attribute denotes the number of times the CM received invalid UCD messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  

**REFERENCE**  
 "RFC 2863."  
`::= { docsIf3CmStatusEntry 6 }`

**docsIf3CmStatusInvalidRangingRsp OBJECT-TYPE**  
**SYNTAX** Counter32  
**UNITS** "messages"  
**MAX-ACCESS** read-only  
**STATUS** current  
**DESCRIPTION**  
 "This attribute denotes the number of times the CM received invalid ranging response messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  

**REFERENCE**  
 "RFC 2863."  
`::= { docsIf3CmStatusEntry 7 }`

**docsIf3CmStatusInvalidRegRsp OBJECT-TYPE**  
**SYNTAX** Counter32  
**UNITS** "messages"  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**  
"This attribute denotes the number of times the CM received invalid registration response messages. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."

**REFERENCE**  
"RFC 2863."  
::= { docsIf3CmStatusEntry 8 }

**docsIf3CmStatusT1Timeouts** OBJECT-TYPE  
SYNTAX Counter32  
UNITS "timeouts"  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"This attribute denotes the number of times counter T1 expired in the CM. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  
**REFERENCE**  
"RFC 2863."  
::= { docsIf3CmStatusEntry 9 }

**docsIf3CmStatusT2Timeouts** OBJECT-TYPE  
SYNTAX Counter32  
UNITS "timeouts"  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"This attribute denotes the number of times counter T2 expired in the CM. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  
**REFERENCE**  
"RFC 2863."  
::= { docsIf3CmStatusEntry 10 }

**docsIf3CmStatusUCCsSuccesses** OBJECT-TYPE  
SYNTAX Counter32  
UNITS "attempts"  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"This attribute denotes the number of successful Upstream Channel Change transactions. Discontinuities in the value of this counter can occur at re-initialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime for the CM MAC Domain interface."  
**REFERENCE**  
"RFC 2863."  
::= { docsIf3CmStatusEntry 11 }

**docsIf3CmStatusUCCFails** OBJECT-TYPE  
SYNTAX Counter32  
UNITS "attempts"  
MAX-ACCESS read-only

```

STATUS      current
DESCRIPTION
    "This attribute denotes the number of failed Upstream
    Channel Change transactions. Discontinuities
    in the value of this counter can occur at re-initialization
    of the managed system, and at other times as indicated
    by the value of ifCounterDiscontinuityTime
    for the CM MAC Domain interface."
REFERENCE
    "RFC 2863."
::= { docsIf3CmStatusEntry 12 }

docsIf3CmStatusEnergyMgt1x1OperStatus OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates whether the CM is currently operating
    in Energy Management 1x1 Mode. If this attribute returns 'true',
    the CM is operating in Energy Management 1x1 Mode."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I20-121155,
    Energy Management Mode Indicator section."
::= { docsIf3CmStatusEntry 13 }

docsIf3CmStatusUsTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3CmStatusUsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines PHY and MAC information about
    the CM's upstream channels operating in Multiple Transmit
    Channel (MTC) mode or in a Pre-3.0 DOCSIS transmit
    channel mode. This object provides per-CM Upstream
    channel information previously available in the
    SNMP table docsIfCmStatusTable."
::= { docsIf3MibObjects 2}

docsIf3CmStatusUsEntry OBJECT-TYPE
SYNTAX      DocsIf3CmStatusUsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3CmStatusUsTable.
    An instance exist for the CM upstream channels configured for
    data transmission."
INDEX {
    ifIndex
}
::= { docsIf3CmStatusUsTable 1 }

DocsIf3CmStatusUsEntry ::= SEQUENCE {
    docsIf3CmStatusUsTxPower
        TenthdBmV,
    docsIf3CmStatusUsT3Timeouts
        Counter32,
    docsIf3CmStatusUsT4Timeouts
        Counter32,
    docsIf3CmStatusUsRangingAborteds
        Counter32,
    docsIf3CmStatusUsModulationType
        DocsisUpstreamType,
}

```

```
docsIf3CmStatusUsEqData
    DocsEqualizerData,
docsIf3CmStatusUsT3Exceededs
    Counter32,
docsIf3CmStatusUsIsMuted
    TruthValue,
docsIf3CmStatusUsRangingStatus
    RangingState
}

docsIf3CmStatusUsTxPower OBJECT-TYPE
    SYNTAX      TenthdBmV
    UNITS      "TenthdBmV"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the operational CM transmit
         power for this upstream channel."
    ::= { docsIf3CmStatusUsEntry 1 }

docsIf3CmStatusUsT3Timeouts OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "timeouts"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute denotes the number of times counter
         T3 expired in the CM for this upstream channel. Discontinuities
         in the value of this counter can occur at
         re-initialization of the managed system, and at other
         times as indicated by the value of ifCounterDiscontinuityTime
         for the associated upstream channel."
    REFERENCE
        "RFC 2863."
    ::= { docsIf3CmStatusUsEntry 2 }

docsIf3CmStatusUsT4Timeouts OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "timeouts"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute denotes the number of times counter
         T4 expired in the CM for this upstream channel. Discontinuities
         in the value of this counter can occur at
         re-initialization of the managed system, and at other
         times as indicated by the value of ifCounterDiscontinuityTime
         for the associated upstream channel."
    REFERENCE
        "RFC 2863."
    ::= { docsIf3CmStatusUsEntry 3 }

docsIf3CmStatusUsRangingAborteds OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "attempts"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute denotes the number of times the ranging
         process was aborted by the CMTS. Discontinuities
         in the value of this counter can occur at re-initialization
         of the managed system, and at other times as
         indicated by the value of ifCounterDiscontinuityTime
```

```

([RFC2863]) for the associated upstream channel."
REFERENCE
"RFC 2863."
 ::= { docsIf3CmStatusUsEntry 4 }

docsIf3CmStatusUsModulationType OBJECT-TYPE
SYNTAX DocsUpstreamType
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute indicates modulation type status
currently used by the CM for this upstream channel. Since
this object specifically identifies PHY Layer
mode, the shared upstream channel type 'tdmaAndAtdma'
is not permitted."
REFERENCE
"RFC 2863."
 ::= { docsIf3CmStatusUsEntry 5 }

docsIf3CmStatusUsEqData OBJECT-TYPE
SYNTAX DocsEqualizerData
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute indicates the pre-equalization data
for the specified upstream Channel on this CM after
convolution with data indicated in the RNG-RSP. This
data is valid when docsIfUpChannelPreEqEnable
RFC 4546 is set to true."
REFERENCE
"RFC 2863.
RFC 4546."
 ::= { docsIf3CmStatusUsEntry 6 }

docsIf3CmStatusUsT3Exceedededs OBJECT-TYPE
SYNTAX Counter32
UNITS "timeouts"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute denotes the number of times for excessive
T3 timeouts. Discontinuities in the value of
this counter can occur at re-initialization of the managed
system, and at other times as indicated by the
value of ifCounterDiscontinuityTime for the associated
upstream channel."
REFERENCE
"RFC 2863."
 ::= { docsIf3CmStatusUsEntry 7 }

docsIf3CmStatusUsIsMuted OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute denotes whether the upstream
channel is muted."
REFERENCE
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I08-080522 section
Media Access Control specification."
 ::= { docsIf3CmStatusUsEntry 8 }

```

```

docsIf3CmStatusUsRangingStatus OBJECT-TYPE
  SYNTAX      RangingState
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute denotes the ranging state of the CM."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, section
     Media Access Control specification."
  ::= { docsIf3CmStatusUsEntry 9 }

docsIf3CmtsCmRegStatusTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3CmtsCmRegStatusEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object defines attributes that represent the CM's
     registration status as tracked by the CMTS."
  ::= { docsIf3MibObjects 3 }

docsIf3CmtsCmRegStatusEntry OBJECT-TYPE
  SYNTAX      DocsIf3CmtsCmRegStatusEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsIf3CmtsCmRegStatusTable."
  INDEX {
    docsIf3CmtsCmRegStatusId
  }
  ::= { docsIf3CmtsCmRegStatusTable 1 }

DocsIf3CmtsCmRegStatusEntry ::= SEQUENCE {
  docsIf3CmtsCmRegStatusId
    Unsigned32,
  docsIf3CmtsCmRegStatusMacAddr
    MacAddress,
  docsIf3CmtsCmRegStatusIPv6Addr
    InetAddressIPv6,
  docsIf3CmtsCmRegStatusIPv6LinkLocal
    InetAddressIPv6,
  docsIf3CmtsCmRegStatusIPv4Addr
    InetAddressIPv4,
  docsIf3CmtsCmRegStatusValue
    CmtsCmRegState,
  docsIf3CmtsCmRegStatusMdIfIndex
    InterfaceIndexOrZero,
  docsIf3CmtsCmRegStatusMdCmSgId
    Unsigned32,
  docsIf3CmtsCmRegStatusRcpId
    RcpId,
  docsIf3CmtsCmRegStatusRccStatusId
    Unsigned32,
  docsIf3CmtsCmRegStatusRcsId
    ChSetId,
  docsIf3CmtsCmRegStatusTcsId
    ChSetId,
  docsIf3CmtsCmRegStatusQosVersion
    DocsisQosVersion,
  docsIf3CmtsCmRegStatusLastRegTime
    DateAndTime,
  docsIf3CmtsCmRegStatusAddrResolutionReqs
    Counter32,
}

```

```

docsIf3CmtsCmRegStatusEnergyMgtEnabled
    BITS,
docsIf3CmtsCmRegStatusEnergyMgtOperStatus
    BITS
}

docsIf3CmtsCmRegStatusId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute uniquely identifies a CM. The CMTS
         must assign a single id value for each CM MAC address seen
         by the CMTS. The CMTS should ensure that the association
         between an Id and MAC Address remains constant
         during CMTS uptime."
 ::= { docsIf3CmtsCmRegStatusEntry 1 }

docsIf3CmtsCmRegStatusMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the MAC address of the CM.
         If the CM has multiple MAC addresses, this is the MAC
         address associated with the MAC Domain interface."
 ::= { docsIf3CmtsCmRegStatusEntry 2 }

docsIf3CmtsCmRegStatusIPv6Addr OBJECT-TYPE
    SYNTAX      InetAddressIPv6
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the IPv6 address of the
         CM. If the CM has no Internet address assigned, or the
         Internet address is unknown, the value of this attribute
         is the all zeros address."
 ::= { docsIf3CmtsCmRegStatusEntry 3 }

docsIf3CmtsCmRegStatusIPv6LinkLocal OBJECT-TYPE
    SYNTAX      InetAddressIPv6
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the IPv6 local scope address
         of the CM. If the CM has no link local address assigned,
         or the Internet address is unknown, the value
         of this attribute is the all zeros address."
 ::= { docsIf3CmtsCmRegStatusEntry 4 }

docsIf3CmtsCmRegStatusIPv4Addr OBJECT-TYPE
    SYNTAX      InetAddressIPv4
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the IPv4 address of this
         CM. If the CM has no IP address assigned, or the IP address
         is unknown, this object returns 0.0.0.0."
 ::= { docsIf3CmtsCmRegStatusEntry 5 }

docsIf3CmtsCmRegStatusValue OBJECT-TYPE
    SYNTAX      CmtsCmRegState
    MAX-ACCESS  read-only

```

```
STATUS      current
DESCRIPTION
    "This attribute represents the current CM connectivity
     state."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem
     Initialization and Reinitialization section."
 ::= { docsIf3CmtsCmRegStatusEntry 6 }

docsIf3CmtsCmRegStatusMdIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the interface Index of
     the CMTS MAC Domain where the CM is active. If the interface
     is unknown, the CMTS returns a value of zero."
 ::= { docsIf3CmtsCmRegStatusEntry 7 }

docsIf3CmtsCmRegStatusMdCmSgId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the ID of the MAC Domain
     CM Service Group Id (MD-CM-SG-ID) in which the CM is registered.
     If the ID is unknown, the CMTS returns a value
     of zero."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem
     Service Group (CM-SG) section."
 ::= { docsIf3CmtsCmRegStatusEntry 8 }

docsIf3CmtsCmRegStatusRcpId OBJECT-TYPE
SYNTAX      RcpId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the RCP-ID associated
     with the CM. If the RCP-ID is unknown the CMTS returns
     a five octet long string of zeros."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, RCP-ID
     section in the Common Radio Frequency Interface
     Encodings Annex."
 ::= { docsIf3CmtsCmRegStatusEntry 9 }

docsIf3CmtsCmRegStatusRccStatusId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the RCC Id the CMTS used
     to configure the CM receive channel set during the registration
     process. If unknown, the CMTS returns the
     value zero."
 ::= { docsIf3CmtsCmRegStatusEntry 10 }

docsIf3CmtsCmRegStatusRcsId OBJECT-TYPE
SYNTAX      ChSetId
```

```

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the Receive Channel Set
    (RCS) that the CM is currently using. If the RCS is unknown,
    the CMTS returns the value zero."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Cable Modem
    Physical Receive Channel Configuration section and the
    Receive Channels section in the Common Radio Frequency
    Interface Encodings Annex."
 ::= { docsIf3CmtsCmRegStatusEntry 11 }

docsIf3CmtsCmRegStatusTcsId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents Transmit Channel Set (TCS)
    the CM is currently using. If the TCS is unknown,
    the CMTS returns the value zero."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Changes to
    the Transmit Channel Set section."
 ::= { docsIf3CmtsCmRegStatusEntry 12 }

docsIf3CmtsCmRegStatusQosVersion OBJECT-TYPE
SYNTAX      DocsisQosVersion
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute denotes the queuing services the CM
    registered, either DOCSIS 1.1 QoS or DOCSIS 1.0 CoS mode."
 ::= { docsIf3CmtsCmRegStatusEntry 13 }

docsIf3CmtsCmRegStatusLastRegTime OBJECT-TYPE
SYNTAX      DateAndTime
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the last time the CM registered."
 ::= { docsIf3CmtsCmRegStatusEntry 14 }

docsIf3CmtsCmRegStatusAddrResolutionReqs OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of upstream
    packets received on the SIDs assigned to a CM that
    are any of the following:
    Upstream IPv4 ARP Requests
    Upstream IPv6 Neighbor Solicitation Requests
    (For Routing CMTSs) Upstream IPv4 or IPv6 packets to
    unresolved destinations in locally connected downstream
    subnets in the HFC.
    Discontinuities in the value of this counter can occur
    at re-initialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime for the associated MAC Domain
    interface."

```

**REFERENCE**

"DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I13-100611,  
 Secure Provisioning section.  
 RFC 2863."  
`::= { docsIf3CmtsCmRegStatusEntry 15 }`

**docsIf3CmtsCmRegStatusEnergyMgtEnabled OBJECT-TYPE**

**SYNTAX**      **BITS** {  
                   `em1x1Mode(0)`  
                   }

**MAX-ACCESS**    read-only  
**STATUS**          current

**DESCRIPTION**

"This attribute indicates which, if any, of the Energy Management Features are enabled for this CM. If this attribute returns `em1x1Mode(0)` bit set, the CM is configured with the Energy Management 1x1 Feature enabled. If this attribute returns all bits cleared, the CM will not request to operate in any Energy Management mode of operation. Note: This attribute only indicates if an Energy Management Feature is enabled/disabled via the CM config file and registration request/response exchange and does not indicate whether the CM is actively operating in an Energy Management Mode."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I20-121113,  
 Energy Management Features section."  
`::= { docsIf3CmtsCmRegStatusEntry 16 }`

**docsIf3CmtsCmRegStatusEnergyMgtOperStatus OBJECT-TYPE**

**SYNTAX**      **BITS** {  
                   `em1x1Mode(0)`  
                   }

**MAX-ACCESS**    read-only  
**STATUS**          current

**DESCRIPTION**

"This attribute indicates whether the CM is currently operating in an Energy Management Mode. If this attribute returns `em1x1Mode(0)` bit set, the CM is operating in Energy Management 1x1 Mode. If this attribute returns all bits cleared, the CM is not operating in any Energy Management Mode. This attribute always returns 0x00 (no bits set) in the case when `docsIf3CmtsCmRegStatusEnergyMgtEnabled` is set to 0x00 (no Energy Management Features enabled)."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I20-121113,  
 Energy Management 1x1 Mode Indicator section."  
`::= { docsIf3CmtsCmRegStatusEntry 17 }`

**docsIf3CmtsCmUsStatusTable OBJECT-TYPE**

**SYNTAX**      **SEQUENCE OF** `DocsIf3CmtsCmUsStatusEntry`

**MAX-ACCESS**    not-accessible  
**STATUS**          current

**DESCRIPTION**

"This object defines status information of the CM currently in use Upstream Logical Channels, as reported by the CMTS."

`::= { docsIf3MibObjects 4 }`

**docsIf3CmtsCmUsStatusEntry OBJECT-TYPE**

**SYNTAX**      `DocsIf3CmtsCmUsStatusEntry`

**MAX-ACCESS**    not-accessible

```

STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3CmtsCmUsStatusTable."
INDEX {
    docsIf3CmtsCmRegStatusId,
    docsIf3CmtsCmUsStatusChIfIndex
}
 ::= { docsIf3CmtsCmUsStatusTable 1 }

DocsIf3CmtsCmUsStatusEntry ::= SEQUENCE {
    docsIf3CmtsCmUsStatusChIfIndex
        InterfaceIndex,
    docsIf3CmtsCmUsStatusModulationType
        DocsisUpstreamType,
    docsIf3CmtsCmUsStatusRxPower
        TenthdBmV,
    docsIf3CmtsCmUsStatusSignalNoise
        TenthdB,
    docsIf3CmtsCmUsStatusMicroreflections
        Unsigned32,
    docsIf3CmtsCmUsStatusEqData
        DocsEqualizerData,
    docsIf3CmtsCmUsStatusUnerroreds
        Counter32,
    docsIf3CmtsCmUsStatusCorrecteds
        Counter32,
    docsIf3CmtsCmUsStatusUncorrectables
        Counter32,
    docsIf3CmtsCmUsStatusHighResolutionTimingOffset
        Integer32,
    docsIf3CmtsCmUsStatusIsMuted
        TruthValue,
    docsIf3CmtsCmUsStatusRangingStatus
        RangingState
}

docsIf3CmtsCmUsStatusChIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute is a key that represents the ifIndex
         of the upstream interface."
    ::= { docsIf3CmtsCmUsStatusEntry 1 }

docsIf3CmtsCmUsStatusModulationType OBJECT-TYPE
    SYNTAX      DocsisUpstreamType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the modulation type currently
         used by this upstream channel."
    ::= { docsIf3CmtsCmUsStatusEntry 2 }

docsIf3CmtsCmUsStatusRxPower OBJECT-TYPE
    SYNTAX      TenthdBmV
    UNITS      "TenthdBmV"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the receive power of this
         upstream channel."

```

```
::= { docsIf3CmtsCmUsStatusEntry 3 }

docsIf3CmtsCmUsStatusSignalNoise OBJECT-TYPE
    SYNTAX      TenthdB
    UNITS      "TenthdB"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents Signal/Noise ratio as
         perceived for upstream data from the CM on this upstream
         channel."
::= { docsIf3CmtsCmUsStatusEntry 4 }

docsIf3CmtsCmUsStatusMicroreflections OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    UNITS      "-dBc"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents microreflections received
         on this upstream channel."
::= { docsIf3CmtsCmUsStatusEntry 5 }

docsIf3CmtsCmUsStatusEqData OBJECT-TYPE
    SYNTAX      DocsEqualizerData
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the equalization data
         for the CM on this upstream channel."
::= { docsIf3CmtsCmUsStatusEntry 6 }

docsIf3CmtsCmUsStatusUnerroreds OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the codewords received
         without error from the CM on this interface. Discontinuities
         in the value of this counter can occur at re-initialization
         of the managed system, and at other
         times as indicated by the value of ifCounterDiscontinuityTime
         for the associated upstream channel."
    REFERENCE
        "RFC 2863."
::= { docsIf3CmtsCmUsStatusEntry 7 }

docsIf3CmtsCmUsStatusCorrecteds OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the codewords received
         with correctable errors from the CM on this upstream
         channel. Discontinuities in the value of this counter
         can occur at re-initialization of the managed system,
         and at other times as indicated by the value of
         ifCounterDiscontinuityTime for the associated upstream
         channel."
    REFERENCE
        "RFC 2863."
::= { docsIf3CmtsCmUsStatusEntry 8 }
```

```

docsIf3CmtsCmUsStatusUncorrectables OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the codewords received
     with uncorrectable errors from the CM on this upstream
     channel. Discontinuities in the value of this counter
     can occur at re-initialization of the managed
     system, and at other times as indicated by the value of
     ifCounterDiscontinuityTime for the associated upstream
     channel."
  REFERENCE
    "RFC 2863."
  ::= { docsIf3CmtsCmUsStatusEntry 9 }

docsIf3CmtsCmUsStatusHighResolutionTimingOffset OBJECT-TYPE
  SYNTAX      Integer32
  UNITS      "time tick/(64*256)"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the current measured round
     trip time on this CM's upstream channel in units
     of (6.25 microseconds/(64*256)). This attribute returns
     zero if the value is unknown."
  ::= { docsIf3CmtsCmUsStatusEntry 10 }

docsIf3CmtsCmUsStatusIsMuted OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute has a value 'true' to indicate that
     the CM's upstream channel has been muted via
     CM-CTRL-REQ/CM-CTRL-RSP message exchange."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, section
     Media Access Control specification."
  ::= { docsIf3CmtsCmUsStatusEntry 11 }

docsIf3CmtsCmUsStatusRangingStatus OBJECT-TYPE
  SYNTAX      RangingState
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute denotes the ranging state of the CM."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, section
     Media Access Control specification."
  ::= { docsIf3CmtsCmUsStatusEntry 12 }

docsIf3MdChCfgTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3MdChCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object configures the association of downstream
     and upstream channels to a particular MAC Domain
     (MD) on a CMTS. The creation of channels and MAC domain
     object interface instances is vendor-specific.

```

In particular, the assignment of the channel interface index is normally vendor-specific. Therefore, this object is intended only for associating channels to a MAC Domain and assumes that those channels were previously configured.

The CMTS may have restrictions on which channels can be configured in the same MAC Domain. For example, it could require the upstream channels to be from the same line card.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the ChId attribute to be set."

```
 ::= { docsIf3MibObjects 5}

docsIf3MdChCfgEntry OBJECT-TYPE
    SYNTAX      DocsIf3MdChCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3MdChCfgTable.
         The ifIndex key corresponds to the MAC Domain interface
         where the channel is configured.
         The CMTS persists all instances of MdChCfg across
         reinitializations."
    INDEX {
        ifIndex,
        docsIf3MdChCfgChIfIndex
    }
 ::= { docsIf3MdChCfgTable 1 }

DocsIf3MdChCfgEntry ::= SEQUENCE {
    docsIf3MdChCfgChIfIndex
        InterfaceIndex,
    docsIf3MdChCfgIsPriCapableDs
        TruthValue,
    docsIf3MdChCfgChId
        ChId,
    docsIf3MdChCfgSfProvAttrMask
        AttributeMask,
    docsIf3MdChCfgRowStatus
        RowStatus
}

docsIf3MdChCfgChIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the interface index of an existing
         upstream or downstream channel that is configured
         to be part of the MAC Domain.
         For the case of upstream interfaces the CMTS could reject
         the assignment of upstream logical channels under
         the same physical upstream interface to different
         MAC Domains."
 ::= { docsIf3MdChCfgEntry 1 }

docsIf3MdChCfgIsPriCapableDs OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
```

```

    "If set to 'true', this attribute configures the downstream
    channel as Primary-Capable.
    The default value for a downstream channel is 'true'.
    This attribute is not relevant for upstream interfaces,
    therefore it reports the value 'false' for such interfaces.
    A CMTS may restrict the permitted value of this attribute
    based upon physical channel capabilities."
 ::= { docsIf3MdChCfgEntry 2 }

docsIf3MdChCfgChId OBJECT-TYPE
    SYNTAX     ChId (1..255)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute contains the 8-bit Downstream Channel
        ID (DCID) or Upstream Channel ID (UCID) configured
        for the channel in the MAC Domain."
 ::= { docsIf3MdChCfgEntry 3 }

docsIf3MdChCfgSfProvAttrMask OBJECT-TYPE
    SYNTAX     AttributeMask
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute contains Provisioned Attribute Mask
        of non-bonded service flow assignment to this channel."
    DEFVAL { '00000000'H }
 ::= { docsIf3MdChCfgEntry 4 }

docsIf3MdChCfgRowStatus OBJECT-TYPE
    SYNTAX     RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The status of this instance."
 ::= { docsIf3MdChCfgEntry 5 }

docsIf3RccCfgTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF DocsIf3RccCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object identifies the scope of the Receive Channel
        Configuration (RCC) and provides a top level container
        for the Receive Module and Receive Channel
        objects. The CMTS selects an instance of this object
        to assign to a CM when it registers.
        This object supports the creation and deletion of multiple
        instances."
 ::= { docsIf3MibObjects 6 }

docsIf3RccCfgEntry OBJECT-TYPE
    SYNTAX     DocsIf3RccCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3RccCfgTable.
        The ifIndex key corresponds to the MAC Domain interface
        where the RCC is configured.
        The CMTS persists all instances of RccCfg across
        reinitializations."
    INDEX {
        ifIndex,

```

```

        docsIf3RccCfgRcpId,
        docsIf3RccCfgRccCfgId
    }
 ::= { docsIf3RccCfgTable 1 }

DocsIf3RccCfgEntry ::= SEQUENCE {
    docsIf3RccCfgRcpId
        RcpId,
    docsIf3RccCfgRccCfgId
        Unsigned32,
    docsIf3RccCfgVendorSpecific
        OCTET STRING,
    docsIf3RccCfgDescription
        SnmpAdminString,
    docsIf3RccCfgRowStatus
        RowStatus
}

docsIf3RccCfgRcpId OBJECT-TYPE
SYNTAX      RcpId
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the 'Receive Channel Profile
     Identifier' (RCP-ID) configured for the MAC Domain
     indicated by this instance."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Standard
     Receive Channel Profile Encodings Annex."
 ::= { docsIf3RccCfgEntry 1 }

docsIf3RccCfgRccCfgId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key denotes an RCC combination assignment for
     a particular RcpId and is unique per combination of
     MAC Domain and RcpId."
 ::= { docsIf3RccCfgEntry 2 }

docsIf3RccCfgVendorSpecific OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(0..252))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute contains vendor-specific information
     of the CM Receive Channel configuration."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Receive Channel
     Profile/Configuration Vendor Specific Parameters section
     in the Common Radio Frequency Interface Encodings Annex."
DEFVAL { ''H }
 ::= { docsIf3RccCfgEntry 3 }

docsIf3RccCfgDescription OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE (0..15))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute contains a human-readable description

```

```

    of the CM RCP Configuration."
DEFVAL { "" }
 ::= { docsIf3RccCfgEntry 4 }

docsIf3RccCfgRowStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "The status of this instance."
 ::= { docsIf3RccCfgEntry 5 }

docsIf3RccStatusTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3RccStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The RCC Status object provides a read-only view of
    the statically-configured (from the RccCfg object)
    and dynamically-created RCCs.
    The CMTS creates an RCC Status instance for each unique
    MAC Domain Cable Modem Service Group (MD-CM-SG) to
    which it signals an RCC to the CM."
 ::= { docsIf3MibObjects 7}

docsIf3RccStatusEntry OBJECT-TYPE
SYNTAX      DocsIf3RccStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3RccStatusTable.
    The ifIndex key corresponds to the MAC Domain interface
    where the RCC is configured."
INDEX {
    ifIndex,
    docsIf3RccStatusRcpId,
    docsIf3RccStatusRccStatusId
}
 ::= { docsIf3RccStatusTable 1 }

DocsIf3RccStatusEntry ::= SEQUENCE {
    docsIf3RccStatusRcpId
        RcpId,
    docsIf3RccStatusRccStatusId
        Unsigned32,
    docsIf3RccStatusRccCfgId
        Unsigned32,
    docsIf3RccStatusValidityCode
        INTEGER,
    docsIf3RccStatusValidityCodeText
        SnmpAdminString
}

docsIf3RccStatusRcpId OBJECT-TYPE
SYNTAX      RcpId
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the RCP-ID to which this instance
    applies."
 ::= { docsIf3RccStatusEntry 1 }

docsIf3RccStatusRccStatusId OBJECT-TYPE

```

```

SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents an RCC combination for a particular
    RcpId either from an RCC configuration object
    or a CMTS-determined RCC and is unique per combination
    of MAC Domain IfIndex and RcpId."
 ::= { docsIf3RccStatusEntry 2 }

docsIf3RccStatusRccCfgId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute identifies an RCC-Configured combination
        from which this instance was defined. If nonzero,
        it corresponds to the RccCfg instance from which
        the RCC was created. Zero means that the RCC was dynamically
        created by the CMTS."
 ::= { docsIf3RccStatusEntry 3 }

docsIf3RccStatusValidityCode OBJECT-TYPE
    SYNTAX      INTEGER {other(1),
                      valid(2),
                      invalid(3),
                      wrongPrimaryDs(4),
                      missingPrimaryDs(5),
                      multiplePrimaryDs(6),
                      duplicateDs(7),
                      wrongFrequencyRange(8),
                      wrongConnectivity(9)
                      }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates whether the RCC instance
        of this object is valid or not. An RCC Status instance
        from a configured or a dynamic RCC could become invalid,
        for example, due changes in the topology."
 ::= { docsIf3RccStatusEntry 4 }

docsIf3RccStatusValidityCodeText OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute contains the CMTS vendor-specific
        log information from the Receive Channel Configuration
        Status encoding."
 ::= { docsIf3RccStatusEntry 5 }

docsIf3RxChCfgTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3RxChCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The Receive Channel Configuration object permits
        an operator to configure how CMs registered with certain
        Receive Channel Profiles will configure the Receive
        Channels within their profile. When a CM registers
        with an RCP for which all Receive Channel Indices
        (RcIds) are configured in the Receive Module object

```

and all Receive Channels are configured within this object, the CMTS should use the configuration within these objects to set the Receive Channel Configuration returned to the CM in a REG-RSP message. A CMTS may require configuration of all pertinent Receive Module and Receive Channel instances in order to register a CM that reports a Receive Channel Profile (RCP), including any standard Receive Channel Profiles. If the CM reports multiple RCPs, and Receive Module and Receive Channel objects have instances for more than one RCP, the particular RCP selected by the CMTS is not specified. A CMTS is not restricted to assigning Receive Modules based only on the contents of this object.

This object supports the creation and deletion of multiple instances.

Creation of a new instance of this object requires the ChIfIndex attribute to be set and a valid reference of a RccCfg instance."

```
 ::= { docsIf3MibObjects 8 }

docsIf3RxChCfgEntry OBJECT-TYPE
SYNTAX      DocsIf3RxChCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3RxChCfgTable.
     The ifIndex key corresponds to the MAC Domain interface
     where the RCC is configured.
     The CMTS persists all instances of ReceiveChannelCfg across
     reinitializations."
INDEX {
    ifIndex,
    docsIf3RccCfgRcpId,
    docsIf3RccCfgRccCfgId,
    docsIf3RxChCfgRcId
}
 ::= { docsIf3RxChCfgTable 1 }

DocsIf3RxChCfgEntry ::= SEQUENCE {
    docsIf3RxChCfgRcId
        Unsigned32,
    docsIf3RxChCfgChIfIndex
        InterfaceIndex,
    docsIf3RxChCfgPrimaryDsIndicator
        TruthValue,
    docsIf3RxChCfgRcRmConnectivityId
        Unsigned32,
    docsIf3RxChCfgRowStatus
        RowStatus
}

docsIf3RxChCfgRcId OBJECT-TYPE
SYNTAX      Unsigned32 (1..255)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents an identifier for the parameters
     of the Receive Channel instance within the Receive
     Channel Profile."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Receive
```

```

Channel Index section in the Common Radio Frequency
Interface Encodings Annex."
 ::= { docsIf3RxChCfgEntry 1 }

docsIf3RxChCfgChIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute contains the interface index of a Downstream
     Channel that this Receive Channel Instance
     defines."
 ::= { docsIf3RxChCfgEntry 2 }

docsIf3RxChCfgPrimaryDsIndicator OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "If set to 'true', this attribute indicates the Receive
     Channel is to be the primary-capable downstream
     channel for the CM receiving this RCC. Otherwise, the
     downstream channel is to be a non-primary-capable
     channel."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Receive Channel
     Primary Downstream Channel Indicator section in the Common
     Radio Frequency Interface Encodings Annex."
  DEFVAL { false }
 ::= { docsIf3RxChCfgEntry 3 }

docsIf3RxChCfgRcRmConnectivityId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..255)
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "This attribute indicates the Receive Module (via
     the RmId from the ReceiveModule object) to which this
     Receive Channel connects. If this object contains
     a zero value (and thus no Receive Channel Connectivity),
     the Receive Channel Connectivity TLV is omitted
     from the RCC."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Receive
     Channel Connectivity section in the Common Radio
     Frequency Interface Encodings Annex."
  DEFVAL { 0 }
 ::= { docsIf3RxChCfgEntry 4 }

docsIf3RxChCfgRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "The status of this instance."
 ::= { docsIf3RxChCfgEntry 5 }

docsIf3RxChStatusTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3RxChStatusEntry
  MAX-ACCESS  not-accessible
  STATUS      current

```

```

DESCRIPTION
    "The Receive Channel Status object reports the status
    of the statically-configured and dynamically-created
    Receive Channels within an RCC."
 ::= { docsIf3MibObjects 9}

docsIf3RxChStatusEntry OBJECT-TYPE
SYNTAX      DocsIf3RxChStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3RxChStatusTable.
    The ifIndex key corresponds to the MAC Domain interface
    where the RCC is configured. When this object is defined
    on the CM, the value of RccStatusId is always 1."
INDEX {
    ifIndex,
    docsIf3RccStatusRcpId,
    docsIf3RccStatusRccStatusId,
    docsIf3RxChStatusRcId
}
 ::= { docsIf3RxChStatusTable 1 }

DocsIf3RxChStatusEntry ::= SEQUENCE {
    docsIf3RxChStatusRcId
        Unsigned32,
    docsIf3RxChStatusChIfIndex
        InterfaceIndex,
    docsIf3RxChStatusPrimaryDsIndicator
        TruthValue,
    docsIf3RxChStatusRcRmConnectivityId
        Unsigned32
}

docsIf3RxChStatusRcId OBJECT-TYPE
SYNTAX      Unsigned32 (1..255)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents an identifier for the parameters
    of the Receive Channel instance within the Receive
    Channel Profile."
 ::= { docsIf3RxChStatusEntry 1 }

docsIf3RxChStatusChIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the interface index of the
    Downstream Channel that this Receive Channel Instance
    defines."
 ::= { docsIf3RxChStatusEntry 2 }

docsIf3RxChStatusPrimaryDsIndicator OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "If set to 'true', this attribute indicates the Receive
    Channel is to be the primary-capable downstream
    channel for the CM receiving this RCC. Otherwise, the
    downstream channel is to be a non-primary-capable

```

```

channel."
 ::= { docsIf3RxChStatusEntry 3 }

docsIf3RxChStatusRcRmConnectivityId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..255)
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute identifies the Receive Module to which
     this Receive Channel connects. A value a zero indicates
     that the Receive Channel Connectivity TLV is
     omitted from the RCC."
 ::= { docsIf3RxChStatusEntry 4 }

docsIf3RxModuleCfgTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3RxModuleCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The Receive Module Configuration object permits
     an operator to configure how CMs with certain Receive
     Channel Profiles (RCPs) will configure the Receive
     Modules within their profile upon CM registration.
     When a CM registers with an RCP for which all Receive
     Module Indices (RmIds) are configured in this object
     and all Receive Channels are configured within the
     Receive Channel (ReceiveChannel) object, the CMTS
     should use the configuration within these objects to
     set the Receive Channel Configuration assigned to
     the CM in a REG-RSP message. A CMTS may require configuration
     of all pertinent Receive Module and Receive
     Channel instances (i.e., MIB table entries) in order
     to register a CM that reports a Receive Channel Profile.
     If the CM reports multiple RCPs, and Receive Module
     and Receive Channel objects have instances (i.e.,
     MIB table entries) for more than one RCP reported by
     the CM, the particular RCP selected by the CMTS is not
     specified. A CMTS is not restricted to assigning Receive
     Modules based only on the contents of this object.

    This object supports the creation and deletion of multiple
    instances.
    Creation of a new instance of this object requires the
    reference of a valid RccCfg instance."
 ::= { docsIf3MibObjects 10}

docsIf3RxModuleCfgEntry OBJECT-TYPE
  SYNTAX      DocsIf3RxModuleCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsIf3RxModuleCfgTable.
     The ifIndex key corresponds to the MAC Domain interface
     where the RCC is configured."
  INDEX {
    ifIndex,
    docsIf3RccCfgRcpId,
    docsIf3RccCfgRccCfgId,
    docsIf3RxModuleCfgRmId
  }
 ::= { docsIf3RxModuleCfgTable 1 }

DocsIf3RxModuleCfgEntry ::= SEQUENCE {

```

```

docsIf3RxModuleCfgRmId
    Unsigned32,
docsIf3RxModuleCfgRmRmConnectivityId
    Unsigned32,
docsIf3RxModuleCfgFirstCenterFrequency
    Unsigned32,
docsIf3RxModuleCfgRowStatus
    RowStatus
}

docsIf3RxModuleCfgRmId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..255)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents an identifier of a Receive Module
         instance within the Receive Channel Profile."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Receive Module
         Index in the Common Radio Frequency Interface Encodings
         Annex."
    ::= { docsIf3RxModuleCfgEntry 1 }

docsIf3RxModuleCfgRmRmConnectivityId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the higher level (i.e.,
         closer to RF) Receive Module to which this Receive Module
         connects. If this object contains a zero value (and
         thus no Receive Module Connectivity), the Receive
         Module Connectivity TLV is omitted from the RCC.
         Within a single instance of the ReceiveModule object,
         the RmRmConnectivityId attribute cannot contain
         the same value as the RmId attribute. The RmRmConnectivityId
         attribute points to a separate ReceiveModule
         object instance with the same value of RccCfgId."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Receive Module
         Connectivity section in the Common Radio Frequency Interface
         Encodings Annex."
    DEFVAL { 0 }
    ::= { docsIf3RxModuleCfgEntry 2 }

docsIf3RxModuleCfgFirstCenterFrequency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "Hz"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the center frequency,
         in Hz, and a multiple of 62500, that indicates the lowest
         frequency channel of the Receive Module, or 0 if not
         applicable to the Receive Module."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Receive Module
         First Channel Center Frequency Assignment section in the
         Common Radio Frequency Interface Encodings Annex."
    ::= { docsIf3RxModuleCfgEntry 3 }

```

```

docsIf3RxModuleCfgRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "The status of this instance."
  ::= { docsIf3RxModuleCfgEntry 4 }

docsIf3RxModuleStatusTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3RxModuleStatusEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The Receive Module Status object provides a read-only
     view of the statically configured and dynamically
     created Receive Modules within an RCC."
  ::= { docsIf3MibObjects 11}

docsIf3RxModuleStatusEntry OBJECT-TYPE
  SYNTAX      DocsIf3RxModuleStatusEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsIf3RxModuleStatusTable.
     The ifIndex key corresponds to the MAC Domain interface
     where the RCC is configured. When this object is defined
     on the CM, the value of RccStatusId is always 1."
  INDEX {
    ifIndex,
    docsIf3RccStatusRcpId,
    docsIf3RccStatusRccStatusId,
    docsIf3RxModuleStatusRmId
  }
  ::= { docsIf3RxModuleStatusTable 1 }

DocsIf3RxModuleStatusEntry ::= SEQUENCE {
  docsIf3RxModuleStatusRmId
    Unsigned32,
  docsIf3RxModuleStatusRmRmConnectivityId
    Unsigned32,
  docsIf3RxModuleStatusFirstCenterFrequency
    Unsigned32
}

docsIf3RxModuleStatusRmId OBJECT-TYPE
  SYNTAX      Unsigned32 (1..255)
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents an identifier of a Receive Module
     instance within the Receive Channel Profile."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Receive
     Module Index section in the Common Radio Frequency
     Interface Encodings Annex."
  ::= { docsIf3RxModuleStatusEntry 1 }

docsIf3RxModuleStatusRmRmConnectivityId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..255)
  MAX-ACCESS  read-only
  STATUS      current

```

```

DESCRIPTION
    "This attribute represents the Receive Module to which
    this Receive Module connects. Requirements for
    module connectivity are detailed in the RmRmConnectivityId
    of the RccCfg object."
 ::= { docsIf3RxModuleStatusEntry 2 }

docsIf3RxModuleStatusFirstCenterFrequency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "Hz"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the low frequency channel
        of the Receive Module, or 0 if not applicable to the
        Receive Module."
 ::= { docsIf3RxModuleStatusEntry 3 }

docsIf3MdNodeStatusTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3MdNodeStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object reports the MD-DS-SG-ID and MD-US-SG-ID
        associated with a MD-CM-SG-ID within a MAC Domain
        and the Fiber Nodes reached by the MD-CM-SG."
 ::= { docsIf3MibObjects 12}

docsIf3MdNodeStatusEntry OBJECT-TYPE
    SYNTAX      DocsIf3MdNodeStatusEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3MdNodeStatusTable.
        The ifIndex key corresponds to the MAC Domain interface
        where the MD-CM-SG-ID is configured."
    INDEX {
        ifIndex,
        docsIf3MdNodeStatusNodeName,
        docsIf3MdNodeStatusMdCmSgId
    }
 ::= { docsIf3MdNodeStatusTable 1 }

DocsIf3MdNodeStatusEntry ::= SEQUENCE {
    docsIf3MdNodeStatusNodeName
        NodeName,
    docsIf3MdNodeStatusMdCmSgId
        Unsigned32,
    docsIf3MdNodeStatusMdDsSgId
        Unsigned32,
    docsIf3MdNodeStatusMdUsSgId
        Unsigned32
}

docsIf3MdNodeStatusNodeName OBJECT-TYPE
    SYNTAX      NodeName (SIZE (1..64))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the name of a fiber node associated
        with a MD-CM-SG of a MAC Domain."
 ::= { docsIf3MdNodeStatusEntry 1 }

```

```

docsIf3MdNodeStatusMdCmSgId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS     current
    DESCRIPTION
        "This attribute is a key and indicates the MD-CM-SG-ID
         of this instance. A particular MdCmSgId in a MAC Domain
         is associated with one or more Fiber Nodes."
    ::= { docsIf3MdNodeStatusEntry 2 }

docsIf3MdNodeStatusMdDsSgId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..255)
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute corresponds to the MD-DS-SG-ID of
         the MD-CM-SG of this object instance. The MdDsSgId values
         are unique within a MAC Domain."
    ::= { docsIf3MdNodeStatusEntry 3 }

docsIf3MdNodeStatusMdUsSgId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..255)
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute corresponds to the MD-US-SG-ID of
         the MD-CM-SG of this object instance. The MdUsSgId values
         are unique within a MAC Domain."
    ::= { docsIf3MdNodeStatusEntry 4 }

docsIf3MdDsSgStatusTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3MdDsSgStatusEntry
    MAX-ACCESS  not-accessible
    STATUS     current
    DESCRIPTION
        "This object returns the list of downstream channel
         associated with a MAC Domain MD-DS-SG-ID."
    ::= { docsIf3MibObjects 13 }

docsIf3MdDsSgStatusEntry OBJECT-TYPE
    SYNTAX      DocsIf3MdDsSgStatusEntry
    MAX-ACCESS  not-accessible
    STATUS     current
    DESCRIPTION
        "The conceptual row of docsIf3MdDsSgStatusTable.
         The ifIndex key corresponds to the MAC Domain interface
         where the MD-DS-SG-ID is configured.
         The CMTS is not required to persist instances of this
         object across reinitializations."
    INDEX {
        ifIndex,
        docsIf3MdDsSgStatusMdDsSgId
    }
    ::= { docsIf3MdDsSgStatusTable 1 }

DocsIf3MdDsSgStatusEntry ::= SEQUENCE {
    docsIf3MdDsSgStatusMdDsSgId
        Unsigned32,
    docsIf3MdDsSgStatusChSetId
        ChSetId
}

```

docsIf3MdDsSgStatusMdDsSgId OBJECT-TYPE

```

SYNTAX      Unsigned32 (1..255)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents a MD-DS-SG-ID in a Mac Domain."
 ::= { docsIf3MdDsSgStatusEntry 1 }

docsIf3MdDsSgStatusChSetId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents a reference to the list
     of downstream channels of the MD-DS-SG-ID."
 ::= { docsIf3MdDsSgStatusEntry 2 }

docsIf3MdUsSgStatusTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3MdUsSgStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object returns the list of upstream channels
     associated with a MAC Domain MD-US-SG-ID."
 ::= { docsIf3MibObjects 14 }

docsIf3MdUsSgStatusEntry OBJECT-TYPE
SYNTAX      DocsIf3MdUsSgStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3MdUsSgStatusTable.
     The ifIndex key corresponds to the MAC Domain interface
     where the MD-DS-SG-ID is configured.
     The CMTS is not required to persist instances of this
     object across reinitializations."
INDEX {
    ifIndex,
    docsIf3MdUsSgStatusMdUsSgId
}
 ::= { docsIf3MdUsSgStatusTable 1 }

DocsIf3MdUsSgStatusEntry ::= SEQUENCE {
    docsIf3MdUsSgStatusMdUsSgId
        Unsigned32,
    docsIf3MdUsSgStatusChSetId
        ChSetId
}

docsIf3MdUsSgStatusMdUsSgId OBJECT-TYPE
SYNTAX      Unsigned32 (1..255)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents a MD-US-SG-ID in a Mac Domain."
 ::= { docsIf3MdUsSgStatusEntry 1 }

docsIf3MdUsSgStatusChSetId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents a reference to the list
     of upstream channels of the MD-US-SG-ID."

```

```

 ::= { docsIf3MdUsSgStatusEntry 2 }

docsIf3MdUsToDsChMappingTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsIf3MdUsToDsChMappingEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object returns the set of downstream channels
     that carry UCDs and MAPs for a particular upstream channel
     in a MAC Domain."
  ::= { docsIf3MibObjects 15}

docsIf3MdUsToDsChMappingEntry OBJECT-TYPE
  SYNTAX      DocsIf3MdUsToDsChMappingEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsIf3MdUsToDsChMappingTable."
  INDEX {
    docsIf3MdUsToDsChMappingUsIfIndex,
    docsIf3MdUsToDsChMappingDsIfIndex,
    docsIf3MdUsToDsChMappingMdIfIndex
  }
  ::= { docsIf3MdUsToDsChMappingTable 1 }

DocsIf3MdUsToDsChMappingEntry ::= SEQUENCE {
  docsIf3MdUsToDsChMappingUsIfIndex
    InterfaceIndex,
  docsIf3MdUsToDsChMappingDsIfIndex
    InterfaceIndex,
  docsIf3MdUsToDsChMappingMdIfIndex
    InterfaceIndex
}

docsIf3MdUsToDsChMappingUsIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents the interface index of the upstream
     channel to which this instance applies."
  ::= { docsIf3MdUsToDsChMappingEntry 1 }

docsIf3MdUsToDsChMappingDsIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents the interface index of a downstream
     channel carrying in UCDs and Maps associated with
     the upstream channel defined by this instance."
  ::= { docsIf3MdUsToDsChMappingEntry 2 }

docsIf3MdUsToDsChMappingMdIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This key represents the MAC domain of the upstream
     and downstream channels of this instance."
  ::= { docsIf3MdUsToDsChMappingEntry 3 }

docsIf3MdCfgTable OBJECT-TYPE

```

```

SYNTAX      SEQUENCE OF DocsIf3MdCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object contains MAC domain level control and
     configuration attributes."
 ::= { docsIf3MibObjects 16}

docsIf3MdCfgEntry OBJECT-TYPE
SYNTAX      DocsIf3MdCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3MdCfgTable.
     The CMTS persists all instances of MdCfg across
     reinitializations.
     The ifIndex key corresponds to the MAC Domain interface."
INDEX {
    ifIndex
}
 ::= { docsIf3MdCfgTable 1 }

DocsIf3MdCfgEntry ::= SEQUENCE {
    docsIf3MdCfgMddInterval
        Unsigned32,
    docsIf3MdCfgIpProvMode
        INTEGER,
    docsIf3MdCfgCmStatusEvCtlEnabled
        TruthValue,
    docsIf3MdCfgUsFreqRange
        INTEGER,
    docsIf3MdCfgMcastDsidFwdEnabled
        TruthValue,
    docsIf3MdCfgMultRxChModeEnabled
        TruthValue,
    docsIf3MdCfgMultTxChModeEnabled
        TruthValue,
    docsIf3MdCfgEarlyAuthEncrCtrl
        INTEGER,
    docsIf3MdCfgTftpProxyEnabled
        TruthValue,
    docsIf3MdCfgSrcAddrVerifEnabled
        TruthValue,
    docsIf3MdCfgDownChannelAnnex
        INTEGER,
    docsIf3MdCfgCmUdcEnabled
        TruthValue,
    docsIf3MdCfgSendUdcRulesEnabled
        TruthValue,
    docsIf3MdCfgServiceTypeIdList
        SnmpTagList,
    docsIf3MdCfgBpi2EnforceCtrl
        INTEGER,
    docsIf3MdCfgEnergyMgt1x1Enabled
        TruthValue
}

docsIf3MdCfgMddInterval OBJECT-TYPE
SYNTAX      Unsigned32 (1..2000)
UNITS      "milliseconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION

```

"This attribute configures the interval for the insertion of MDD messages in each downstream channel of a MAC Domain."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Parameters and Constants Annex."

**DEFVAL** { 2000 }

::= { docsIf3MdCfgEntry 1 }

**docsIf3MdCfgIpProvMode** OBJECT-TYPE

SYNTAX INTEGER {  
    ipv4Only(0),  
    ipv6Only(1),  
    alternate(2),  
    dualStack(3)  
}

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"This attribute configures the CMTS IP provisioning mode for a MAC Domain.  
When this attribute is set to 'ipv4Only' the CM will acquire a single IPv4 address for the CM management stack.  
When this attribute is set to 'ipv6Only' the CM will acquire a single IPv6 address for the CM management stack.  
When this attribute is set to 'alternate' the CM will acquire a single IPv6 address for the CM management stack and, if failures occur, the CM will fall back to provision and operation with an IPv4 address.  
When this attribute is set to 'dualStack' the CM will acquire both an IPv6 and IPv4 address for provisioning and operation."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IP Initialization Parameters TLV section."

**DEFVAL** { ipv6Only }

::= { docsIf3MdCfgEntry 2 }

**docsIf3MdCfgCmStatusEvCtlEnabled** OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"If set to 'true', this attribute enables the signaling of the CM-Status Event reporting mechanism."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, CM-STATUS Event Control section "

**DEFVAL** { true }

::= { docsIf3MdCfgEntry 3 }

**docsIf3MdCfgUsFreqRange** OBJECT-TYPE

SYNTAX INTEGER {  
    standard(0),  
    extended(1)  
}

MAX-ACCESS read-write

STATUS current

**DESCRIPTION**

"This attribute indicates in MDD messages the upstream frequency upper band edge of an upstream Channel."

A value 'standard' means Standard Frequency Range and a value 'extended' means Extended Frequency Range."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Upstream Frequency Upper Band Edge TLV section."

**DEFVAL { standard }**  
 **::= { docsIf3MdCfgEntry 4 }**

**docsIf3MdCfgMcastDsidFwdEnabled** OBJECT-TYPE  
**SYNTAX** TruthValue  
**MAX-ACCESS** read-write  
**STATUS** current  
**DESCRIPTION**  
 "If set to 'true', this attribute enables the CMTS to use IP Multicast DSID Forwarding (MDF) for the MAC domain."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Multicast DSID-based Forwarding (MDF) Modes section in the Compatibility with Previous Versions of DOCSIS Annex."

**DEFVAL { true }**  
 **::= { docsIf3MdCfgEntry 5 }**

**docsIf3MdCfgMultRxChModeEnabled** OBJECT-TYPE  
**SYNTAX** TruthValue  
**MAX-ACCESS** read-write  
**STATUS** current  
**DESCRIPTION**  
 "If set to 'true', this attribute enables Downstream Channel Bonding for the MAC Domain."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Downstream Channel Bonding section."

**DEFVAL { true }**  
 **::= { docsIf3MdCfgEntry 6 }**

**docsIf3MdCfgMultTxChModeEnabled** OBJECT-TYPE  
**SYNTAX** TruthValue  
**MAX-ACCESS** read-write  
**STATUS** current  
**DESCRIPTION**  
 "If set to 'true', this attribute enables Multiple Transmit Channel (MTC) Mode for the MAC Domain."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Upstream Channel Bonding section."

**DEFVAL { true }**  
 **::= { docsIf3MdCfgEntry 7 }**

**docsIf3MdCfgEarlyAuthEncrCtrl** OBJECT-TYPE  
**SYNTAX** INTEGER {  
 disableEae(1),  
 enableEaeRangingBasedEnforcement(2),  
 enableEaeCapabilityBasedEnforcement(3),  
 enableEaeTotalEnforcement(4)  
}  
**MAX-ACCESS** read-write  
**STATUS** current  
**DESCRIPTION**

"This attribute enables or disables early authentication and encryption (EAE) signaling for the MAC Domain. It also defines the type of EAE enforcement in the case that EAE is enabled. If set to 'disableEAE', EAE is disabled for the MAC Domain.

If set to 'enableEaeRangingBasedEnforcement', 'enableEaeCapabilityBasedEnforcement' or 'enableEaeTotalEnforcement', EAE is enabled for the MAC Domain.

The following EAE enforcement methods are defined in the case where EAE signaling is enabled:  
The option 'enableEaeRangingBasedEnforcement' indicates EAE is enforced on CMs that perform ranging with a B-INIT-RNG-REQ message.  
The option 'enableEaeCapabilityBasedEnforcement' indicates EAE is enforced on CMs that perform ranging with a B-INIT-RNG-REQ message in which the EAE capability flag is set.  
The option 'enableEaeTotalEnforcement' indicates EAE is enforced on all CMs regardless of their EAE capabilities."

#### REFERENCE

"DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I06-071206,  
Early Authentication and Encryption section."

DEFVAL { enableEaeRangingBasedEnforcement }  
::= { docsIf3MdCfgEntry 8 }

#### docsIf3MdCfgTftpProxyEnabled OBJECT-TYPE

SYNTAX TruthValue  
MAX-ACCESS read-write  
STATUS current

#### DESCRIPTION

"If set to 'true', this attribute enables TFTP Proxy functionality for the MAC Domain."

#### REFERENCE

"DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I06-071206,  
TFTP Configuration File Security section."

DEFVAL { true }  
::= { docsIf3MdCfgEntry 9 }

#### docsIf3MdCfgSrcAddrVerifEnabled OBJECT-TYPE

SYNTAX TruthValue  
MAX-ACCESS read-write  
STATUS current

#### DESCRIPTION

"If set to 'true', this attribute enables Source Address Verification (SAV) functionality for the MAC Domain."

#### REFERENCE

"DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I06-071206,  
Source Address Verification section."

DEFVAL { true }  
::= { docsIf3MdCfgEntry 10 }

#### docsIf3MdCfgDownChannelAnnex OBJECT-TYPE

SYNTAX INTEGER {  
unknown(1),  
other(2),  
annexA(3),  
annexB(4),  
annexC(5)

```

    }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "This attribute defines the ITU-J-83 Annex being used
   for this MAC Domain. The value of this attribute
   indicates the conformance of the implementation to
   important regional cable standards.
  Valid enumerations for the attribute are:
  unknown
  other
  annexA : Annex A from ITU-J83 is used.
  annexB : Annex B from ITU-J83 is used.
  annexC : Annex C from ITU-J83 is used.
  Values 6-255 are reserved."
DEFVAL { unknown }
 ::= { docsIf3MdCfgEntry 11 }

docsIf3MdCfgCmUdcEnabled OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "If set to 'true', this attribute instructs the CMTS MAC
   Domain to enable Upstream Drop Classifiers (UDC) for the
   CMs attempting registration in this MAC Domain."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
   Specification CM-SP-MULPIv3.0-I08-080522, Subscriber Management
   TLVs section in the Common Radio Frequency Interface Encodings
   Annex."
DEFVAL { false }
 ::= { docsIf3MdCfgEntry 12 }

docsIf3MdCfgSendUdcRulesEnabled OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "If set to 'true' and when the CM signals to the CMTS
   'Upstream Drop Classifier Group ID' encodings, this attribute
   instructs the CMTS MAC Domain to send the Subscriber
   Management Filters rules associated with the 'Upstream Drop
   Classifier Group ID' encodings to the CM in the form of UDCs
   when the following conditions occurs:
  - The attribute CmUdcEnabled value for this MAC Domain
    is set to 'true', and
  - The CM has the UDC capability advertised as supported.
  If there is no a single Subscriber Management Filter
  configured in the CMTS for the CM's signaled UDC Group ID,
  the CMTS does not send UDC encodings to the CM.

  It is vendor specific whether the CMTS maintains enforcement
  of the CM signaled or default Subscriber Management Filter
  groups in the upstream direction."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
   Specification CM-SP-MULPIv3.0-I08-080522, Subscriber Management
   TLVs section in the Common Radio Frequency Interface Encodings
   Annex."
DEFVAL { false }
 ::= { docsIf3MdCfgEntry 13 }

```

```

docsIf3MdCfgServiceTypeList OBJECT-TYPE
    SYNTAX      SnmpTagList
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute indicates the list of Service Type IDs
         associated with the MAC Domain.
         During the CM registration process the CMTS will attempt to
         redirect the CM to a MAC Domain where the CM's Service Type TLV
         is contained in this attribute."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Service Type
         Identifier section in the Common Radio Frequency Interface
         Encodings Annex."
    DEFVAL { "" }
    ::= { docsIf3MdCfgEntry 14 }

docsIf3MdCfgBpi2EnforceCtrl OBJECT-TYPE
    SYNTAX      INTEGER {
                    disable(0),
                    qosCfgFileWithBpi2AndCapabPrivSupportEnabled(1),
                    qosCfgFileWithBpi2Enabled(2),
                    qosCfgFile(3),
                    total(4)
                }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute indicates the level of BPI+ enforcement
         policies with the MAC Domain.

         The following BPI+ enforcement policies are defined in
         the case where BPI+ is enabled:

         The option 'disable' indicates the CMTS does not enforce BPI+.

         The option 'qosCfgFileWithBpi2AndCapabPrivSupportEnabled'
         indicates the CMTS enforces BPI+ on CMs that register with a
         DOCSIS 1.1 style configuration file with parameters indicating
         BPI+ is enabled (missing TLV 29 or containing TLV 29 set to
         enable) and with a Modem Capabilities Privacy Support TLV (5.6)
         set to BPI+ support.

         The option 'qosCfgFileWithBpi2Enabled' indicates the CMTS
         enforces BPI+ on CMs that register with a DOCSIS 1.1 style
         configuration file with parameters indicating BPI+ is enabled
         (missing TLV 29 or containing TLV 29 set to enable).

         The option 'qosCfgFile' indicates the CMTS enforces BPI+ on CMs
         that register with a DOCSIS 1.1 style configuration file.

         The option 'total' indicates the CMTS enforces BPI+ on all CMs."
    REFERENCE
        "DOCSIS 3.0 Security Specification CM-SP-SECv3.0-I12-100115,
         BPI+ Enforcement section."
    DEFVAL { qosCfgFileWithBpi2Enabled }
    ::= { docsIf3MdCfgEntry 15 }

docsIf3MdCfgEnergyMgt1x1Enabled OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current

```

```

DESCRIPTION
    "This attribute indicates whether the CMTS is configured for
    1x1 Energy Management Mode of operation on a per MAC Domain
    basis. If this attribute is set to 'true', the CMTS is
    configured for 1x1 Energy Management Mode of operation on this
    MAC Domain. If this attribute is set to 'false', the Energy
    Management 1x1 Mode of operation is disabled in the CMTS on
    this MAC Domain"
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I20-121113,
    Energy Management Capabilities section."
DEFVAL { false }
 ::= { docsIf3MdCfgEntry 16 }

docsIf3BondingGrpCfgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3BondingGrpCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines statically configured Downstream
    Bonding Groups and Upstream Bonding Groups on
    the CMTS.
    This object supports the creation and deletion of multiple
    instances.
    Creation of a new instance of this object requires the
    ChList attribute to be set."
 ::= { docsIf3MibObjects 17 }

docsIf3BondingGrpCfgEntry OBJECT-TYPE
SYNTAX      DocsIf3BondingGrpCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3BondingGrpCfgTable.
    The ifIndex key corresponds to the MAC Domain interface
    where the Bonding Group is configured.
    The CMTS persists all instances of BondingGrpCfg
    across reinitializations."
INDEX {
    ifIndex,
    docsIf3BondingGrpCfgDir,
    docsIf3BondingGrpCfgCfgId
}
 ::= { docsIf3BondingGrpCfgTable 1 }

DocsIf3BondingGrpCfgEntry ::= SEQUENCE {
    docsIf3BondingGrpCfgDir
        IfDirection,
    docsIf3BondingGrpCfgCfgId
        Unsigned32,
    docsIf3BondingGrpCfgChList
        ChannelList,
    docsIf3BondingGrpCfgSfProvAttrMask
        AttributeMask,
    docsIf3BondingGrpCfgDsidReseqWaitTime
        Unsigned32,
    docsIf3BondingGrpCfgDsidReseqWarnThrshld
        Unsigned32,
    docsIf3BondingGrpCfgRowStatus
        RowStatus
}

```

```
docsIf3BondingGrpCfgDir OBJECT-TYPE
    SYNTAX      IfDirection
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute defines the ordered list of channels
         that comprise the channel set"
    ::= { docsIf3BondingGrpCfgEntry 1 }

docsIf3BondingGrpCfgCfgId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the configured bonding group
         identifier in the indicated direction for the MAC Domain.
         This attribute is used for the sole purpose of tracking
         bonding groups defined by management systems."
    ::= { docsIf3BondingGrpCfgEntry 2 }

docsIf3BondingGrpCfgChList OBJECT-TYPE
    SYNTAX      ChannelList (SIZE (2..255))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute contains the list of channels of the
         bonding group."
    ::= { docsIf3BondingGrpCfgEntry 3 }

docsIf3BondingGrpCfgSfProvAttrMask OBJECT-TYPE
    SYNTAX      AttributeMask
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the Provisioned Attribute
         Mask encoding for the bonding group."
    DEFVAL { '80000000'H }
    ::= { docsIf3BondingGrpCfgEntry 4 }

docsIf3BondingGrpCfgDsidReseqWaitTime OBJECT-TYPE
    SYNTAX      Unsigned32 (0 | 1..180 | 255)
    UNITS      "hundredMicroseconds"
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "For a Downstream Bonding Group, this attribute provides
         the DSID Resequencing Wait Time that is to be used
         for all DSIDs associated with this Downstream Bonding
         Group. The value of 255 indicates that the DSID
         Resequencing Wait Time is determined by the CMTS. The
         value zero is not supported for downstream bonding
         groups.
        For an Upstream Bonding Group, this attribute has no
         meaning and returns the value 0."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Service Flow
         Assignment section."
    DEFVAL { 255 }
    ::= { docsIf3BondingGrpCfgEntry 5 }

docsIf3BondingGrpCfgDsidReseqWarnThrshld OBJECT-TYPE
    SYNTAX      Unsigned32 (0..179 | 255)
```

```

UNITS      "hundredMicroseconds"
MAX-ACCESS read-create
STATUS     current
DESCRIPTION
  "For a Downstream Bonding Group, this attribute provides
  the DSID Resequencing Warning Threshold that
  is to be used for all DSIDs associated with this Downstream
  Bonding Group. The value of 255 indicates that
  the DSID Resequencing Warning Threshold is determined
  by the CMTS. The value of 0 indicates that the threshold
  warnings are disabled. When
  the value of DsidReseqWaitTime is not equal to 0 or 255,
  the CMTS must ensure that the value of this object is either
  255 or less than the value of DsidReseqWaitTime."
DEFVAL { 255 }
 ::= { docsIf3BondingGrpCfgEntry 6 }

docsIf3BondingGrpCfgRowStatus OBJECT-TYPE
SYNTAX     RowStatus
MAX-ACCESS read-create
STATUS     current
DESCRIPTION
  "The status of this instance."
 ::= { docsIf3BondingGrpCfgEntry 7 }

docsIf3DsBondingGrpStatusTable OBJECT-TYPE
SYNTAX     SEQUENCE OF DocsIf3DsBondingGrpStatusEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
  "This object returns administratively-configured
  and CMTS defined downstream bonding groups."
 ::= { docsIf3MibObjects 18}

docsIf3DsBondingGrpStatusEntry OBJECT-TYPE
SYNTAX     DocsIf3DsBondingGrpStatusEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
  "The conceptual row of docsIf3DsBondingGrpStatusTable.
  The ifIndex key corresponds to the MAC Domain interface
  where the Bonding Group is configured."
INDEX {
  ifIndex,
  docsIf3DsBondingGrpStatusChSetId
}
 ::= { docsIf3DsBondingGrpStatusTable 1 }

DocsIf3DsBondingGrpStatusEntry ::= SEQUENCE {
  docsIf3DsBondingGrpStatusChSetId
    ChSetId,
  docsIf3DsBondingGrpStatusMdDsSgId
    Unsigned32,
  docsIf3DsBondingGrpStatusCfgId
    Unsigned32
}

docsIf3DsBondingGrpStatusChSetId OBJECT-TYPE
SYNTAX     ChSetId
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
  "This key represents the identifier for the Downstream

```

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    Bonding Group or the single-downstream channel
    of this instance."
 ::= { docsIf3DsBondingGrpStatusEntry 1 }

docsIf3DsBondingGrpStatusMdDsSgId OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute corresponds to the MD-DS-SG-ID that
    includes all the downstream channels of the Downstream
    Bonding Group. The value zero indicates that the
    bonding group does not contain channels from a single
    MD-DS-SG and therefore the bonding group is not valid
    and usable."
 ::= { docsIf3DsBondingGrpStatusEntry 2 }

docsIf3DsBondingGrpStatusCfgId OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute provides the BondingGrpCfgId for
    the downstream bonding group if it was configured.
    Otherwise, the zero value indicates that the CMTS will
    define the bonding group."
 ::= { docsIf3DsBondingGrpStatusEntry 3 }

docsIf3UsBondingGrpStatusTable OBJECT-TYPE
SEQUENCE OF DocsIf3UsBondingGrpStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object returns administratively-configured
    and CMTS-defined upstream bonding groups."
 ::= { docsIf3MibObjects 19}

docsIf3UsBondingGrpStatusEntry OBJECT-TYPE
SYNTAX      DocsIf3UsBondingGrpStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3UsBondingGrpStatusTable.
    The ifIndex key corresponds to the MAC Domain interface
    where the Bonding Group is configured."
INDEX {
    ifIndex,
    docsIf3UsBondingGrpStatusChSetId
}
 ::= { docsIf3UsBondingGrpStatusTable 1 }

DocsIf3UsBondingGrpStatusEntry ::= SEQUENCE {
    docsIf3UsBondingGrpStatusChSetId
        ChSetId,
    docsIf3UsBondingGrpStatusMdUsSgId
        Unsigned32,
    docsIf3UsBondingGrpStatusCfgId
        Unsigned32
}

docsIf3UsBondingGrpStatusChSetId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  not-accessible

```

```

STATUS      current
DESCRIPTION
    "This key represents the identifier for the Upstream
    Bonding Group or the single-upstream channel of this
    instance."
 ::= { docsIf3UsBondingGrpStatusEntry 1 }

docsIf3UsBondingGrpStatusMdUsSgId OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute corresponds to the MD-US-SG-ID that
    includes all the upstream channels of the Upstream
    Bonding Group. The value zero indicates that the bonding
    group does not contain channels from a single MD-US-SG
    and therefore the bonding group is not valid
    and usable."
 ::= { docsIf3UsBondingGrpStatusEntry 2 }

docsIf3UsBondingGrpStatusCfgId OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute provides the BondingGrpCfgId for
    the upstream bonding group if it was configured.
    Otherwise, the zero value indicates that the CMTS
    defines the bonding group."
 ::= { docsIf3UsBondingGrpStatusEntry 3 }

docsIf3UsChExtTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3UsChExtEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines management extensions for upstream
    channels, in particular SCDMA parameters."
 ::= { docsIf3MibObjects 20}

docsIf3UsChExtEntry OBJECT-TYPE
SYNTAX      DocsIf3UsChExtEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3UsChExtTable.
    The ifIndex key corresponds to each of the upstream
    channels."
INDEX {
    ifIndex
}
 ::= { docsIf3UsChExtTable 1 }

DocsIf3UsChExtEntry ::= SEQUENCE {
    docsIf3UsChExtSacCodeHoppingSelectionMode
        INTEGER,
    docsIf3UsChExtScdmaSelectionStringActiveCodes
        ScdmaSelectionString
}

docsIf3UsChExtSacCodeHoppingSelectionMode OBJECT-TYPE
SYNTAX      INTEGER {
    none(0),

```

```

        sac1NoCodeHopping(1),
        sac1CodeHoppingMode1(2),
        sac2CodeHoppingMode2(3),
        sac2NoCodeHopping(4)
    }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the selection mode for active
     codes and code hopping.
    'none'
        Non-SCDMA channel
    'sac1NoCodeHopping'
        Selectable active codes mode 1 and code hopping disabled

    'sac1CodeHoppingMode1'
        Selectable active codes mode 1 and code hopping mode
1
    'sac2CodeHoppingMode2'
        Selectable active codes mode 2 and code hopping mode
2
    'sac2NoCodeHopping'
        Selectable active codes mode 2 and code hopping disabled."
REFERENCE
    "DOCSIS 3.0 Physical Layer Specification
     CM-SP-PHYv3.0-I05-070803, Mini-slot Numbering
     Parameters in UCD section."
::= { docsIf3UsChExtEntry 1 }

```

```

docsIf3UsChExtScdmaSelectionStringActiveCodes OBJECT-TYPE
SYNTAX      ScdmaSelectionString
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the active codes of the
     upstream channel and it is applicable only when
     SacCodeHoppingSelectionMode is 'sac2CodeHoppingMode2.'"
REFERENCE
    "DOCSIS 3.0 Physical Layer Specification
     CM-SP-PHYv3.0-I05-070803, Mini-slot Numbering
     Parameters in UCD section."
::= { docsIf3UsChExtEntry 2 }

```

```
docsIf3CmCapabilities OBJECT IDENTIFIER ::= { docsIf3MibObjects 21 }
```

```

docsIf3CmCapabilitiesReq OBJECT-TYPE
SYNTAX      Tlv8
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the TLV encoding for TLV-5
     sent in a REG-REQ. The first byte of this encoding is
     expected to be '05'H."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Modem Capabilities
     Encoding section in the Common Radio Frequency Interface
     Encodings Annex."
::= { docsIf3CmCapabilities 1 }

```

```

docsIf3CmCapabilitiesRsp OBJECT-TYPE
SYNTAX      Tlv8
MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
    "This attribute contains the TLV encoding for TLV-5
    received in a REG-RSP.
    The first byte of this encoding is expected to be '05'H."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Modem Capabilities
    Encoding section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsIf3CmCapabilities 2 }

docsIf3UsChSetTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3UsChSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines a set of upstream channels. These
    channel sets may be associated with channel bonding
    groups, MD-US-SGs, MD-CM-SGs, or any other channel
    set that the CMTS may derive from other CMTS processes."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Partial
    Service Encoding section and Cable Modem Attribute
    Masks section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsIf3MibObjects 22}

docsIf3UsChSetEntry OBJECT-TYPE
SYNTAX      DocsIf3UsChSetEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3UsChSetTable.
    The ifIndex key corresponds to the MAC Domain interface
    where the upstream channel set is defined."
INDEX {
    ifIndex,
    docsIf3UsChSetId
}
 ::= { docsIf3UsChSetTable 1 }

DocsIf3UsChSetEntry ::= SEQUENCE {
    docsIf3UsChSetId
        ChSetId,
    docsIf3UsChSetChList
        ChannelList
}

docsIf3UsChSetId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key defines a reference identifier for the upstream
    channel set within the MAC Domain."
 ::= { docsIf3UsChSetEntry 1 }

docsIf3UsChSetChList OBJECT-TYPE
SYNTAX      ChannelList (SIZE (0 | 2..255))
MAX-ACCESS  read-only
STATUS      current

```

```

DESCRIPTION
    "This attribute defines the ordered list of channels
     that comprise the upstream channel set"
 ::= { docsIf3UsChSetEntry 2 }

docsIf3DsChSetTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3DsChSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object defines a set of downstream channels.
         These channel sets may be associated with channel bonding
         groups, MD-DS-SGs, MD-CM-SGs, or any other channel
         set that the CMTS may derive from other CMTS processes."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Partial
         Service Encoding section and Cable Modem Attribute
         Masks section in the Common Radio Frequency Interface
         Encodings Annex."
 ::= { docsIf3MibObjects 23}

docsIf3DsChSetEntry OBJECT-TYPE
    SYNTAX      DocsIf3DsChSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3DsChSetTable.
         The ifIndex key corresponds to the MAC Domain interface
         where the downstream channel set is defined."
    INDEX {
        ifIndex,
        docsIf3DsChSetId
    }
 ::= { docsIf3DsChSetTable 1 }

DocsIf3DsChSetEntry ::= SEQUENCE {
    docsIf3DsChSetId
        ChSetId,
    docsIf3DsChSetChList
        ChannelList
}

docsIf3DsChSetId OBJECT-TYPE
    SYNTAX      ChSetId
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key defines a reference identifier for the downstream
         channel set within the MAC Domain."
 ::= { docsIf3DsChSetEntry 1 }

docsIf3DsChSetChList OBJECT-TYPE
    SYNTAX      ChannelList (SIZE (0 | 2..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute defines the ordered list of channels
         that comprise the downstream channel set."
 ::= { docsIf3DsChSetEntry 2 }

docsIf3SignalQualityExtTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3SignalQualityExtEntry

```

```

MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
  "This object provides an in-channel received modulation
  error ratio metric for CM and CMTS."
 ::= { docsIf3MibObjects 24}

docsIf3SignalQualityExtEntry OBJECT-TYPE
  SYNTAX DocsIf3SignalQualityExtEntry
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "The conceptual row of docsIf3SignalQualityExtTable.
     At the CM, this object describes the received modulation
     error ratio of each downstream channel. At the CMTS,
     it describes the received modulation error ratio of each
     logical upstream channel.
     An entry in this table exists for each ifEntry with an
     ifType of docsCableDownstream(128) for Cable Modems.
     For Cable Modem Termination Systems, an entry exists for
     each ifEntry with an ifType of docsCableUpstreamChannel(205)."
  INDEX {
    ifIndex
  }
 ::= { docsIf3SignalQualityExtTable 1 }

DocsIf3SignalQualityExtEntry ::= SEQUENCE {
  docsIf3SignalQualityExtRxMER
    TenthdB,
  docsIf3SignalQualityExtRxMerSamples
    Unsigned32
}

docsIf3SignalQualityExtRxMER OBJECT-TYPE
  SYNTAX TenthdB (-2147483648..2147483647)
  UNITS "TenthdB"
  MAX-ACCESS read-only
  STATUS current
  DESCRIPTION
    "RxMER provides an in-channel received Modulation
     Error Ratio (MER). RxMER is defined as an estimate,
     provided by the demodulator, of the ratio:
     (average constellation energy with equally likely
     symbols) / (average squared magnitude of error vector)

     RxMER is measured just prior to FEC (trellis/Reed-Solomon)
     decoding. RxMER includes the effects of the
     HFC channel as well as implementation effects of the
     modulator and demodulator. Error vector estimation
     may vary among demodulator implementations. The CMTS
     RxMER is averaged over a given number of bursts at
     the burst receiver, which may correspond to transmissions
     from multiple users. In the case of S-CDMA mode,
     RxMER is measured on the de-spread signal."
 ::= { docsIf3SignalQualityExtEntry 1 }

docsIf3SignalQualityExtRxMerSamples OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS read-only
  STATUS current
  DESCRIPTION
    "RxMerSamples is a statistically significant number
     of symbols for the CM, or bursts for the CMTS, processed

```

to arrive at the RxMER value. For the CMTS, the MER measurement includes only valid bursts that are not in contention regions."

```
::= { docsIf3SignalQualityExtEntry 2 }
```

docsIf3CmtsSignalQualityExtTable OBJECT-TYPE

SYNTAX SEQUENCE OF DocsIf3CmtsSignalQualityExtEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This object provides metrics and parameters associated with received carrier, noise and interference power levels in the upstream channels of the CMTS."

```
::= { docsIf3MibObjects 25 }
```

docsIf3CmtsSignalQualityExtEntry OBJECT-TYPE

SYNTAX DocsIf3CmtsSignalQualityExtEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The conceptual row of docsIf3CmtsSignalQualityExtTable. The ifIndex key corresponds to each of the upstream channels. The CMTS persists the configured values of all instances of CmtsSignalQualityExt across reinitialization."

INDEX {

    ifIndex

}

```
::= { docsIf3CmtsSignalQualityExtTable 1 }
```

DocsIf3CmtsSignalQualityExtEntry ::= SEQUENCE {

    docsIf3CmtsSignalQualityExtCNIR  
        TenthdB,  
    docsIf3CmtsSignalQualityExtExpectedRxSignalPower  
        TenthdBmV

}

docsIf3CmtsSignalQualityExtCNIR OBJECT-TYPE

SYNTAX TenthdB

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This attribute provides an upstream in-channel Carrier-to-Noise plus Interference Ratio (CNIR). CNIR is defined as the ratio of the expected commanded received signal power at the CMTS input, assuming QPSK0 modulation, to the noise plus interference in the channel.

This measurement occurs prior to the point at which the desired CM signal, when present, is demodulated. The measurement includes the effect of the receive matched filter but does not include the effect of any ingress filtering. Both the signal power and noise/interference power are referenced to the same point, e.g., CMTS input."

```
::= { docsIf3CmtsSignalQualityExtEntry 1 }
```

docsIf3CmtsSignalQualityExtExpectedRxSignalPower OBJECT-TYPE

SYNTAX TenthdBmV

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"ExpectedReceivedSignalPower is the power of the expected commanded received signal in the channel,

```

referenced to the CMTS input."
 ::= { docsIf3CmtsSignalQualityExtEntry 2 }

docsIf3CmtsSpectrumAnalysisMeasTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3CmtsSpectrumAnalysisMeasEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object is used to configure the logical upstream
         interfaces to perform the spectrum measurements.
         This object supports creation and deletion of instances."
    ::= { docsIf3MibObjects 26}

docsIf3CmtsSpectrumAnalysisMeasEntry OBJECT-TYPE
    SYNTAX      DocsIf3CmtsSpectrumAnalysisMeasEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3CmtsSpectrumAnalysisMeasTable.
         The ifIndex key corresponds to each of the upstream
         channels.
         The CMTS is not required to persist instances of this
         object across reinitializations."
    INDEX {
        ifIndex
    }
    ::= { docsIf3CmtsSpectrumAnalysisMeasTable 1 }

DocsIf3CmtsSpectrumAnalysisMeasEntry ::= SEQUENCE {
    docsIf3CmtsSpectrumAnalysisMeasAmplitudeData
        AmplitudeData,
    docsIf3CmtsSpectrumAnalysisMeasTimeInterval
        Unsigned32,
    docsIf3CmtsSpectrumAnalysisMeasRowStatus
        RowStatus
}

docsIf3CmtsSpectrumAnalysisMeasAmplitudeData OBJECT-TYPE
    SYNTAX      AmplitudeData
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute provides a list of the spectral amplitudes
         corresponding to the frequency bins ordered
         from lowest to highest frequencies covering the frequency
         span. Information about the center frequency,
         frequency span, number of bins and resolution bandwidth
         are included to provide context to the measurement
         point
         The CMTS must support the number of bins as an odd number
         in order to provide a spectrum representation that
         is symmetric about the middle data point or bin. The
         CMTS must support a number of bins greater than or equal
         to 257 for frequency spans greater than or equal to
         6.4 MHz.

         The CMTS must not exceed 25 kHz bin spacing for measurement
         of frequency spans less than or equal to 6.4 MHz.

         The bins measurements are updated periodically at time
         intervals given by the TimeInterval attribute."
    ::= { docsIf3CmtsSpectrumAnalysisMeasEntry 1 }

```

```

docsIf3CmtsSpectrumAnalysisMeasTimeInterval OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "milliseconds"
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "TimeInterval is the CMTS estimated average repetition
         period of measurements. This attribute defines
         the average rate at which new spectra can be retrieved."
    ::= { docsIf3CmtsSpectrumAnalysisMeasEntry 2 }

docsIf3CmtsSpectrumAnalysisMeasRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS     current
    DESCRIPTION
        "The status of this instance."
    ::= { docsIf3CmtsSpectrumAnalysisMeasEntry 3 }

docsIf3CmtsCmCtrl OBJECT IDENTIFIER ::= { docsIf3MibObjects 27 }

docsIf3CmtsCmCtrlCmdMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "This attribute represents the MAC Address of the CM which the
         CMTS is instructed to send the CM-CTRL-REQ message."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522,
         Media Access Control Specification section."
    DEFVAL { '000000000000' }
    ::= { docsIf3CmtsCmCtrl 1 }

docsIf3CmtsCmCtrlCmdMuteUsChId OBJECT-TYPE
    SYNTAX      ChId
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "This attribute represents the Upstream Channel ID (UCID) to
         mute or unmute. A value of zero indicates all upstream
         channels. This attribute is only applicable when the
         docsIf3CmtsCmCtrlCmdCommit attribute is set to
         'mute'."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522,
         Media Access Control Specification section."
    DEFVAL { 0 }
    ::= { docsIf3CmtsCmCtrl 2 }

docsIf3CmtsCmCtrlCmdMuteInterval OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "milliseconds"
    MAX-ACCESS  read-write
    STATUS     current
    DESCRIPTION
        "This attribute represents the length of time that the mute
         operation is in effect. This attribute is only applicable
         when the docsIf3CmtsCmCtrlCmdCommit attribute is set to
         'mute'. A value of 0 is an indication to unmute the
         channel referenced by the docsIf3CmtsCmCtrlCmdMuteUsChId

```

```

attribute while a value of 0xFFFFFFFF is used to mute
the channel referenced by the docsIf3CmtsCmCtrlCmdMuteUsChId
attribute indefinitely."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522,
  Media Access Control Specification section."
DEFVAL { 1 }
 ::= { docsIf3CmtsCmCtrl 3 }

docsIf3CmtsCmCtrlCmdDisableForwarding OBJECT-TYPE
SYNTAX     TruthValue
MAX-ACCESS  read-write
STATUS     current
DESCRIPTION
  "When set to 'true', this attribute disables data forwarding
  to the CMCI when the docsIf3CmtsCmCtrlCmdCommit attribute is
  set to 'disableForwarding'.
  When set to 'false', this attribute enables data forwarding
  to the CMCI when the docsIf3CmtsCmCtrlCmdCommit attribute is
  set to 'disableForwarding'.
  This attribute is only applicable when the
  docsIf3CmtsCmCtrlCmdCommit attribute is set to
  'disableForwarding'.""
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522,
  Media Access Control Specification section."
DEFVAL { false }
 ::= { docsIf3CmtsCmCtrl 4 }

docsIf3CmtsCmCtrlCmdCommit OBJECT-TYPE
SYNTAX     INTEGER {
            mute(1),
            cmReinit(2),
            disableForwarding(3) }
MAX-ACCESS  read-write
STATUS     current
DESCRIPTION
  "This attribute indicates the type of command for the
  CMTS to trigger in the CM-CTRL-REQ message.
  This attribute will return the value of the last operation
  performed or the default value if no operation has been
  performed."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522,
  Media Access Control Specification section."
DEFVAL { mute }
 ::= { docsIf3CmtsCmCtrl 5 }

docsIf3CmDpvStatsTable OBJECT-TYPE
SYNTAX     SEQUENCE OF DocsIf3CmDpvStatsEntry
MAX-ACCESS  not-accessible
STATUS     current
DESCRIPTION
  "This object represents the DOCSIS Path Verify Statistics
  collected in the cable modem device.
  The CMTS controls the logging of DPV statistics in the
  cable modem. Therefore the context and nature of the
  measurements are governed by the CMTS and not self-descriptive
  when read from the CM."
 ::= { docsIf3MibObjects 28}

```

```

docsIf3CmDpvStatsEntry OBJECT-TYPE
    SYNTAX      DocsIf3CmDpvStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3CmDpvStatsTable."
    INDEX {
        ifIndex,
        docsIf3CmDpvStatsGrpId
    }
 ::= { docsIf3CmDpvStatsTable 1 }

DocsIf3CmDpvStatsEntry ::= SEQUENCE {
    docsIf3CmDpvStatsGrpId
        Unsigned32,
    docsIf3CmDpvStatsLastMeasLatency
        Unsigned32,
    docsIf3CmDpvStatsLastMeasTime
        DateAndTime,
    docsIf3CmDpvStatsMinLatency
        Unsigned32,
    docsIf3CmDpvStatsMaxLatency
        Unsigned32,
    docsIf3CmDpvStatsAvgLatency
        Unsigned32,
    docsIf3CmDpvStatsNumMeas
        Unsigned32,
    docsIf3CmDpvStatsLastClearTime
        DateAndTime
}

docsIf3CmDpvStatsGrpId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..2)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the DPV Group ID. The CM reports
         two instance of DPV statistics per downstream normally
         referred as Statistical Group 1 and Statistical
         Group 2."
 ::= { docsIf3CmDpvStatsEntry 1 }

docsIf3CmDpvStatsLastMeasLatency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "nanoseconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the last latency measurement
         for this statistical group."
 ::= { docsIf3CmDpvStatsEntry 2 }

docsIf3CmDpvStatsLastMeasTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the last measurement time
         of the last latency measurement for this statistical
         group.
        This attribute reports the EPOC time value when no measurements
         are being reported or after the statistics

```

```

        were cleared."
 ::= { docsIf3CmDpvStatsEntry 3 }

docsIf3CmDpvStatsMinLatency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "nanoseconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the minimum latency measurement
         for this statistical group since the last
         time statistics were cleared."
 ::= { docsIf3CmDpvStatsEntry 4 }

docsIf3CmDpvStatsMaxLatency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "nanoseconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the maximum latency measurement
         for this statistical group since the last
         time statistics were cleared."
 ::= { docsIf3CmDpvStatsEntry 5 }

docsIf3CmDpvStatsAvgLatency OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "nanoseconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the average latency measurement
         for this statistical group since the last
         time statistics were cleared. The averaging mechanism
         is controlled by the CMTS, and can be a simple average
         (mean) or an exponential moving average."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, DOCSIS Path
         Verification section."
 ::= { docsIf3CmDpvStatsEntry 6 }

docsIf3CmDpvStatsNumMeas OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "measurements"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the number of latency measurements
         made for this statistical group since the
         last time statistics were cleared."
 ::= { docsIf3CmDpvStatsEntry 7 }

docsIf3CmDpvStatsLastClearTime OBJECT-TYPE
    SYNTAX      DateAndTime
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the last time statistics
         were cleared for this statistical group."
 ::= { docsIf3CmDpvStatsEntry 8 }

docsIf3CmEventCtrlTable OBJECT-TYPE

```

```

SYNTAX      SEQUENCE OF DocsIf3CmEventCtrlEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object represents the control mechanism to enable the
     dispatching of events based on the event Id. The following
     rules define the event control behavior:

    - The CmEventCtrl object has no instances or contains an
      instance with Event ID 0. All events matching the Local Log
      settings of docsDevEvReporting are sent to local log ONLY.

    - The CmEventCtrl object contains configured instances
      Only events matching the Event IDs configured in the object
      are sent according to the settings of the docsDevEvReporting
      object.

    The CM does not persist instances of CmEventCtrl across
    reinitializations."
REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
     Specification CM-SP-OSSIv3.0-I11-100115, Section N.2.2.5
     CmEventCtrl Object."
::= { docsIf3MibObjects 29}

docsIf3CmEventCtrlEntry OBJECT-TYPE
SYNTAX      DocsIf3CmEventCtrlEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3CmEventCtrlTable."
INDEX {
    docsIf3CmEventCtrlEventId
}
 ::= { docsIf3CmEventCtrlTable 1 }

DocsIf3CmEventCtrlEntry ::= SEQUENCE {
    docsIf3CmEventCtrlEventId
        Unsigned32,
    docsIf3CmEventCtrlStatus
        RowStatus
}

docsIf3CmEventCtrlEventId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the Event ID of the event being
     enabled for delivery to a dispatch mechanism (e.g., syslog)."
REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
     Specification CM-SP-OSSIv3.0-I07-080522, Format and Content
     for Event, Syslog, and SNMP Notification Annex."
::= { docsIf3CmEventCtrlEntry 1 }

docsIf3CmEventCtrlStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "The status of this instance."
::= { docsIf3CmEventCtrlEntry 2 }

```

```

docsIf3CmtsEventCtrlTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3CmtsEventCtrlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object represents the control mechanism to enable the
         dispatching of events based on the event Id. The following
         rules define the event control behavior:
         

- o The CmtsEventCtrl object has no instances or contains an instance with
             Event ID 0. All events matching the Local Log settings of docsDevEvReporting are
             sent to local log ONLY.
- o The CmtsEventCtrl object contains configured instances
             Only events matching the Event IDs configured in the object
             are sent according to the settings of the docsDevEvReporting
             object.
- o The CMTS persists all instances of CmtsEventCtrl across
             reinitializations."


    REFERENCE
        "DOCSIS 3.0 Operations Support System Interface Specification
         CM-SP-OSSIv3.0-I11-100115, Section N.2.3.4 CmtsEventCtrl Object."
        ::= { docsIf3MibObjects 30}

docsIf3CmtsEventCtrlEntry OBJECT-TYPE
    SYNTAX      DocsIf3CmtsEventCtrlEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3CmtsEventCtrlTable."
    INDEX {
        docsIf3CmtsEventCtrlEventId
    }
    ::= { docsIf3CmtsEventCtrlTable 1 }

DocsIf3CmtsEventCtrlEntry ::= SEQUENCE {
    docsIf3CmtsEventCtrlEventId
        Unsigned32,
    docsIf3CmtsEventCtrlStatus
        RowStatus
}

docsIf3CmtsEventCtrlEventId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the Event ID of the event being
         enabled for delivery to a dispatch mechanism (e.g., syslog)."
    REFERENCE
        "DOCSIS 3.0 Operations Support System Interface
         Specification CM-SP-OSSIv3.0-I07-080522, Format and Content
         for Event, Syslog, and SNMP Notification Annex."
        ::= { docsIf3CmtsEventCtrlEntry 1 }

docsIf3CmtsEventCtrlStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION

```

```

        "The status of this instance."
 ::= { docsIf3CmtsEventCtrlEntry 2 }

docsIf3CmMdCfgTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3CmMdCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object contains CM MAC domain level control and
         configuration attributes."
 ::= { docsIf3MibObjects 31}

docsIf3CmMdCfgEntry OBJECT-TYPE
    SYNTAX      DocsIf3CmMdCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsIf3CmMdCfgTable.
         The ifIndex key corresponds to the MAC Domain interface."
    INDEX {
        ifIndex
    }
 ::= { docsIf3CmMdCfgTable 1 }

DocsIf3CmMdCfgEntry ::= SEQUENCE {
    docsIf3CmMdCfgIpProvMode
        INTEGER,
    docsIf3CmMdCfgIpProvModeResetOnChange
        TruthValue,
    docsIf3CmMdCfgIpProvModeResetOnChangeHoldOffTimer
        Unsigned32,
    docsIf3CmMdCfgIpProvModeStorageType
        StorageType
}

docsIf3CmMdCfgIpProvMode OBJECT-TYPE
    SYNTAX      INTEGER {
        ipv4Only(0),
        ipv6Only(1),
        honorMdd(4)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute specifies whether the CM honors or ignores the CMTS MDD TLV
5.1
        setting in order to configure its IP provisioning mode. The CM relies upon the
        CMTS to facilitate the successful IP address acquisition independently of
        the MDD.
        When this attribute is set to 'ipv4Only' the CM will
        initiate the acquisition of a single IPv4 address for the CM management stack.
        When this attribute is set to 'ipv6Only' the CM will
        initiate the acquisition of a single IPv6 address for the CM management stack.
        When this attribute is set to 'honorMdd' the CM will
        initiate the acquisition of an IPv6 or IPv4 address as directed by the MDD
message for
        provisioning and operation."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I14-101008, IP Initialization
         Parameters TLV section."
    DEFVAL { honorMdd }
 ::= { docsIf3CmMdCfgEntry 1 }

```

```

docsIf3CmMdCfgIpProvModeResetOnChange OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute determines if the CM is to automatically
         reset upon change of the IpProvMode attribute. The attribute has a
         default value of 'false' (2) which means that the CM does not reset
         upon change to IpProvMode attribute. When this attribute is set to
         'true' (1), the CM resets upon a change to the IpProvMode attribute."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I14-101008, IP Initialization
         Parameters TLV section."
    DEFVAL { false }
    ::= { docsIf3CmMdCfgEntry 2 }

docsIf3CmMdCfgIpProvModeResetOnChangeHoldOffTimer OBJECT-TYPE
    SYNTAX      Unsigned32 (0..300)
    UNITS      "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute determines how long a CM with
         IpProvModeResetOnChange set to 'true' waits to reset. When the
         IpProvModeResetOnChange attribute is set to 'true' (1), the CM
         will decrement from the configured timer value before resetting.
         The default value of the IpProvModeResetOnChangeHoldOffTimer is 0
         seconds which is equivalent to an immediate reset."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I14-101008, IP Initialization
         Parameters TLV section."
    DEFVAL { 0 }
    ::= { docsIf3CmMdCfgEntry 3 }

docsIf3CmMdCfgIpProvModeStorageType OBJECT-TYPE
    SYNTAX      StorageType
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute determines if the CM persists the value of
         IpProvMode across a single reset or across all resets. The
         default value of this attribute is 'nonVolatile' (3) which means
         that the CM persists the value of IpProvMode across all resets.
         The CM persists the value of IpProvMode across only a single
         reset when IpProvModeStorageType is set to volatile(2). Other
         StorageType values are not applicable for this object; an attempt to
         set this object to a value of other(1), permanent(4), or readOnly(5)
         will be rejected with an error code of inconsistentValue."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I14-101008, IP Initialization
         Parameters TLV section."
    DEFVAL { nonVolatile }
    ::= { docsIf3CmMdCfgEntry 4 }

docsIf3CmEnergyMgtCfg OBJECT IDENTIFIER ::= { docsIf3MibObjects 32 }

docsIf3CmEnergyMgtCfgFeatureEnabled OBJECT-TYPE
    SYNTAX      BITS{emlx1Feature(0)}
    MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
    "This attribute indicates which energy savings features have
    been enabled in the Cable Modem. The CM enables use of Energy
    Management Features only if both the Energy Management Feature
    Control TLV and Energy Management Modem Capability Response from
    the CMTS indicate that the feature is enabled. If bit 0 is set,
    the Energy Management 1x1 Mode feature is enabled."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I20-121113,
    Energy Management Feature Control section."
::= { docsIf3CmEnergyMgtCfg 1 }

docsIf3CmEnergyMgtCfgCyclePeriod OBJECT-TYPE
SYNTAX      Unsigned32(0..65535)
UNITS       "seconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies a minimum time period (in seconds)
    that must elapse between EM-REQ transactions in certain
    situations:
        o In the case of Energy Management 1x1 Mode, this attribute
            sets the minimum cycle time that a CM will use for sending
            requests to enter Energy Management 1x1 Mode.

        o In the case that the CM fails to receive an EM-RSP message
            after the maximum number of retries, this attribute sets
            the minimum amount of time to elapse before the CM can
            attempt another EM-REQ transaction."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I20-121113,
    Energy Management Cycle Period section."
DEFVAL { 900 }
 ::= { docsIf3CmEnergyMgtCfg 2 }

docsIf3CmEnergyMgt1x1CfgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsIf3CmEnergyMgt1x1CfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object provides configuration state information
    on the CM for the Energy Management 1x1 Mode feature."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I20-121113,
    Energy Management 1x1 Mode Encodings section."
::= { docsIf3MibObjects 33}

docsIf3CmEnergyMgt1x1CfgEntry OBJECT-TYPE
SYNTAX      DocsIf3CmEnergyMgt1x1CfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsIf3CmEnergyMgt1x1CfgTable."
INDEX {
    docsIf3CmEnergyMgt1x1CfgDirection
}
 ::= { docsIf3CmEnergyMgt1x1CfgTable 1 }

DocsIf3CmEnergyMgt1x1CfgEntry ::= SEQUENCE {

```

```

docsIf3CmEnergyMgt1x1CfgDirection
    IfDirection,
docsIf3CmEnergyMgt1x1CfgEntryBitrateThrshld
    Unsigned32,
docsIf3CmEnergyMgt1x1CfgEntryTimeThrshld
    Unsigned32,
docsIf3CmEnergyMgt1x1CfgExitBitrateThrshld
    Unsigned32,
docsIf3CmEnergyMgt1x1CfgExitTimeThrshld
    Unsigned32
}

docsIf3CmEnergyMgt1x1CfgDirection OBJECT-TYPE
SYNTAX      IfDirection
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This index indicates whether the threshold applies to the
     upstream or downstream."
::= { docsIf3CmEnergyMgt1x1CfgEntry 1 }

docsIf3CmEnergyMgt1x1CfgEntryBitrateThrshld OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bps"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute specifies the upstream or downstream bitrate
     threshold (in bps) below which the CM will request to enter
     Energy Management 1x1 Mode operation."
::= { docsIf3CmEnergyMgt1x1CfgEntry 2 }

docsIf3CmEnergyMgt1x1CfgEntryTimeThrshld OBJECT-TYPE
SYNTAX      Unsigned32 (1..65535)
UNITS       "seconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute specifies the number of consecutive seconds
     that the upstream or downstream data rate needs to remain below
     the Upstream or Downstream Entry Bitrate Threshold in order to
     determine that a transition to Energy Management 1x1 Mode is
     required."
::= { docsIf3CmEnergyMgt1x1CfgEntry 3 }

docsIf3CmEnergyMgt1x1CfgExitBitrateThrshld OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bps"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute specifies the upstream or downstream bitrate
     threshold (in bps) above which the CM will request to leave
     Energy Management 1x1 Mode operation."
::= { docsIf3CmEnergyMgt1x1CfgEntry 4 }

docsIf3CmEnergyMgt1x1CfgExitTimeThrshld OBJECT-TYPE
SYNTAX      Unsigned32 (1..65535)
UNITS       "seconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute specifies the number of consecutive seconds

```

that the upstream or downstream data rate needs to remain above the Upstream or Downstream Exit Bitrate Threshold in order to determine that a transition out of Energy Management 1x1 Mode is required."

```
::= { docsIf3CmEnergyMgt1x1CfgEntry 5 }
```

```
docsIf3CmSpectrumAnalysisCtrlCmd OBJECT IDENTIFIER ::= { docsIf3MibObjects 34}
```

```
docsIf3CmSpectrumAnalysisCtrlCmdEnable OBJECT-TYPE
```

```
SYNTAX      TruthValue
```

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

```
STATUS      current
```

```
DESCRIPTION
```

"This attribute is used to enable or disable the spectrum analyzer feature. Setting this attribute to true triggers the CM to initiate measurements for the spectrum analyzer feature based on the other configuration attributes for the feature. By default, the feature is disabled unless explicitly enabled.

Note that the feature may be disabled by the system under certain circumstances if the spectrum analyzer would affect critical services. In such a case, the attribute will return 'false' when read, and will reject sets to 'true' with an error. Once the feature is enabled, any Set operation on the docsIf3CmSpectrumAnalysisCtrlCmd MIB group might not be effective until the feature is re-enabled again."

```
DEFVAL { false }
```

```
::= { docsIf3CmSpectrumAnalysisCtrlCmd 1 }
```

```
docsIf3CmSpectrumAnalysisCtrlCmdInactivityTimeout OBJECT-TYPE
```

```
SYNTAX      INTEGER (0..86400)
```

```
UNITS      "seconds"
```

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

```
STATUS      current
```

```
DESCRIPTION
```

"This attribute controls the length of time after the last spectrum analysis measurement before the feature is automatically disabled. If set to a value of 0, the feature will remain enabled until it is explicitly disabled."

```
DEFVAL { 300 }
```

```
::= { docsIf3CmSpectrumAnalysisCtrlCmd 2 }
```

```
docsIf3CmSpectrumAnalysisCtrlCmdFirstSegmentCenterFrequency OBJECT-TYPE
```

```
SYNTAX      Unsigned32
```

```
UNITS      "Hz"
```

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

```
STATUS      current
```

```
DESCRIPTION
```

"This attribute controls the center frequency of the first segment for the spectrum analysis measurement. The frequency bins for this segment lie symmetrically to the left and right of this center frequency.

If the number of bins in a segment is odd, the segment center frequency lies directly on the center bin.

If the number of bins in a segment is even, the segment center frequency lies halfway between two bins.

Changing the value of this attribute may result in changes to the docsIf3CmSpectrumAnalysisMeasTable. Note that if this attribute is set to an invalid value, the device may return an error, or may adjust the

```

        value of the attribute to the closest valid value."
DEFVAL { 93000000 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 3 }

docsIf3CmSpectrumAnalysisCtrlCmdLastSegmentCenterFrequency OBJECT-TYPE
SYNTAX      Unsigned32
UNITS      "Hz"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute controls the center frequency of
     the last segment of the spectrum analysis measurement.

    The frequency bins for this segment lie symmetrically
    to the left and right of this center frequency.
    If the number of bins in a segment is odd, the segment
    center frequency lies directly on the center bin.
    If the number of bins in a segment is even, the segment
    center frequency lies halfway between two bins.

    The value of the LastSegmentCenterFrequency attribute
    should be equal to the FirstSegmentCenterFrequency
    plus and integer number of segment spans as determined
    by the SegmentFrequencySpan.

    Changing the value of this attribute may result in changes
    to the docsIf3CmSpectrumAnalysisMeasTable.

    Note that if this attribute is set to an invalid value,
    the device may return an error, or may adjust the
    value of the attribute to the closest valid value."
DEFVAL { 993000000 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 4 }

docsIf3CmSpectrumAnalysisCtrlCmdSegmentFrequencySpan OBJECT-TYPE
SYNTAX      Unsigned32 (1000000..900000000)
UNITS      "Hz"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute controls the frequency span of each
     segment (instance) in the docsIf3CmSpectrumAnalysisMeasTable.

    If set to a value of 0, then a default span will be
    chosen based on the hardware capabilities of the
    device. Segments are contiguous from the
    FirstSegmentCenterFrequency to the
    LastSegmentCenterFrequency and the center frequency
    for each successive segment is incremented by the
    SegmentFrequencySpan.
    The number of segments is (LastSegmentCenterFrequency -
    FirstSegmentCenterFrequency)/SegmentFrequencySpan + 1.
    A segment is equivalent to an instance in the
    docsIf3CmSpectrumAnalysisMeasTable. The chosen
    SegmentFrequencySpan affects the number of entries in
    the docsIf3CmSpectrumAnalysisMeasTable. A more granular
    SegmentFrequencySpan may adversely affect the amount of
    time needed to query the table entries in addition to
    possibly increasing the acquisition time.

    Changing the value of this attribute may result in
    changes to the docsIf3CmSpectrumAnalysisMeasTable.

```

```

Note that if this attribute is set to an invalid value,
the device may return an error, or may adjust the value
of the object to the closest valid value."
DEFVAL { 7500000 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 5 }

docsIf3CmSpectrumAnalysisCtrlCmdNumBinsPerSegment OBJECT-TYPE
SYNTAX      Unsigned32 (2..2048)
UNITS      "bins-per-segment"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute controls the number of bins collected
     by the measurement performed for each segment (instance)
     in the docsIf3CmSpectrumAnalysisMeasTable.

Note that if this attribute is set to an invalid value,
the device may return an error, or may adjust the value
of the attribute to the closest valid value."
DEFVAL { 256 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 6 }

docsIf3CmSpectrumAnalysisCtrlCmdEquivalentNoiseBandwidth OBJECT-TYPE
SYNTAX      Unsigned32 (50..500)
UNITS      "hundredthsbin"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute allows the user to request an equivalent
     noise bandwidth for the resolution bandwidth filter used
     in the spectrum analysis. This corresponds to the
     spectral width of the window function used when performing
     a discrete Fourier transform for the analysis.

The window function which corresponds to a value written
to this object may be obtained by reading the value of the
WindowFunction attribute.

If an unsupported value is requested, the device may
return an error, or choose the closest valid value to the
one which is requested.
If the closest value is chosen, then a subsequent read of
this attribute will return the actual value which is in use."
DEFVAL { 150 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 7 }

docsIf3CmSpectrumAnalysisCtrlCmdWindowFunction OBJECT-TYPE
SYNTAX      SpectrumAnalysisWindowFunction
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute controls or indicates the windowing function
     which will be used when performing the discrete Fourier
     transform for the analysis. The WindowFunction and the
     Equivalent Noise Bandwidth are related. If a particular
     WindowFunction is selected, then the EquivalentNoiseBandwidth
     for the function which is in use, will be reported by the
     EquivalentNoiseBandwidth attribute. Alternatively if
     an EquivalentNoiseBandwidth value is chosen then if a
     WindowFunction function representing that
     EquivalentNoiseBandwidth is defined in the CM, that value will
     be reported in the WindowFunction MIB object, or a value of
     'other' will be reported. Use of 'modern' windowing

```

functions not yet defined will likely be reported as 'other'.

Note that all window functions may not be supported by all devices. If an attempt is made to set the object to an unsupported window function, or if writing of the WindowFunction is not supported, an error will be returned."

```
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 8 }
```

**docsIf3CmSpectrumAnalysisCtrlCmdNumberOfAverages** OBJECT-TYPE

SYNTAX	Unsigned32 (1..1000)
MAX-ACCESS	read-write
STATUS	current

DESCRIPTION

"This attribute controls the number of averages that will be performed on spectral bins. The average will be computed using the 'leaky integrator' method, where:

$$\text{reported bin value} = \alpha * \text{accumulated bin values} + (1-\alpha) * \text{current bin value.}$$

Alpha is one minus the reciprocal of the number of averages. For example, if N=25, then alpha = 0.96. A value of 1 indicates no averaging. Re-writing the number of averages will restart the averaging process. If there are no accumulated values, the accumulators are made equal to the first measured bin amplitudes.

If an attempt is made to set the attribute to an unsupported number of averages, an error will be returned."

```
DEFVAL { 1 }
 ::= { docsIf3CmSpectrumAnalysisCtrlCmd 9 }
```

**docsIf3CmSpectrumAnalysisMeasTable** OBJECT-TYPE

SYNTAX	SEQUENCE OF DocsIf3CmSpectrumAnalysisMeasEntry
MAX-ACCESS	not-accessible
STATUS	current

DESCRIPTION

"This table provides a list of spectral analysis measurements as performed across a range of center frequencies. The table is capable of representing a full scan of the spectrum."

```
 ::= { docsIf3MibObjects 35 }
```

**docsIf3CmSpectrumAnalysisMeasEntry** OBJECT-TYPE

SYNTAX	DocsIf3CmSpectrumAnalysisMeasEntry
MAX-ACCESS	not-accessible
STATUS	current

DESCRIPTION

"Each row in the docsIf3CmSpectrumAnalysisMeasTable represents the spectral analysis around a single center frequency point in the spectrum."

```
INDEX { docsIf3CmSpectrumAnalysisMeasFrequency }
 ::= { docsIf3CmSpectrumAnalysisMeasTable 1 }
```

**DocsIf3CmSpectrumAnalysisMeasEntry** ::=

```
SEQUENCE {
    docsIf3CmSpectrumAnalysisMeasFrequency      Integer32,
    docsIf3CmSpectrumAnalysisMeasAmplitudeData  AmplitudeData,
    docsIf3CmSpectrumAnalysisMeasTotalSegmentPower TenthdB
}
```

**docsIf3CmSpectrumAnalysisMeasFrequency** OBJECT-TYPE

SYNTAX	Integer32
--------	-----------

```

MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
  "This index indicates the center frequency of the spectral
  analysis span which is represented by this instance."
 ::= { docsIf3CmSpectrumAnalysisMeasEntry 1 }

docsIf3CmSpectrumAnalysisMeasAmplitudeData OBJECT-TYPE
  SYNTAX     AmplitudeData
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "This attribute provides a list of the spectral amplitudes as
    measured at the center frequency specified by the Frequency
    index.

    The frequency bins are ordered from lowest to highest
    frequencies covering the frequency span. Information about the
    center frequency, frequency span, number of bins and resolution
    bandwidth are included to provide context to the measurement
    point."
 ::= { docsIf3CmSpectrumAnalysisMeasEntry 2 }

docsIf3CmSpectrumAnalysisMeasTotalSegmentPower OBJECT-TYPE
  SYNTAX     TenthdB
  MAX-ACCESS read-only
  STATUS     current
  DESCRIPTION
    "This attribute provides the total RF power present in the
    segment with the center frequency equal to the Frequency index
    and the span equal to the SegmentFrequencySpan. The value
    represents the sum of the spectrum power in all of the
    associated bins. The value is computed by summing power (not
    dB) values and converting the final sum to TenthdB."
 ::= { docsIf3CmSpectrumAnalysisMeasEntry 3 }

docsIf3CmtsCmEmStatsTable OBJECT-TYPE
  SYNTAX     SEQUENCE OF DocsIf3CmtsCmEmStatsEntry
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "This table defines Energy Management mode statistics for the
    CM as reported by the CMTS. For example, such metrics can
    provide insight into configuration of appropriate EM 1x1 Mode
    Activity Detection thresholds on the CM and/or to get feedback
    on how/if the current thresholds are working well or are
    causing user experience issues."
 ::= { docsIf3MibObjects 36 }

docsIf3CmtsCmEmStatsEntry OBJECT-TYPE
  SYNTAX     DocsIf3CmtsCmEmStatsEntry
  MAX-ACCESS not-accessible
  STATUS     current
  DESCRIPTION
    "The conceptual row of docsIf3CmtsCmEmStatsTable."
 INDEX { docsIf3CmtsCmRegStatusId }
 ::= { docsIf3CmtsCmEmStatsTable 1 }

DocsIf3CmtsCmEmStatsEntry ::=
  SEQUENCE {
    docsIf3CmtsCmEmStatsEm1x1ModeTotalDuration Unsigned32
  }

```

```

docsIf3CmtsCmEmStatsEmlx1ModeTotalDuration OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS      "seconds"
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This attribute indicates the total time duration, in seconds
         since registration, the CM identified by
         docsIf3CmtsCmRegStatusId has been in Energy Management 1x1
         mode, as controlled by the DBC-REQ Energy Management 1x1
         Mode Indicator TLV."
    ::= { docsIf3CmtsCmEmStatsEntry 1 }

docsIf3CmEm1x1StatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIf3CmEm1x1StatsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "This object defines Energy Management 1x1 mode statistics on
         the CM to provide insight into configuration of appropriate EM
         1x1 Mode Activity Detection thresholds and/or to get feedback
         on how/if the current thresholds are working well or are
         causing user experience issues.
         These statistics are only applicable/valid when the Energy
         Management 1x1 mode is enabled in the CM."
    ::= { docsIf3MibObjects 37 }

docsIf3CmEm1x1StatsEntry OBJECT-TYPE
    SYNTAX      DocsIf3CmEm1x1StatsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The conceptual row of docsIf3CmEm1x1StatsTable.
         An instance exist for the CM MAC Domain Interface."
    INDEX { ifIndex }
    ::= { docsIf3CmEm1x1StatsTable 1 }

DocsIf3CmEm1x1StatsEntry ::=
SEQUENCE {
    docsIf3CmEm1x1StatsNumberTimesCrossedBelowUsEntryThrshlds  Unsigned32,
    docsIf3CmEm1x1StatsNumberTimesCrossedBelowDsEntryThrshlds  Unsigned32,
    docsIf3CmEm1x1StatsTotalDuration
    Unsigned32,
    docsIf3CmEm1x1StatsTotalDurationBelowUsThrshlds
    Unsigned32,
    docsIf3CmEm1x1StatsTotalDurationBelowDsThrshlds
    Unsigned32,
    docsIf3CmEm1x1StatsTotalDurationBelowUsDsThrshlds
    Unsigned32
}

docsIf3CmEm1x1StatsNumberTimesCrossedBelowUsEntryThrshlds OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This attribute indicates the number of times since
         registration the CM crossed below the upstream entry bitrate
         threshold for a number of consecutive seconds equal to or
         exceeding the upstream entry time threshold."
    ::= { docsIf3CmEm1x1StatsEntry 1 }

docsIf3CmEm1x1StatsNumberTimesCrossedBelowDsEntryThrshlds OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS read-only

```

```

STATUS      current
DESCRIPTION
  "This attribute indicates the number of times since
  registration the CM crossed below the downstream entry
  bitrate threshold for a number of consecutive seconds equal
  to or exceeding the downstream entry time threshold."
 ::= { docsIf3CmEm1x1StatsEntry 2 }

docsIf3CmEm1x1StatsTotalDuration OBJECT-TYPE
  SYNTAX      Unsigned32
  UNITS       "seconds"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the total time duration, in seconds
     since registration, the CM has been in Energy Management 1x1
     mode, as controlled by the DBC-REQ Energy Management 1x1 Mode
     Indicator TLV. This attribute differs from
     docsIf3CmEm1x1StatsTotalDurationBelowUsDsThrshlds because it
     is dependent on effects of the Energy Management Cycle
     Period, and processing of EM-REQ/EM-RSP messages and DBC
     messages that specifically indicate entry into or exit from
     Energy Management 1x1 mode."
 ::= { docsIf3CmEm1x1StatsEntry 3 }

docsIf3CmEm1x1StatsTotalDurationBelowUsThrshlds OBJECT-TYPE
  SYNTAX      Unsigned32
  UNITS       "seconds"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the total time duration, in seconds
     since registration, the CM satisfied upstream conditions for
     entry into or remaining in Energy Management 1x1 mode."
 ::= { docsIf3CmEm1x1StatsEntry 4 }

docsIf3CmEm1x1StatsTotalDurationBelowDsThrshlds OBJECT-TYPE
  SYNTAX      Unsigned32
  UNITS       "seconds"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the total time duration, in seconds
     since registration, the CM satisfied downstream conditions for
     entry into or remaining in Energy Management 1x1 mode."
 ::= { docsIf3CmEm1x1StatsEntry 5 }

docsIf3CmEm1x1StatsTotalDurationBelowUsDsThrshlds OBJECT-TYPE
  SYNTAX      Unsigned32
  UNITS       "seconds"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the total time duration, in seconds
     since registration, the CM, with respect to both upstream and
     downstream entry and exit thresholds, satisfied conditions for
     entry into and remaining in Energy Management 1x1 mode. This
     attribute differs from docsIf3CmEm1x1StatsTotalDuration
     because it is not dependent on effects of the Energy
     Management Cycle Period or processing of EM-REQ/EM-RSP
     messages and DBC messages that specifically indicate entry
     into or exit from Energy Management 1x1 mode."
 ::= { docsIf3CmEm1x1StatsEntry 6 }

```

```
-- Conformance Definitions
docsIf3MibConformance OBJECT IDENTIFIER ::= { docsIf3Mib 2 }
docsIf3MibCompliances OBJECT IDENTIFIER ::= { docsIf3MibConformance 1 }
docsIf3MibGroups      OBJECT IDENTIFIER ::= { docsIf3MibConformance 2 }

docsIf3CmtsCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for the CMTS."

    MODULE -- this MODULE
MANDATORY-GROUPS {
    docsIf3CmtsGroup,
    docsIf3CmtsNotificationGroup
}
OBJECT docsIf3CmtsCmUsStatusRangingStatus
SYNTAX      RangingState {other(1),
                           aborted(2),
                           retriesExceeded(3),
                           success(4),
                           continue(5)
}
DESCRIPTION
    "The CMTS does not report 'timeoutT4'."

::= { docsIf3MibCompliances 1 }

docsIf3CmCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for the CM."

    MODULE -- this MODULE
MANDATORY-GROUPS {
    docsIf3CmGroup,
    docsIf3CmNotificationGroup
}

OBJECT      docsIf3CmSpectrumAnalysisCtrlCmdWindowFunction
MIN-ACCESS  read-only
DESCRIPTION
    "This object can be read-only for vendor implementations where the
     CM Spectrum Analysis window function is not configurable."

::= { docsIf3MibCompliances 2 }

docsIf3CmtsGroup OBJECT-GROUP
OBJECTS {
    docsIf3SignalQualityExtRxMER,
    docsIf3SignalQualityExtRxMerSamples,
    docsIf3MdNodeStatusMdDsSgId,
    docsIf3MdNodeStatusMdUsSgId,
    docsIf3MdDsSgStatusChSetId,
    docsIf3MdUsSgStatusChSetId,
    docsIf3CmtsSignalQualityExtCNIR,
    docsIf3CmtsSignalQualityExtExpectedRxSignalPower,
    docsIf3CmtsSpectrumAnalysisMeasAmplitudeData,
    docsIf3CmtsSpectrumAnalysisMeasTimeInterval,
    docsIf3CmtsSpectrumAnalysisMeasRowStatus,
    docsIf3CmtsCmRegStatusMacAddr,
```

docsIf3CmtsCmRegStatusIPv6Addr,  
docsIf3CmtsCmRegStatusIPv6LinkLocal,  
docsIf3CmtsCmRegStatusIPv4Addr,  
docsIf3CmtsCmRegStatusValue,  
docsIf3CmtsCmRegStatusMdIfIndex,  
docsIf3CmtsCmRegStatusMdCmSgId,  
docsIf3CmtsCmRegStatusRcpId,  
docsIf3CmtsCmRegStatusRccStatusId,  
docsIf3CmtsCmRegStatusRcsId,  
docsIf3CmtsCmRegStatusTcsId,  
docsIf3CmtsCmRegStatusQosVersion,  
docsIf3CmtsCmRegStatusLastRegTime,  
docsIf3CmtsCmRegStatusAddrResolutionReqs,  
docsIf3CmtsCmRegStatusEnergyMgtEnabled,  
docsIf3CmtsCmRegStatusEnergyMgtOperStatus,  
docsIf3CmtsCmUsStatusModulationType,  
docsIf3CmtsCmUsStatusRxPower,  
docsIf3CmtsCmUsStatusSignalNoise,  
docsIf3CmtsCmUsStatusMicroreflections,  
docsIf3CmtsCmUsStatusEqData,  
docsIf3CmtsCmUsStatusUnerroreds,  
docsIf3CmtsCmUsStatusCorrecteds,  
docsIf3CmtsCmUsStatusUncorrectables,  
docsIf3CmtsCmUsStatusHighResolutionTimingOffset,  
docsIf3CmtsCmUsStatusIsMuted,  
docsIf3CmtsCmUsStatusRangingStatus,  
docsIf3UsChExtSacCodeHoppingSelectionMode,  
docsIf3UsChExtScdmaSelectionStringActiveCodes,  
docsIf3MdCfgMddInterval,  
docsIf3MdCfgIpProvMode,  
docsIf3MdCfgCmStatusEvCtlEnabled,  
docsIf3MdCfgUsFreqRange,  
docsIf3MdCfgMcastDsidFwdEnabled,  
docsIf3MdCfgMultRxChModeEnabled,  
docsIf3MdCfgMultTxChModeEnabled,  
docsIf3MdCfgEarlyAuthEnrcrCtrl,  
docsIf3MdCfgTftpProxyEnabled,  
docsIf3MdCfgSrcAddrVerifEnabled,  
docsIf3MdCfgDownChannelAnnex,  
docsIf3MdCfgCmUdcEnabled,  
docsIf3MdCfgSendUdcRulesEnabled,  
docsIf3MdCfgServiceTypeIdList,  
docsIf3MdCfgBpi2EnforceCtrl,  
docsIf3MdCfgEnergyMgt1x1Enabled,  
docsIf3MdChCfgIsPriCapableDs,  
docsIf3MdChCfgChId,  
docsIf3MdChCfgSfProvAttrMask,  
docsIf3MdChCfgRowStatus,  
docsIf3MdUsToDsChMappingMdIfIndex,  
docsIf3DsChSetChList,  
docsIf3UsChSetChList,  
docsIf3BondingGrpCfgChList,  
docsIf3BondingGrpCfgSfProvAttrMask,  
docsIf3BondingGrpCfgDsidReseqWaitTime,  
docsIf3BondingGrpCfgDsidReseqWarnThrshld,  
docsIf3BondingGrpCfgRowStatus,  
docsIf3DsBondingGrpStatusMdDsSgId,  
docsIf3DsBondingGrpStatusCfgId,  
docsIf3UsBondingGrpStatusMdUsSgId,  
docsIf3UsBondingGrpStatusCfgId,  
docsIf3RccCfgVendorSpecific,  
docsIf3RccCfgDescription,  
docsIf3RccCfgRowStatus,

```

docsIf3RxChCfgChIfIndex,
docsIf3RxChCfgPrimaryDsIndicator,
docsIf3RxChCfgRcRmConnectivityId,
docsIf3RxChCfgRowStatus,
docsIf3RxModuleCfgRmRmConnectivityId,
docsIf3RxModuleCfgFirstCenterFrequency,
docsIf3RxModuleCfgRowStatus,
docsIf3RccStatusRccCfgId,
docsIf3RccStatusValidityCode,
docsIf3RccStatusValidityCodeText,
docsIf3RxChStatusChIfIndex,
docsIf3RxChStatusPrimaryDsIndicator,
docsIf3RxChStatusRcRmConnectivityId,
docsIf3RxModuleStatusRmRmConnectivityId,
docsIf3RxModuleStatusFirstCenterFrequency,
docsIf3CmtsCmCtrlCmdMacAddr,
docsIf3CmtsCmCtrlCmdMuteUsChId,
docsIf3CmtsCmCtrlCmdMuteInterval,
docsIf3CmtsCmCtrlCmdDisableForwarding,
docsIf3CmtsCmCtrlCmdCommit,
docsIf3CmtsEventCtrlStatus,
docsIf3CmtsCmEmStatsEm1x1ModeTotalDuration
}
STATUS      current
DESCRIPTION
  "Group of objects implemented in the CMTS"
::= { docsIf3MibGroups 1 }

docsIf3CmGroup OBJECT-GROUP
  OBJECTS {
    docsIf3SignalQualityExtRxMER,
    docsIf3SignalQualityExtRxMerSamples,
    docsIf3CmStatusValue,
    docsIf3CmStatusCode,
    docsIf3CmStatusResets,
    docsIf3CmStatusLostSyncs,
    docsIf3CmStatusInvalidMaps,
    docsIf3CmStatusInvalidUcds,
    docsIf3CmStatusInvalidRangingRsp,
    docsIf3CmStatusInvalidRegRsp,
    docsIf3CmStatusT1Timeouts,
    docsIf3CmStatusT2Timeouts,
    docsIf3CmStatusUCCsSuccesses,
    docsIf3CmStatusUCCFails,
    docsIf3CmStatusEnergyMgt1x1OperStatus,
    docsIf3CmStatusUsTxPower,
    docsIf3CmStatusUsT3Timeouts,
    docsIf3CmStatusUsT4Timeouts,
    docsIf3CmStatusUsRangingAborteds,
    docsIf3CmStatusUsModulationType,
    docsIf3CmStatusUsEqData,
    docsIf3CmStatusUsT3Exceededs,
    docsIf3CmStatusUsIsMuted,
    docsIf3CmStatusUsRangingStatus,
    docsIf3CmCapabilitiesReq,
    docsIf3CmCapabilitiesRsp,
    docsIf3UsChExtSacCodeHoppingSelectionMode,
    docsIf3UsChExtScdmaSelectionStringActiveCodes,
    docsIf3RxChStatusChIfIndex,
    docsIf3RxChStatusPrimaryDsIndicator,
    docsIf3RxChStatusRcRmConnectivityId,
    docsIf3RxModuleStatusRmRmConnectivityId,
    docsIf3RxModuleStatusFirstCenterFrequency,

```

```

docsIf3CmDpvStatsLastMeasLatency,
docsIf3CmDpvStatsLastMeasTime,
docsIf3CmDpvStatsMinLatency,
docsIf3CmDpvStatsMaxLatency,
docsIf3CmDpvStatsAvgLatency,
docsIf3CmDpvStatsNumMeas,
docsIf3CmDpvStatsLastClearTime,
docsIf3CmEventCtrlStatus,
docsIf3CmMdCfgIpProvMode,
docsIf3CmMdCfgIpProvModeResetOnChange,
docsIf3CmMdCfgIpProvModeResetOnChangeHoldOffTimer,
docsIf3CmMdCfgIpProvModeStorageType,
docsIf3CmEnergyMgtCfgFeatureEnabled,
docsIf3CmEnergyMgtCfgCyclePeriod,
docsIf3CmEnergyMgt1x1CfgDirection,
docsIf3CmEnergyMgt1x1CfgEntryBitrateThrshld,
docsIf3CmEnergyMgt1x1CfgEntryTimeThrshld,
docsIf3CmEnergyMgt1x1CfgExitBitrateThrshld,
docsIf3CmEnergyMgt1x1CfgExitTimeThrshld,
docsIf3CmSpectrumAnalysisCtrlCmdEnable,
docsIf3CmSpectrumAnalysisCtrlCmdInactivityTimeout,
docsIf3CmSpectrumAnalysisCtrlCmdFirstSegmentCenterFrequency,
docsIf3CmSpectrumAnalysisCtrlCmdLastSegmentCenterFrequency,
docsIf3CmSpectrumAnalysisCtrlCmdSegmentFrequencySpan,
docsIf3CmSpectrumAnalysisCtrlCmdNumBinsPerSegment,
docsIf3CmSpectrumAnalysisCtrlCmdEquivalentNoiseBandwidth,
docsIf3CmSpectrumAnalysisCtrlCmdWindowFunction,
docsIf3CmSpectrumAnalysisCtrlCmdNumberOfAverages,
docsIf3CmSpectrumAnalysisMeasAmplitudeData,
docsIf3CmSpectrumAnalysisMeasTotalSegmentPower,
docsIf3CmEm1x1StatsNumberTimesCrossedBelowUsEntryThrshlds,
docsIf3CmEm1x1StatsNumberTimesCrossedBelowDsEntryThrshlds,
docsIf3CmEm1x1StatsTotalDuration,
docsIf3CmEm1x1StatsTotalDurationBelowUsThrshlds,
docsIf3CmEm1x1StatsTotalDurationBelowDsThrshlds,
    docsIf3CmEm1x1StatsTotalDurationBelowUsDsThrshlds
}
STATUS      current
DESCRIPTION
    "Group of objects implemented in the CM"
::= { docsIf3MibGroups 2 }

docsIf3CmtsNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        docsIf3CmtsEventNotif
    }
    STATUS      current
    DESCRIPTION
        "CMTS is required to support notifications in this group"
    ::= { docsIf3MibGroups 3 }

docsIf3CmNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        docsIf3CmEventNotif
    }
    STATUS      current
    DESCRIPTION
        "CM is required to support notifications in this group"
    ::= { docsIf3MibGroups 4 }

END

```

## Q.7 DOCS-QOS3-MIB<sup>392</sup>

```

DOCS-QOS3-MIB DEFINITIONS ::= BEGIN
IMPORTS
  MODULE-IDENTITY,
  OBJECT-TYPE,
  Unsigned32,
  Counter32,
  Counter64
    FROM SNMPv2-SMI          -- RFC 2578
  TEXTUAL-CONVENTION,
  RowStatus,
  TruthValue,
  MacAddress,
  TimeStamp,
  StorageType
    FROM SNMPv2-TC          -- RFC 2579
  OBJECT-GROUP,
  MODULE-COMPLIANCE
    FROM SNMPv2-CONF         -- RFC 2580
  SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB -- RFC 3411
  InterfaceIndex,
  ifIndex
    FROM IF-MIB              -- RFC 2863
  InetAddressType,
  InetAddress,
  InetPortNumber
    FROM INET-ADDRESS-MIB
  DscpOrAny
    FROM DIFFSERV-DSCP-TC
  IfDirection,
  AttributeMask,
  AttrAggrRuleMask,
  ChSetId,
  Dsid,
  ChId,
  ChannelList
    FROM DOCS-IF3-MIB
  clabProjDocsis,
  DocsL2vpnIfList
    FROM CLAB-DEF-MIB;

```

docsQosMib MODULE-IDENTITY

```

LAST-UPDATED      "201407290000Z" - July 29, 2014
ORGANIZATION     "Cable Television Laboratories, Inc."
CONTACT-INFO
  "Postal: Cable Television Laboratories, Inc.
  858 Coal Creek Circle
  Louisville, Colorado 80027-9750
  U.S.A.
  Phone: +1 303-661-9100
  Fax:   +1 303-661-9199
  E-mail: mibs@cablelabs.com"
DESCRIPTION
  "This MIB module contains the management objects for the
  management of QoS for channel bonding.

```

<sup>392</sup> MIB replaced per OSSIV3.0-N-07.0480-3 by ab on 7/13/07, per OSSIV3.0-N-07.0552-4 by ab on 11/12/07, per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN; revised per OSSIV3.0-N-08.0700-4 by JS on 1/9/09 ; per OSSIV3.0-N-09.0775-3 on 5/8/09 by JB and per OSSIV3.0-N-09.0776-4 on 9/16/09 by JB. Revised per OSSIV3.0-N-10.0966-2 on 1/23/11, per OSSIV3.0-N-10.0984-1 on 1/26/11, per OSSIV3.0-11.1025-3 on 2/29/12 by JB, per OSSIV3.0-12.1064-3 on 7/27/12 by JS; OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

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REVISION "201407290000Z" - July 29, 2014

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-14.1151-2 and published as I24"

REVISION "201208090000Z" -- August 9, 2012

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-12.1064-3 and published as I19"

REVISION "201203290000Z" -- March 29, 2012

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-11.1025-3 and published as I18"

REVISION "201102100000Z" -- February 10, 2011

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-10.0966-2 and OSSIv3.0-N-10.0984-1  
and published as I14"

REVISION "200910020000Z" -- October 2, 2009

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-09.0776-4  
and published as I10"

REVISION "200905290000Z" -- May 29, 2009

DESCRIPTION  
"Revised Version includes ECN  
OSSIv3.0-N-09.0775-3  
and published as I09"

REVISION "200901210000Z" -- January 21, 2009

DESCRIPTION  
"Revised Version includes ECNs  
OSSIv3.0-N-08.0651-3  
OSSIv3.0-N-08.0700-4  
and published as I08"

REVISION "200805220000Z" -- May 22, 2008

DESCRIPTION  
"Revised Version includes ECN OSSIv3.0-N-08.0645-4  
and published as I07"

REVISION "200712060000Z" -- December 6, 2007

DESCRIPTION  
"Revised Version includes ECN OSSIv3.0-N-07.0522-3  
and published as I05"

REVISION "200708030000Z" -- August 03, 2007

DESCRIPTION  
"Revised Version includes ECN OSSIv3.0-N-07.0480-3  
and published as I04"

REVISION "200705180000Z" -- May 18, 2007

DESCRIPTION  
"Revised Version includes ECNs  
OSSIv3.0-N-07.0445-3  
OSSIv3.0-N-07.0437-4  
OSSIv3.0-N-07.0412-2  
OSSIv3.0-N-07.0410-4  
and published as I03"

REVISION "200612071700Z" -- Dec 7, 2006

DESCRIPTION  
"Initial version, published as part of the CableLabs  
OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207."  
::= { clabProjDocsis 21 }

-- Textual Conventions

```

BitRate ::= TEXTUAL-CONVENTION
DISPLAY-HINT "d"
STATUS current
DESCRIPTION
  "The rate of traffic in unit of bits per second.
   Used to specify traffic rate for QOS."
SYNTAX Unsigned32

SchedulingType ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
  "The scheduling service provided by a CMTS for an
   upstream Service Flow. If the parameter is omitted
   from an upstream QOS Parameter Set, this object
   takes the value of bestEffort (2). This parameter
   must be reported as undefined (1) for downstream
   QOS Parameter Sets."
SYNTAX INTEGER {
  undefined (1),
  bestEffort (2),
  nonRealTimePollingService(3),
  realTimePollingService(4),
  unsolicitedGrantServiceWithAD(5),
  unsolicitedGrantService(6)
}

docsQosMibObjects OBJECT IDENTIFIER ::= { docsQosMib 1 }

docsQosPktClassTable OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosPktClassEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
  "This object describes the packet classification
  configured on the CM or CMTS.
  The model is that a packet either received as input from
  an interface or transmitted for output on an interface
  may be compared against an ordered list of rules
  pertaining to the packet contents. Each rule is an instance
  of this object. A matching rule provides a Service
  Flow ID to which the packet is classified.
  All rules need to match for a packet to match a classifier.


```

The attributes in this row correspond to a set of Classifier Encoding parameters in a DOCSIS MAC management message. The BitMap attribute indicates which particular parameters were present in the classifier as signaled in the DOCSIS message.

If the referenced parameter was not present in the signaled Classifier, the corresponding attribute in this instance reports a value as specified by that attribute description."

REFERENCE  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flows and Classifiers section."  
 ::= { docsQosMibObjects 1 }

```

docsQosPktClassEntry OBJECT-TYPE
SYNTAX DocsQosPktClassEntry
MAX-ACCESS not-accessible
STATUS current

```

```
DESCRIPTION
    "The conceptual row of docsQosPktClassTable.
     The ifIndex key corresponds to the MAC Domain interface
     of the service flow of this classifier."
INDEX { ifIndex,
         docsQosServiceFlowId,
         docsQosPktClassId
       }
 ::= { docsQosPktClassTable 1 }

DocsQosPktClassEntry ::= SEQUENCE {
    docsQosPktClassId
        Unsigned32,
    docsQosPktClassDirection
        IfDirection,
    docsQosPktClassPriority
        Unsigned32,
    docsQosPktClassIpTosLow
        OCTET STRING,
    docsQosPktClassIpTosHigh
        OCTET STRING,
    docsQosPktClassIpTosMask
        OCTET STRING,
    docsQosPktClassIpProtocol
        Unsigned32,
    docsQosPktClassIpSourceAddr
        InetAddress,
    docsQosPktClassIpSourceMask
        InetAddress,
    docsQosPktClassIpDestAddr
        InetAddress,
    docsQosPktClassIpDestMask
        InetAddress,
    docsQosPktClassSourcePortStart
        InetPortNumber,
    docsQosPktClassSourcePortEnd
        InetPortNumber,
    docsQosPktClassDestPortStart
        InetPortNumber,
    docsQosPktClassDestPortEnd
        InetPortNumber,
    docsQosPktClassDestMacAddr
        MacAddress,
    docsQosPktClassDestMacMask
        MacAddress,
    docsQosPktClassSourceMacAddr
        MacAddress,
    docsQosPktClassEnetProtocolType
        INTEGER,
    docsQosPktClassEnetProtocol
        Unsigned32,
    docsQosPktClassUserPriLow
        Unsigned32,
    docsQosPktClassUserPriHigh
        Unsigned32,
    docsQosPktClassVlanId
        Unsigned32,
    docsQosPktClassState
        INTEGER,
    docsQosPktClassPkts
        Counter64,
    docsQosPktClassBitMap
        BITS,
```

```

docsQosPktClassIpAddrType
    InetAddressType,
docsQosPktClassFlowLabel
    Unsigned32,
docsQosPktClassCmInterfaceMask
    DocsL2vpnIfList,
docsQosPktClassIcmpTypeLow
    Unsigned32,
docsQosPktClassIcmpTypeHigh
    Unsigned32
}

docsQosPktClassId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key indicates the assigned identifier to the
         packet classifier instance by the CMTS, which is unique
         per Service Flow.
        For UDCs this corresponds to the Service Flow Reference
         of the classifier."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Classifier
         Identifier section in the Common Radio Frequency Interface
         Encodings Annex."
    ::= { docsQosPktClassEntry 1 }

docsQosPktClassDirection OBJECT-TYPE
    SYNTAX      IfDirection
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the direction to which the
         classifier is applied."
    ::= { docsQosPktClassEntry 2 }

docsQosPktClassPriority OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute specifies the order of evaluation
         of the classifiers.
        The higher the value, the higher the priority.
        The value of 0 is used as default in provisioned Service
         Flows Classifiers.
        The default value of 64 is used for dynamic Service Flow
         Classifiers.

        If the referenced parameter is not present in a classifier,
         this attribute reports the default
         value as defined above."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Rule Priority
         section in the Common Radio Frequency Interface Encodings
         Annex."
    ::= { docsQosPktClassEntry 3 }

docsQosPktClassIpTosLow OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (1))

```

```

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the low value of a range of
    TOS byte values.
    If the referenced parameter is not present in a classifier,
    this attribute reports the value of 0.

The IP TOS octet, as originally defined in RFC 791, has
been superseded by the 6-bit Differentiated Services
Field (DSField, RFC 3260) and the 2-bit Explicit
Congestion Notification Field (ECN field, RFC 3168).
This object is defined as an 8-bit octet as per the DOCSIS
Specification for packet classification."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Type of
    Service Range and Mask and IPv6 Traffic Class Range and
    Mask sections in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosPktClassEntry 4 }

docsQosPktClassIpTosHigh OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (1))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the 8-bit high value of a
    range of TOS byte values.
    If the referenced parameter is not present in a classifier,
    this attribute reports the value of 0.
    The IP TOS octet as originally defined in RFC 791 has been
    superseded by the 6-bit Differentiated Services
    Field (DSField, RFC 3260) and the 2-bit Explicit Congestion
    Notification Field (ECN field, RFC 3168).
    This object is defined as an 8-bit octet as defined by
    the DOCSIS Specification for packet classification."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Type of
    Service Range and Mask and IPv6 Traffic Class Range and
    Mask sections in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosPktClassEntry 5 }

docsQosPktClassIpTosMask OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (1))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the mask value is bitwise
    ANDed with TOS byte in an IP packet, and this value is
    used for range checking of TosLow and TosHigh.

    If the referenced parameter is not present in a classifier,
    this attribute reports the value of 0.

    The IP TOS octet as originally defined in RFC 791 has been
    superseded by the 6-bit Differentiated Services
    Field (DSField, RFC 3260) and the 2-bit Explicit Congestion
    Notification Field (ECN field, RFC 3168).
    This object is defined as an 8-bit octet per the DOCSIS
    Specification for packet classification."

```

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Type of Service Range and Mask and IPv6 Traffic Class Range and Mask sections in the Common Radio Frequency Interface Encodings Annex."  
 ::= { docsQosPktClassEntry 6 }

**docsQosPktClassIpProtocol OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..258)  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**

"This attribute indicates the value of the IP Protocol field required for IP packets to match this rule.

The value 256 matches traffic with any IP Protocol value.  
 The value 257 by convention matches both TCP and UDP.

If the referenced parameter is not present in a classifier, this attribute reports the value of 258."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IP Protocol and IPv6 Next Header Type sections in the Common Radio Frequency Interface Encodings Annex."  
 ::= { docsQosPktClassEntry 7 }

**docsQosPktClassIpSourceAddr OBJECT-TYPE**

**SYNTAX** InetAddress  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**

"This attribute specifies the value of the IP Source Address required for packets to match this rule.

An IP packet matches the rule when the packet IP Source Address bitwise ANDed with the InetSourceMask value equals the InetSourceAddr value.

The address type of this object is specified by InetAddressType.

If the referenced parameter is not present in a classifier, this object reports the value of '00000000'H."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Source Address and IPv6 Source Address sections in the Common Radio Frequency Interface Encodings Annex."  
 ::= { docsQosPktClassEntry 8 }

**docsQosPktClassIpSourceMask OBJECT-TYPE**

**SYNTAX** InetAddress  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**

"This attribute specifies which bits of a packet's IP Source Address are compared to match this rule.

An IP packet matches the rule when the packet source address bitwise ANDed with the InetSourceMask value equals the docsIetfQosIpPktClassInetSourceAddr value.

The address type of this attribute is specified by InetAddressType.

If the referenced parameter is not present in a classifier,

this attribute reports the value of 'FFFFFFF'H."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Source Mask and IPv6 Source Prefix Length (bits) sections in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosPktClassEntry 9 }

**docsQosPktClassIpDestAddr OBJECT-TYPE**

**SYNTAX**      InetAddress

**MAX-ACCESS**    read-only

**STATUS**        current

**DESCRIPTION**

"This attribute specifies the value of the IP Destination Address required for packets to match this rule.

An IP packet matches the rule when the packet IP Destination Address bitwise ANDed with the InetDestMask value equals the InetDestAddr value.

The address type of this attribute is specified by InetAddressType.

If the referenced parameter is not present in a classifier, this attribute reports the value of '00000000'.

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Destination Address and IPv6 Destination Address sections in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosPktClassEntry 10 }

**docsQosPktClassIpDestMask OBJECT-TYPE**

**SYNTAX**      InetAddress

**MAX-ACCESS**    read-only

**STATUS**        current

**DESCRIPTION**

"This attribute specifies which bits of a packet's IP Destination Address are compared to match this rule.

An IP packet matches the rule when the packet destination address bitwise ANDed with the InetDestMask value equals the docsIetfQosIpPktClassInetDestAddr value.

The address type of this attribute is specified by InetAddressType.

If the referenced parameter is not present in a classifier, this attribute reports the value of 'FFFFFFF'.

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv4 Destination Mask and IPv6 Destination Prefix Length (bits) sections in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosPktClassEntry 11 }

**docsQosPktClassSourcePortStart OBJECT-TYPE**

**SYNTAX**      InetPortNumber

**MAX-ACCESS**    read-only

**STATUS**        current

**DESCRIPTION**

"This attribute specifies the low-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This attribute is irrelevant for non-TCP/UDP IP packets."

If the referenced parameter is not present in a classifier,  
this attribute reports the value of 0."

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, TCP/UDP Source  
 Port Start section in the Common Radio Frequency Interface  
 Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 12 \ }$

**docsQosPktClassSourcePortEnd** OBJECT-TYPE  
**SYNTAX**      InetPortNumber  
**MAX-ACCESS**    read-only  
**STATUS**        current  
**DESCRIPTION**  
 "This attribute specifies the high-end inclusive  
 range of TCP/UDP source port numbers to which a packet  
 is compared. This attribute is irrelevant for non-TCP/UDP  
 IP packets.  
 If the referenced parameter is not present in a classifier,  
 this attribute reports the value of 65535."  

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, TCP/UDP Source  
 Port End section in the Common Radio Frequency Interface  
 Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 13 \ }$

**docsQosPktClassDestPortStart** OBJECT-TYPE  
**SYNTAX**      InetPortNumber  
**MAX-ACCESS**    read-only  
**STATUS**        current  
**DESCRIPTION**  
 "This attribute specifies the low-end inclusive range  
 of TCP/UDP destination port numbers to which a packet  
 is compared.  
 If the referenced parameter is not present in a classifier,  
 this attribute reports the value of 0."  

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, TCP/UDP  
 Destination Port Start section in the Common Radio Frequency  
 Interface Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 14 \ }$

**docsQosPktClassDestPortEnd** OBJECT-TYPE  
**SYNTAX**      InetPortNumber  
**MAX-ACCESS**    read-only  
**STATUS**        current  
**DESCRIPTION**  
 "This attribute specifies the high-end inclusive  
 range of TCP/UDP destination port numbers to which a  
 packet is compared.  
 If the referenced parameter is not present in a classifier,  
 this attribute reports the value of 65535."  

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, TCP/UDP Destination  
 Port End section in the Common Radio Frequency Interface  
 Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 15 \ }$

**docsQosPktClassDestMacAddr** OBJECT-TYPE  
**SYNTAX**       MacAddress

```

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "An Ethernet packet matches an entry when its destination
  MAC address bitwise ANDed with DestMacMask equals
  the value of DestMacAddr.
  If the referenced parameter is not present in a classifier,
  this attribute reports the value of '000000000000'H."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Destination MAC
  Address section in the Common Radio Frequency Interface
  Encodings Annex."
 ::= { docsQosPktClassEntry 16 }

docsQosPktClassDestMacMask OBJECT-TYPE
SYNTAX      MacAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "An Ethernet packet matches an entry when its destination
  MAC address bitwise ANDed with DestMacMask equals
  the value of DestMacAddr.
  If the referenced parameter is not present in a classifier,
  this attribute reports the value of '000000000000'H."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Destination
  MAC Address section in the Common Radio Frequency Interface
  Encodings Annex."
 ::= { docsQosPktClassEntry 17 }

docsQosPktClassSourceMacAddr OBJECT-TYPE
SYNTAX      MacAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "An Ethernet packet matches this entry when its source
  MAC address equals the value of this attribute.
  If the referenced parameter is not present in a classifier,
  this attribute reports the value of 'FFFFFFFFFFFF'"
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Source MAC
  Address section in the Common Radio Frequency Interface
  Encodings Annex."
 ::= { docsQosPktClassEntry 18 }

docsQosPktClassEonetProtocolType OBJECT-TYPE
SYNTAX      INTEGER {
  none(0),
  ethertype(1),
  dsap(2),
  mac(3),
  all(4)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "This attribute indicates the format of the layer 3
  protocol ID in the Ethernet packet. A value of 'none'
  means that the rule does not use the layer 3 protocol type

```

as a matching criteria.

A value of 'ethertype' means that the rule applies only to frames that contain an EtherType value. EtherType values are contained in packets using the Dec-Intel-Xerox (DIX) encapsulation or the RFC1042 Sub-Network Access Protocol (SNAP) encapsulation formats.

A value of 'dsap' means that the rule applies only to frames using the IEEE802.3 encapsulation format with a Destination Service Access Point (DSAP) other than 0xAA (which is reserved for SNAP).

A value of 'mac' means that the rule applies only to MAC management messages for MAC management messages.

A value of 'all' means that the rule matches all Ethernet packets.

If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1P/Q header.

If the referenced parameter is not present in a classifier, this attribute reports the value of 0."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, EtherType/DSAP/MacType section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosPktClassEntry 19 }

#### docsQosPktClassEnetProtocol OBJECT-TYPE

SYNTAX Unsigned32 (0..65535)

MAX-ACCESS read-only

STATUS current

#### DESCRIPTION

"If EnetProtocolType is 'none', this attribute is ignored when considering whether a packet matches the current rule.

If EnetProtocolType is 'ethertype', this attribute gives the 16-bit value of the EtherType that the packet must match in order to match the rule.

If EnetProtocolType is 'dsap', the lower 8 bits of this attribute's value must match the DSAP byte of the packet in order to match the rule.

If EnetProtocolType is 'mac', the lower 8 bits of this attribute's value represent a lower bound (inclusive) of MAC management message type codes matched, and the upper 8 bits represent the upper bound (inclusive) of matched MAC message type codes. Certain message type codes are excluded from matching, as specified in the reference.

If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this attribute applies to the embedded EtherType field within the 802.1P/Q header.

If the referenced parameter is not present in the classifier, the value of this attribute is reported as 0."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, EtherType/DSAP/MacType section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosPktClassEntry 20 }

```

docsQosPktClassUserPriLow OBJECT-TYPE
    SYNTAX      Unsigned32 (0..7)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute applies only to Ethernet frames using
         the 802.1P/Q tag header (indicated with EtherType
         0x8100). Such frames include a 16-bit Tag that contains
         a 3-bit Priority field and a 12-bit VLAN number.

        Tagged Ethernet packets must have a 3-bit Priority field
        within the range of PriLow to PriHigh in order to
        match this rule.

        If the referenced parameter is not present in the classifier,
        the value of this attribute is reported as 0."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, IEEE 802.1P
         User_Priority section in the Common Radio Frequency Interface
         Encodings Annex."
    ::= { docsQosPktClassEntry 22 }

```

```

docsQosPktClassUserPriHigh OBJECT-TYPE
    SYNTAX      Unsigned32 (0..7)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute applies only to Ethernet frames using
         the 802.1P/Qtag header (indicated with EtherType
         0x8100). Such frames include a 16-bit Tag that contains
         a 3-bit Priority field and a 12-bit VLAN number.

        Tagged Ethernet packets must have a 3-bit Priority field
        within the range of PriLow to
        PriHigh in order to match this rule.

        If the referenced parameter is not present in the classifier,
        the value of this attribute is reported as 7."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, IEEE 802.1P
         User_Priority section in the Common Radio Frequency Interface
         Encodings Annex."
    ::= { docsQosPktClassEntry 23 }

```

```

docsQosPktClassVlanId OBJECT-TYPE
    SYNTAX      Unsigned32 (0 | 1..4094)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute applies only to Ethernet frames
         using the 802.1P/Q tag header.

        Tagged packets must have a VLAN Identifier that matches
        the value in order to match the rule.

        If the referenced parameter is not present in the classifier,
        the value of this attribute is reported as 0."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, IEEE 802.1Q VLAN_ID
         section in the Common Radio Frequency Interface Encodings Annex."
    ::= { docsQosPktClassEntry 24 }

```

```
docsQosPktClassState OBJECT-TYPE
```

```

SYNTAX      INTEGER {
            active(1),
            inactive(2)
        }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates whether or not the classifier
     is enabled to classify packets to a Service Flow.

    If the referenced parameter is not present in the classifier,
     the value of this attribute is reported as 'true'."

REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Classifier
     Activation State section in the Common Radio Frequency Interface
     Encodings Annex."
::= { docsQosPktClassEntry 25 }

docsQosPktClassPkts OBJECT-TYPE
SYNTAX      Counter64
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of packets that have
     been classified using this entry. This includes
     all packets delivered to a Service Flow maximum rate
     policing function, whether or not that function drops
     the packets.

    This counter's last discontinuity is the
     ifCounterDiscontinuityTime for the same ifIndex that
     indexes this attribute."
::= { docsQosPktClassEntry 26 }

docsQosPktClassBitMap OBJECT-TYPE
SYNTAX      BITS {
                    rulePriority(0),
                    activationState(1),
                    ipTos(2),
                    ipProtocol(3),
                    ipSourceAddr(4),
                    ipSourceMask(5),
                    ipDestAddr(6),
                    ipDestMask(7),
                    sourcePortStart(8),
                    sourcePortEnd(9),
                    destPortStart(10),
                    destPortEnd(11),
                    destMac(12),
                    sourceMac(13),
                    ethertype(14),
                    userPri(15),
                    vlanId(16),
                    flowLabel(17),
                    cmInterfaceMask(18)
                }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates which parameter encodings
     were actually present in the DOCSIS packet classifier
     encoding signaled in the DOCSIS message that created

```

or modified the classifier. Note that Dynamic Service Change messages have replace semantics, so that all non-default parameters must be present whether the classifier is being created or changed.

A bit of this attribute is set to 1 if the parameter indicated by the comment was present in the classifier encoding, and to 0 otherwise.

Note that BITS are encoded most significant bit first, so that if, for example, bits 6 and 7 are set, this attribute is encoded as the octet string '030000'H."

```
 ::= { docsQosPktClassEntry 27 }
```

**docsQosPktClassIpAddrType** OBJECT-TYPE

SYNTAX	IetAddressType
MAX-ACCESS	read-only
STATUS	current

**DESCRIPTION**

"This attribute indicates the type of the Internet address for InetSourceAddr, InetSourceMask, InetDestAddr, and InetDestMask.

If the referenced parameter is not present in a classifier, this object reports the value of 'ipv4'."

```
 ::= { docsQosPktClassEntry 28 }
```

**docsQosPktClassFlowLabel** OBJECT-TYPE

SYNTAX	Unsigned32 (0..1048575)
MAX-ACCESS	read-only
STATUS	current

**DESCRIPTION**

"This attribute represents the Flow Label field in the IPv6 header to be matched by the classifier.

The value zero indicates that the Flow Label is not specified as part of the classifier and is not matched against the packets."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, IPv6 Flow Label section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosPktClassEntry 29 }
```

**docsQosPktClassCmInterfaceMask** OBJECT-TYPE

SYNTAX	DocsL2vpnIfList
MAX-ACCESS	read-only
STATUS	current

**DESCRIPTION**

"This attribute represents a bit-mask of the CM in-bound interfaces to which this classifier applies.

This attribute only applies to QOS upstream Classifiers and upstream Drop Classifiers. For QOS downstream classifiers this object reports the zero-length string."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, CM Interface Mask (CMIM) Encoding section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosPktClassEntry 30 }
```

**docsQosPktClassIcmpTypeLow** OBJECT-TYPE

SYNTAX	Unsigned32 (0..255)
MAX-ACCESS	read-only
STATUS	current

**DESCRIPTION**  
 "This attribute specifies the low-end inclusive range of the ICMP type numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 0."

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I17-120329, TypeLow encodings section in the Common Radio Frequency Interface Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 31 \}$

**docsQosPktClassIcmpTypeHigh OBJECT-TYPE**  
**SYNTAX** Unsigned32 (0..255)  
**MAX-ACCESS** read-only  
**STATUS** current  
**DESCRIPTION**  
 "This attribute specifies the high-end inclusive range of the ICMP type numbers to which a packet is compared. If the referenced parameter is not present in a classifier, this attribute reports the value of 255."  

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I17-120329, TypeLow encodings section in the Common Radio Frequency Interface Encodings Annex."  
 $::= \{ \text{docsQosPktClassEntry} \ 32 \}$

**docsQosParamSetTable OBJECT-TYPE**  
**SYNTAX** SEQUENCE OF DocsQosParamSetEntry  
**MAX-ACCESS** not-accessible  
**STATUS** current  
**DESCRIPTION**  
 "This object describes the set of QOS parameters defined in a managed device.  
 DOCSIS 1.0 COS service profiles are not represented in this object.  
 Each row corresponds to a DOCSIS QOS Parameter Set as signaled via DOCSIS MAC management messages. Each attribute of an instance of this object corresponds to one or part of one Service Flow Encoding.  
 The BitMap attribute indicates which particular parameters were signaled in the original registration or dynamic service request message that created the QOS Parameter Set.  
 In many cases, even if a QOS Parameter Set parameter was not signaled, the DOCSIS specification calls for a default value to be used. That default value is reported as the value of the corresponding attribute in this object instance.  
 Many attributes are not applicable, depending on the Service Flow direction, upstream scheduling type or Service Flow bonding configuration. The attribute value reported in this case is specified by those attributes descriptions."  

**REFERENCE**  
 "DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Encodings section in the Common Radio Frequency Interface Encodings Annex."  
 $::= \{ \text{docsQosMibObjects} \ 2 \}$

```
docsQosParamSetEntry OBJECT-TYPE
    SYNTAX      DocsQosParamSetEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsQosParamSetTable.
         The ifIndex key corresponds to the MAC Domain interface of the
         service flow of this Qos Param Set."
INDEX { ifIndex,
        docsQosParamSetType,
        docsQosParamSetServiceFlowId
    }
 ::= { docsQosParamSetTable 1 }

DocsQosParamSetEntry ::= SEQUENCE {
    docsQosParamSetServiceClassName
        SnmpAdminString,
    docsQosParamSetPriority
        Unsigned32,
    docsQosParamSetMaxTrafficRate
        BitRate,
    docsQosParamSetMaxTrafficBurst
        Unsigned32,
    docsQosParamSetMinReservedRate
        BitRate,
    docsQosParamSetMinReservedPkt
        Unsigned32,
    docsQosParamSetActiveTimeout
        Unsigned32,
    docsQosParamSetAdmittedTimeout
        Unsigned32,
    docsQosParamSetMaxConcatBurst
        Unsigned32,
    docsQosParamSetSchedulingType
        SchedulingType,
    docsQosParamSetNomPollInterval
        Unsigned32,
    docsQosParamSetTolPollJitter
        Unsigned32,
    docsQosParamSetUnsolicitGrantSize
        Unsigned32,
    docsQosParamSetNomGrantInterval
        Unsigned32,
    docsQosParamSetTolGrantJitter
        Unsigned32,
    docsQosParamSetGrantsPerInterval
        Unsigned32,
    docsQosParamSetTosAndMask
        OCTET STRING,
    docsQosParamSetTosOrMask
        OCTET STRING,
    docsQosParamSetMaxLatency
        Unsigned32,
    docsQosParamSetType
        INTEGER,
    docsQosParamSetRequestPolicyOct
        OCTET STRING,
    docsQosParamSetBitMap
        BITS,
    docsQosParamSetServiceFlowId
        Unsigned32,
    docsQosParamSetRequiredAttrMask
        AttributeMask,
```

```

docsQosParamSetForbiddenAttrMask
    AttributeMask,
docsQosParamSetAttrAggrRuleMask
    AttrAggrRuleMask,
docsQosParamSetAppId
    Unsigned32,
docsQosParamSetMultiplierContentionReqWindow
    Unsigned32,
docsQosParamSetMultiplierBytesReq
    Unsigned32,
docsQosParamSetMaxReqPerSidCluster
    Unsigned32,
docsQosParamSetMaxOutstandingBytesPerSidCluster
    Unsigned32,
docsQosParamSetMaxTotBytesReqPerSidCluster
    Unsigned32,
docsQosParamSetMaxTimeInSidCluster
    Unsigned32,
docsQosParamSetPeakTrafficRate
    Unsigned32,
docsQosParamSetDsResequencing
    INTEGER,
docsQosParamSetMaximumBuffer
    Unsigned32,
docsQosParamSetMinimumBuffer
    Unsigned32,
docsQosParamSetTargetBuffer
    Unsigned32
}

docsQosParamSetServiceClassName OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..15))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the Service Class Name
         from which the parameter set values were derived.
         If the referenced parameter is not present in the corresponding
         DOCSIS QOS Parameter Set, this attribute returns the
         zero-length string."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Service Class Name
         section in the Common Radio Frequency Interface
         Encodings Annex."
    ::= { docsQosParamSetEntry 4 }

docsQosParamSetPriority OBJECT-TYPE
    SYNTAX      Unsigned32 (0..7)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the relative priority
         of a Service Flow. Higher numbers indicate higher priority.

         This priority should only be used to differentiate Service
         Flow from identical parameter sets.
         This attribute returns 0 if the referenced parameter
         is not present in the corresponding DOCSIS QOS Parameter
         Set or if the parameter is not applicable."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Traffic Priority"

```

```

section in the Common Radio Frequency Interface Encodings
Annex."
 ::= { docsQosParamSetEntry 5 }

docsQosParamSetMaxTrafficRate OBJECT-TYPE
SYNTAX      BitRate
UNITS       "bps"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the maximum sustained
    traffic rate allowed for this Service Flow in bits/sec.
    It counts all MAC frame data PDUs from the bytes following
    the MAC header HCS to the end of the CRC. The number
    of bytes forwarded is limited during any time interval.
    The value 0 means no maximum traffic rate is enforced.
    This attribute applies to both upstream and
    downstream Service Flows.
    This attribute returns 0 if the referenced parameter
    is not present in the corresponding DOCSIS QOS Parameter
    Set, or if the parameter is not applicable."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Maximum Sustained
    Traffic Rate section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 6 }

docsQosParamSetMaxTrafficBurst OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies the token bucket size in
    bytes for this parameter set. The value is calculated
    from the byte following the MAC header HCS to the end
    of the CRC. This object is applied in conjunction with
    MaxTrafficRate to calculate maximum sustained traffic
    rate.
    If the referenced parameter is not present in the corresponding
    DOCSIS QOS Parameter Set, this attribute
    returns 3044 for scheduling types 'bestEffort', 'nonRealTimePollingService'
    and 'realTimePollingService'.

    If this parameter is not applicable, it is reported as
    0."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Maximum Traffic
    Burst section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 7 }

docsQosParamSetMinReservedRate OBJECT-TYPE
SYNTAX      BitRate
UNITS       "bps"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies the guaranteed minimum
    rate in bits/sec for this parameter set. The value is
    calculated from the byte following the MAC header HCS

```

to the end of the CRC. The value of 0 indicates that no bandwidth is reserved.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0. If the parameter is not applicable, it is reported as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Minimum Reserved Traffic Rate section of the Common Radio Frequency Interface Encodings Annex."

**::= { docsQosParamSetEntry 8 }**

**docsQosParamSetMinReservedPkt OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..65535)

**UNITS** "bytes"

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies an assumed minimum packet size in bytes for which the MinReservedRate will be provided. The value is calculated from the byte following the MAC header HCS to the end of the CRC. If the referenced parameter is omitted from a DOCSIS QOS parameter set, the used and reported value is CMTS implementation and the CM reports a value of 0. If the referenced parameter is not applicable to the direction or scheduling type of the Service Flow, both CMTS and CM report the value 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Assumed Minimum Reserved Rate Packet Size, in the Common Radio Frequency Interface Encodings Annex."

**::= { docsQosParamSetEntry 9 }**

**docsQosParamSetActiveTimeout OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..65535)

**UNITS** "seconds"

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the maximum duration in seconds that resources remain unused on an active service flow before the CMTS signals that both the active and admitted parameter sets are null. The value 0 signifies an infinite amount of time.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Timeout for Active QoS Parameters section in the Common Radio Frequency Interface Encodings Annex."

**::= { docsQosParamSetEntry 10 }**

**docsQosParamSetAdmittedTimeout OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..65535)

**UNITS** "seconds"

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the maximum duration in seconds that resources remain in admitted state before resources must be released. The value of 0 signifies an infinite amount of time. If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns 200."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Timeout for Admitted QoS Parameters section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosParamSetEntry 11 }
```

**docsQosParamSetMaxConcatBurst OBJECT-TYPE**

<b>SYNTAX</b>	Unsigned32 (0..65535)
<b>UNITS</b>	"bytes"
<b>MAX-ACCESS</b>	read-only
<b>STATUS</b>	current

**DESCRIPTION**

"This attribute specifies the maximum concatenated burst in bytes that an upstream Service Flow is allowed.

The value is calculated from the FC byte of the Concatenation MAC Header to the last CRC byte of the last concatenated MAC frame, inclusive. The value of 0 specifies no maximum burst.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set, this attribute returns the value of 1522 for scheduling types 'bestEffort', 'nonRealTimePollingService', and 'realTimePollingService'.

If the parameter is not applicable, it is reported as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Maximum Concatenated Burst section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosParamSetEntry 12 }
```

**docsQosParamSetSchedulingType OBJECT-TYPE**

<b>SYNTAX</b>	SchedulingType
<b>MAX-ACCESS</b>	read-only
<b>STATUS</b>	current

**DESCRIPTION**

"This attribute specifies the upstream scheduling service used for upstream Service Flow.

If the referenced parameter is not present in the corresponding DOCSIS QOS Parameter Set of an upstream Service Flow, this attribute returns the value of 'bestEffort'. For QOS parameter sets of downstream Service Flows, this attribute's value is reported as 'undefined'."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Scheduling Type section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosParamSetEntry 13 }
```

**docsQosParamSetNomPollInterval OBJECT-TYPE**

<b>SYNTAX</b>	Unsigned32
<b>UNITS</b>	"microseconds"
<b>MAX-ACCESS</b>	read-only
<b>STATUS</b>	current

**DESCRIPTION**

"This attribute specifies the nominal interval in microseconds between successive unicast request opportunities on an upstream Service Flow. This attribute applies only to upstream Service Flows with SchedulingType of value 'nonRealTimePollingService', 'realTimePollingService', and 'unsolicitedGrantServiceWithAD'. The parameter is mandatory for 'realTimePollingService'. If the parameter is omitted with 'nonRealTimePollingService', the CMTS uses an implementation-dependent value. If the parameter is omitted with 'unsolicitedGrantServiceWithAD(5)' the CMTS uses the value of the Nominal Grant Interval parameter. In all cases, the CMTS reports the value it is using when the parameter is applicable. The CM reports the signaled parameter value if it was signaled. Otherwise, it returns 0. If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Polling Interval section in the Common Radio Frequency Interface Encodings Annex."

```
::= { docsQosParamSetEntry 14 }
```

**docsQosParamSetTolPollJitter OBJECT-TYPE**

**SYNTAX** Unsigned32  
**UNITS** "microseconds"  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**

"This attribute specifies the maximum amount of time in microseconds that the unicast request interval may be delayed from the nominal periodic schedule on an upstream Service Flow. This parameter is applicable only to upstream Service Flows with a SchedulingType of 'realTimePollingService' or 'unsolicitedGrantServiceWithAD'.

If the referenced parameter is applicable but not present in the corresponding DOCSIS QOS Parameter Set, the CMTS uses an implementation-dependent value and reports the value it is using. The CM reports a value of 0 in this case.

If the parameter is not applicable to the direction or upstream scheduling type of the Service Flow, both CMTS and CM report this attribute's value as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Tolerated Poll Jitter section in the Common Radio Frequency Interface Encodings Annex."

```
::= { docsQosParamSetEntry 15 }
```

**docsQosParamSetUnsolicitGrantSize OBJECT-TYPE**

**SYNTAX** Unsigned32 (0..65535)  
**UNITS** "bytes"  
**MAX-ACCESS** read-only  
**STATUS** current

**DESCRIPTION**

"This attribute specifies the unsolicited grant size

in bytes. The grant size includes the entire MAC frame data PDU from the Frame Control byte to the end of the MAC frame.

The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServicewithAD' or 'unsolicitedGrantService', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case.

If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Unsolicited Grant Size section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosParamSetEntry 16 }

#### docsQosParamSetNomGrantInterval OBJECT-TYPE

SYNTAX Unsigned32

UNITS "microseconds"

MAX-ACCESS read-only

STATUS current

#### DESCRIPTION

"This attribute specifies the nominal interval in microseconds between successive data grant opportunities on an upstream Service Flow.

The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServicewithAD' or 'unsolicitedGrantService(6)', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case.

If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Nominal Grant Interval section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosParamSetEntry 17 }

#### docsQosParamSetTolGrantJitter OBJECT-TYPE

SYNTAX Unsigned32

UNITS "microseconds"

MAX-ACCESS read-only

STATUS current

#### DESCRIPTION

"This attribute specifies the maximum amount of time in microseconds that the transmission opportunities may be delayed from the nominal periodic schedule.

The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServicewithAD' or 'unsolicitedGrantService(6)', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case.

If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS

QOS Parameter Set, both CMTS and CM report this attribute's value as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Tolerated Grant Jitter section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosParamSetEntry 18 }
```

**docsQosParamSetGrantsPerInterval OBJECT-TYPE**

SYNTAX Unsigned32 (0..127)

UNITS "dataGrants"

MAX-ACCESS read-only

STATUS current

**DESCRIPTION**

"This attribute specifies the number of data grants per Nominal Grant Interval (NomGrantInterval). The referenced parameter is applicable only for upstream flows with a SchedulingType of 'unsolicitedGrantServiceWithAD' or 'unsolicitedGrantService', and it is mandatory when applicable. Both CMTS and CM report the signaled value of the parameter in this case.

If the referenced parameter is not applicable to the direction or scheduling type of the corresponding DOCSIS QOS Parameter Set, both CMTS and CM report this attribute's value as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Grants per Interval section in the Common Radio Frequency Interface Encodings Annex."

```
 ::= { docsQosParamSetEntry 19 }
```

**docsQosParamSetTosAndMask OBJECT-TYPE**

SYNTAX OCTET STRING (SIZE(1))

MAX-ACCESS read-only

STATUS current

**DESCRIPTION**

"This attribute specifies the AND mask for the IP TOS byte for overwriting an IPv4 packet's TOS value or IPv6 packet's Traffic Class value. The IP packet TOS byte is bitwise ANDed with TosAndMask, then the result is bitwise ORed with TosOrMask and the result is written to the IP packet TOS byte.

A value of 'FF'H for TosAndMask and a value of '00'H for TosOrMask means that the IP Packet TOS byte is not overwritten.

This combination is reported if the referenced parameter is not present in a QOS Parameter Set.

The IP TOS octet as originally defined in RFC 791 has been superseded by the 6-bit Differentiated Services Field (DSField, RFC 3260) and the 2-bit Explicit Congestion Notification Field (ECN field, RFC 3168).

The IPv6 Traffic Class octet RFC 2460 is consistent with that new definition.

Network operators SHOULD avoid specifying values of TosAndMask and TosOrMask that would result in the modification of the ECN bits.

In particular, operators should not use values of TosAndMask that have either of the least-significant two bits set to 0. Similarly, operators should not use values of TosOrMask that have either of the least-significant

two bits set to 1.  
 Even though this attribute is only enforced by the CMTS,  
 the CM reports the value as signaled in the referenced  
 parameter."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, IP Type Of Service  
 (DSCP) Overwrite section in the Common Radio Frequency  
 Interface Encodings Annex; [RFC 3168]; [RFC 3260];  
 [RFC 2460]; [RFC 791]."  
 ::= { docsQosParamSetEntry 20 }

**docsQosParamSetTosOrMask OBJECT-TYPE**

**SYNTAX** OCTET STRING (SIZE (1))

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the OR mask for the IPv4 TOS  
 value or IPv6 Traffic Class value. See the description  
 of TosAndMask for further details.  
 The IP TOS octet, as originally defined in RFC 791 has  
 been superseded by the 6-bit Differentiated Services  
 Field (DSField, RFC 3260) and the 2-bit Explicit Congestion  
 Notification Field (ECN field, RFC 3168).  
 The IPv6 Traffic Class octet RFC 2460 is consistent  
 with that new definition.  
 Network operators SHOULD avoid specifying values of  
 TosAndMask and TosORMask that would result in the modification  
 of the ECN bits."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, IP Type Of Service  
 (DSCP) Overwrite section in the Common Radio Frequency  
 Interface Encodings Annex; [RFC 3168]; [RFC 3260];  
 [RFC 2460]; [RFC 791]."  
 ::= { docsQosParamSetEntry 21 }

**docsQosParamSetMaxLatency OBJECT-TYPE**

**SYNTAX** Unsigned32

**UNITS** "microseconds"

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the maximum latency between  
 the reception of a packet by the CMTS on its NSI and  
 the forwarding of the packet to the RF interface. A value  
 of 0 signifies no maximum latency is enforced. This  
 attribute only applies to downstream Service Flows.

If the referenced parameter is not present in the corresponding  
 downstream DOCSIS QOS Parameter Set, this  
 attribute returns 0. This parameter is not applicable  
 to upstream DOCSIS QOS Parameter Sets, so its value  
 is reported as 0 in that case."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, Maximum Downstream  
 Latency section in the Common Radio Frequency Interface  
 Encodings Annex."  
 ::= { docsQosParamSetEntry 22 }

**docsQosParamSetType OBJECT-TYPE**

**SYNTAX** INTEGER {

```

        active (1),
        admitted(2),
        provisioned(3)
    }
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
    "This key represents the QoS Parameter Set Type of the
    Service Flow.

    The following values are defined:
    'active'
    Indicates the Active QOS parameter set, describing
    the service currently being provided by the DOCSIS MAC
    domain to the service flow.

    'admitted'
    Indicates the Admitted QOS Parameter Set, describing
    services reserved by the DOCSIS MAC domain for use
    by the service flow.

    'provisioned'
    Indicates the QOS Parameter Set defined in the DOCSIS
    CM Configuration file for the service flow."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow
    Scheduling Type section in the Common Radio Frequency
    Interface Encodings Annex; [RFC 4323]."
::= { docsQosParamSetEntry 23 }
```

```

docsQosParamSetRequestPolicyOct OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (4))
            -- A 32-bit mask represented most significant byte
            -- first. The 32-bit integer represented in this
            -- manner equals the binary value of the referenced
            -- integer parameter of the DOCSIS RFI
            -- specification.
            -- The BITS syntax is not used in order to avoid
            -- the confusion caused by different bit-numbering
            -- conventions.

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies which transmit interval
    opportunities the CM omits for upstream transmission
    requests and packet transmissions. This object
    takes its default value for downstream Service Flows.
    Unless otherwise indicated, a bit value of 1 means
    that a CM must not use that opportunity for upstream transmission.
```

The format of this string enumerated the bits from 0 to 31 from left to right, for example bit 0 corresponds to the left most bit of the fourth octet. (octets numbered from right to left). The bit positions are defined as follows:

- 'broadcastReqOpp'
- all CMs broadcast request opportunities
- 'priorityReqMulticastReq'
- priority request multicast request opportunities
- 'reqDataForReq'
- request/data opportunities for requests
- 'reqDataForData'
- request/data opportunities for data
- 'piggybackReqWithData'

```

    piggyback requests with data
'concatenateData'
    concatenate data
'fragmentData'
    fragment data
'suppressPayloadHeaders'
    suppress payload headers
'dropPktsExceedUGSize'
    A value of 1 means that the service flow must drop
    packets that do not fit in the Unsolicited Grant size.

```

If the referenced parameter is not present in a QOS Parameter Set, the value of this object is reported as '00000000'H."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Request/Transmission Policy section in the Common Radio Frequency Interface Encodings Annex."  
`::= { docsQosParamSetEntry 24 }`

`docsQosParamSetBitMap OBJECT-TYPE`  
`SYNTAX BITS {`

```

        trafficPriority(0),
        maxTrafficRate(1),
        maxTrafficBurst(2),
        minReservedRate(3),
        minReservedPkt(4),
        activeTimeout(5),
        admittedTimeout(6),
        maxConcatBurst(7),
        schedulingType(8),
        requestPolicy(9),
        nomPollInterval(10),
        tolPollJitter(11),
        unsolicitGrantSize(12),
        nomGrantInterval(13),
        tolGrantJitter(14),
        grantsPerInterval(15),
        tosOverwrite(16),
        maxLatency(17),
        requiredAttrMask(18),
        forbiddenAttrMask(19),
        attrAggrMask(20),
        applicationId(21),
        multipCntrReqWindow(22),
        multipBytesReq(23),
        maxReqPerSidCluster(24),
        maxOutstandingBytesPerSidCluster(25),
        maxTotalBytesReqPerSidCluster(26),
        maximumTimeInSidCluster(27),
        peakTrafficRate(28),
        dsResequencing(29)
    }

```

`MAX-ACCESS read-only`  
`STATUS current`

#### DESCRIPTION

"This attribute indicates the set of QOS Parameter Set parameters actually signaled in the DOCSIS registration or dynamic service request message that created or modified the QOS Parameter Set. A bit is set to 1 when the associated parameter is present in the original request as follows:

```

'trafficPriority'  Traffic Priority
'maxTrafficRate'  Maximum Sustained Traffic Rate

'maxTrafficBurst'  Maximum Traffic Burst
'minReservedRate'  Minimum Reserved Traffic Rate

'minReservedPkt'  Assumed Minimum Reserved Rate Packet
Size
'activeTimeout'  Timeout for Active QoS Parameters

'admittedTimeout'  Timeout for Admitted QoS Parameters

'maxConcatBurst'  Maximum Concatenated Burst
'schedulingType'  Service Flow Scheduling Type
'requestPolicy'  Request/Transmission Policy
'nomPollInterval'  Nominal Polling Interval
'tolPollJitter'  Tolerated Poll Jitter
'unsolicitGrantSize'  Unsolicited Grant Size
'nomGrantInterval'  Nominal Grant Interval
'tolGrantJitter'  Tolerated Grant Jitter
'grantsPerInterval'  Grants per Interval
'tosOverwrite'  IP Type of Service (DSCP) Overwrite
'maxLatency'  Maximum Downstream Latency
'requiredAttrMask'  Service Flow Required Attribute
    Mask
'forbiddenAttrMask'  Service Flow Forbidden Attribute
    Mask
'attrAggrMask'  Service Flow Attribute Aggregation
    Mask
'applicationId'  Application Identifier
'multipCntnReqWindow'  Multiplier to Contention
    Request Backoff Window
'multipBytesReq'  Multiplier to Number of Bytes Requested
'maxReqPerSidCluster'  Maximum Requests per SID Cluster
'maxOutstandingBytesPerSidCluster'  Maximum Outstanding
    Bytes per SID Cluster
'maxTotalBytesReqPerSidCluster'  Maximum Total
    Bytes Requested per SID
    Cluster
'maximumTimeInSidCluster'  Maximum Time in the SID Cluster
'peakTrafficRate'  Peak Traffic Rate
'dsResequencing'  Downstream Resequencing

```

Note that when Service Class names are expanded, the registration or dynamic response message may contain parameters expanded by the CMTS based on a stored service class. These expanded parameters are not indicated by a 1 bit in this attribute.

Note that even though some QOS Parameter Set parameters may not be signaled in a message (so that the parameter's bit in this object is 0), the DOCSIS specification requires that default values be used. These default values are reported as the corresponding attribute."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Encodings section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosParamSetEntry 25 }

```

docsQosParamSetServiceFlowId OBJECT-TYPE
SYNTAX      Unsigned32 (1.. 4294967295)
MAX-ACCESS  not-accessible

```

```

STATUS      current
DESCRIPTION
    "This key represents the Service Flow ID for the service
    flow."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service
    Identifier section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 26 }

docsQosParamSetRequiredAttrMask OBJECT-TYPE
SYNTAX      AttributeMask
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies the Required Attribute
    Mask to compare with the Provisioned Required Attributes
    when selecting the bonding groups for the service
    flow.
    If the referenced parameter is not present in the corresponding
    DOCSIS QOS Parameter Set, this attribute returns '00000000'H."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Required
    Attribute Mask section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 27 }

docsQosParamSetForbiddenAttrMask OBJECT-TYPE
SYNTAX      AttributeMask
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies the Forbidden Attribute
    Mask to compare with the Provisioned Forbidden Attributes
    when selecting the bonding groups for the service
    flow.
    If the referenced parameter is not present in the corresponding
    DOCSIS QOS Parameter Set, this attribute returns '00000000'H."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow Forbidden
    Attribute Mask section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 28 }

docsQosParamSetAttrAggrRuleMask OBJECT-TYPE
SYNTAX      AttrAggrRuleMask
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies the Attribute Aggregation
    Mask to compare the Service Flow Required and Forbidden
    Attributes with the CMTS dynamically-created
    bonding group when selecting the bonding groups for
    the service flow.
    If the referenced parameter is not present in the corresponding
    DOCSIS QOS Parameter Set, this attribute returns '00000000'H."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow
    Attribute Aggregation Mask section in the Common Radio

```

```

Frequency Interface Encodings Annex."
 ::= { docsQosParamSetEntry 29 }

docsQosParamSetAppId OBJECT-TYPE
 SYNTAX      Unsigned32
 MAX-ACCESS  read-only
 STATUS      current
 DESCRIPTION
   "This attribute represents the Application Identifier
    associated with the service flow for purposes beyond the
    scope of this specification.
   If the referenced parameter is not present in the corresponding
   DOCSIS QOS Parameter Set, this attribute returns 0."
REFERENCE
   "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Application
    Identifier section in the Common Radio Frequency Interface
    Encodings Annex."
 ::= { docsQosParamSetEntry 30 }

docsQosParamSetMultiplierContentionReqWindow OBJECT-TYPE
 SYNTAX      Unsigned32 (4..12)
 UNITS      "eighths"
 MAX-ACCESS  read-only
 STATUS      current
 DESCRIPTION
   "This attribute specifies the multiplier to be applied by a
    CM when performing contention request backoff for data requests.
   This attribute only applies to upstream Service Flows in 3.0
   operation. If the referenced parameter is not present in the
   upstream DOCSIS QOS Parameter Set or is not applicable, this
   attribute returns 8."
REFERENCE
   "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Multiplier to
    Contention Request Backoff Window section in the Common
    Radio Frequency Interface Encodings Annex."
 ::= { docsQosParamSetEntry 31 }

docsQosParamSetMultiplierBytesReq OBJECT-TYPE
 SYNTAX      Unsigned32 (1 | 2 | 4 | 8 | 16)
 UNITS      "requests"
 MAX-ACCESS  read-only
 STATUS      current
 DESCRIPTION
   "This attribute specifies the assumed bandwidth request
    multiplier. This attribute only applies to upstream Service
    Flows in 3.0 operation. If the referenced parameter is not
    present in the upstream DOCSIS QOS Parameter Set, or is not
    applicable, this attribute returns 4."
REFERENCE
   "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Multiplier
    to Number of Bytes Requested section in the Common
    Radio Frequency Interface Encodings Annex."
 ::= { docsQosParamSetEntry 32 }

docsQosParamSetMaxReqPerSidCluster OBJECT-TYPE
 SYNTAX      Unsigned32 (0..255)
 UNITS      "bytes"
 MAX-ACCESS  read-only
 STATUS      deprecated
 DESCRIPTION

```

"This attribute specifies the maximum number of requests that a CM can make within a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit.

This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0. If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with docsQosServiceFlowMaxReqPerSidCluster in the docsQosServiceFlowTable."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Maximum Requests per SID Cluster section in the Common Radio Frequency Interface Encodings Annex."  
`::= { docsQosParamSetEntry 33 }`

#### docsQosParamSetMaxOutstandingBytesPerSidCluster OBJECT-TYPE

SYNTAX Unsigned32

UNITS "bytes"

MAX-ACCESS read-only

STATUS deprecated

#### DESCRIPTION

"This attribute specifies the maximum number of bytes for which a CM can have requests outstanding on a given SID Cluster. If defined number of bytes are outstanding and further requests are required, the CM must switch to a different SID Cluster if one is available. A value of 0 indicates there is no limit.

This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with docsQosServiceFlowMaxOutstandingBytesPerSidCluster in the docsQosServiceFlowTable."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Maximum Outstanding Bytes per SID Cluster section in the Common Radio Frequency Interface Encodings Annex."  
`::= { docsQosParamSetEntry 34 }`

#### docsQosParamSetMaxTotBytesReqPerSidCluster OBJECT-TYPE

SYNTAX Unsigned32

UNITS "bytes"

MAX-ACCESS read-only

STATUS deprecated

#### DESCRIPTION

"This attribute specifies the maximum total number of bytes a CM can have requested using a given SID Cluster before it must switch to a different SID Cluster to make further requests. A value of 0 indicates there is no limit.

This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0.

If the referenced parameter is not present in the DOCSIS QOS Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with  
**docsQosServiceFlowMaxTotBytesReqPerSidCluster** in the  
**docsQosServiceFlowTable**."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, Maximum Total Bytes  
 Requested per SID Cluster section in the Common Radio  
 Frequency Interface Encodings Annex."  
 $::= \{ \text{docsQosParamSetEntry } 35 \}$

**docsQosParamSetMaxTimeInSidCluster** OBJECT-TYPE

SYNTAX Unsigned32 (0..65535)

UNITS "milliseconds"

MAX-ACCESS read-only

STATUS deprecated DESCRIPTION

"This attribute specifies the maximum time in milliseconds  
 that a CM may use a particular SID Cluster before it must  
 switch to a different SID Cluster to make further requests.  
 A value of 0 indicates there is no limit.

This attribute only applies to upstream Service Flows in 3.0  
 operation, in other cases it is reported as 0.  
 If the referenced parameter is not present in the DOCSIS QOS  
 Parameter Set, this attribute returns 0.

This attribute has been deprecated and replaced with  
**docsQosServiceFlowMaxTimeInSidCluster** in the  
**docsQosServiceFlowTable**."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522, Maximum Time in  
 the SID Cluster section in the Common Radio Frequency  
 Interface Encodings Annex."  
 $::= \{ \text{docsQosParamSetEntry } 36 \}$

**docsQosParamSetPeakTrafficRate** OBJECT-TYPE

SYNTAX Unsigned32

UNITS "bps"

MAX-ACCESS read-only

STATUS current

**DESCRIPTION**

"This attribute specifies the rate parameter 'P' of a  
 token-bucket-based peak rate limiter for packets of a  
 service flow. A value of 0 signifies no  
 Peak Traffic Rate is enforced.

If the referenced parameter is not present in the  
 corresponding DOCSIS QOS Parameter Set,  
 this attribute returns 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface  
 Specification CM-SP-MULPIv3.0-I08-080522,  
 Peak Traffic Rate section in the Common Radio Frequency  
 Interface Encodings Annex."  
 $::= \{ \text{docsQosParamSetEntry } 37 \}$

**docsQosParamSetDsResequencing** OBJECT-TYPE

SYNTAX INTEGER {

  resequencingDsidIfBonded(0),  
  noResequencingDsid(1),  
  notApplicable(2)  
  }

```

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute specifies if a resequencing DSID need to be
     allocated to the service flow.
    The value 'resequencingDsidIfBonded' indicates that a resequencing DSID
     is required if the service flow is assigned to a downstream
     bonding group.
    The value 'noResequencingDsid' indicates no resequencing DSID
     is associated with the service flow.
    The value 'notApplicable' indicates the value of this attribute
     is not applicable.

    This attribute only applies to downstream Service Flows in 3.0
     operation. If the referenced parameter is not present in the
     corresponding downstream DOCSIS QOS Parameter Set, this
     attribute returns 'resequencingDsidIfBonded'. This parameter is not applicable
to
     upstream DOCSIS QOS Parameter Sets, so the value 'notApplicable' is reported
     in that case."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522,
     Peak Traffic Rate section in the Common Radio Frequency
     Interface Encodings Annex."
::= { docsQosParamSetEntry 38 }

docsQosParamSetMinimumBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS      "bytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the configured minimum buffer size
     for the service flow."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I15-110210, Buffer Control
     section in the Common Radio Frequency Interface Encodings
     Annex."
::= { docsQosParamSetEntry 39 }

docsQosParamSetTargetBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS      "bytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the configured target buffer size
     for the service flow. The value 0 indicates that no target buffer
     size was configured, and the device will use a vendor specific
     value."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I15-110210, Buffer Control
     section in the Common Radio Frequency Interface Encodings
     Annex."
::= { docsQosParamSetEntry 40 }

docsQosParamSetMaximumBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS      "bytes"
MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
    "This attribute represents the configured maximum buffer size
    for the service flow. The value 4294967295 indicates that no maximum buffer
    size was configured, and thus there is no limit to the buffer size."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I15-110210, Buffer Control
    section in the Common Radio Frequency Interface Encodings
    Annex."
 ::= { docsQosParamSetEntry 41 }

docsQosServiceFlowTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosServiceFlowEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object describes the set of DOCSIS-QOS Service
    Flows in a managed device."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service
    flows and Classifiers section."
 ::= { docsQosMibObjects 3}

docsQosServiceFlowEntry OBJECT-TYPE
SYNTAX      DocsQosServiceFlowEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosServiceFlowTable.
    The ifIndex key corresponds to the MAC Domain interface
    of this service flow."
INDEX { ifIndex,
        docsQosServiceFlowId
    }
 ::= { docsQosServiceFlowTable 1 }

DocsQosServiceFlowEntry ::= SEQUENCE {
    docsQosServiceFlowId
        Unsigned32,
    docsQosServiceFlowSID
        Unsigned32,
    docsQosServiceFlowDirection
        IfDirection,
    docsQosServiceFlowPrimary
        TruthValue,
    docsQosServiceFlowParamSetTypeStatus
        BITS,
    docsQosServiceFlowChSetId
        ChSetId,
    docsQosServiceFlowAttrAssignSuccess
        TruthValue,
    docsQosServiceFlowDsid
        Dsid,
    docsQosServiceFlowMaxReqPerSidCluster
        Unsigned32,
    docsQosServiceFlowMaxOutstandingBytesPerSidCluster
        Unsigned32,
    docsQosServiceFlowMaxTotBytesReqPerSidCluster
        Unsigned32,
    docsQosServiceFlowMaxTimeInSidCluster
        Unsigned32,
}

```

```
docsQosServiceFlowBufferSize
    Unsigned32
}

docsQosServiceFlowId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents an identifier assigned to a Service
        Flow by CMDS within a MAC Domain.
        The value 0 is used only for the purpose of reporting instances
        of the PktClass object pertaining UDCs and
        not used for association of QOS classifiers to service
        flows."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Service Flow
        Identifier section in the Common Radio Frequency Interface
        Encodings Annex."
 ::= { docsQosServiceFlowEntry 1 }

docsQosServiceFlowsID OBJECT-TYPE
    SYNTAX      Unsigned32 (0..16383)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Service Identifier (SID) assigned to an admitted
        or active Service Flow. This attribute
        reports a value of 0 if a Service ID is not associated with
        the Service Flow. Only active
        or admitted upstream Service Flows will have a Service
        ID (SID)."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Service
        Identifier section in the Common Radio Frequency Interface
        Encodings Annex."
 ::= { docsQosServiceFlowEntry 6 }

docsQosServiceFlowDirection OBJECT-TYPE
    SYNTAX      IfDirection
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the direction of the Service
        Flow."
 ::= { docsQosServiceFlowEntry 7 }

docsQosServiceFlowPrimary OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute reflects whether Service Flow is the
        primary
        or a secondary Service Flow."
 ::= { docsQosServiceFlowEntry 8 }

docsQosServiceFlowParamSetTypeStatus OBJECT-TYPE
    SYNTAX      BITS {
                    active(0),
```

```

                admitted(1),
                provisioned(2)
            }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the status of the service
    flow based on the admission state.
    'active' bit set to '1' indicates that the service flow
    is active and that the corresponding QOS ParamSet
    is stored in the CMTS.
    'admitted' bit set to '1' indicates that the service
    flow resources were reserved and that the corresponding
    QOS ParamSet is stored in the CMTS.
    'provisioned' bit set to '1' indicates that the service
    flow was defined in the CM config file and that the
    corresponding QOS ParamSet is stored in the CMTS."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service
    Flow Section."
::= { docsQosServiceFlowEntry 9 }

docsQosServiceFlowChSetId OBJECT-TYPE
SYNTAX      ChSetId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the Channel Set Id associated
    with the service flow."
::= { docsQosServiceFlowEntry 10 }

docsQosServiceFlowAttrAssignSuccess OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "If set to 'true', this attribute indicates that the
    current channel set associated with the service flow
    meets the Required and Forbidden Attribute Mask encodings.
    Since this attribute is not applicable for a CM, the
    CM always returns 'false'."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow
    section."
::= { docsQosServiceFlowEntry 11 }

docsQosServiceFlowDsid OBJECT-TYPE
SYNTAX      Dsid
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the DSID associated with
    the downstream service flow. downstream service flows
    without a DSID or upstream Service Flows report
    the value zero."
::= { docsQosServiceFlowEntry 12 }

docsQosServiceFlowMaxReqPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
UNITS      "bytes"
MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
  "This attribute specifies the maximum number of requests
  that a CM can make within a given SID Cluster before it
  must switch to a different SID Cluster to make further
  requests. A value of 0 indicates there is no limit.
  This attribute only applies to upstream Service Flows in 3.0
  operation, in other cases it is reported as 0."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Maximum Requests
  per SID Cluster section in the Common Radio Frequency
  Interface Encodings Annex."
 ::= { docsQosServiceFlowEntry 13 }

docsQosServiceFlowMaxOutstandingBytesPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "This attribute specifies the maximum number of bytes
  for which a CM can have requests outstanding on a given
  SID Cluster. If defined number of bytes are outstanding
  and further requests are required, the CM must switch to
  a different SID Cluster if one is available. A value of 0
  indicates there is no limit.
  This attribute only applies to upstream Service Flows
  in 3.0 operation, in other cases it is reported as 0."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Maximum
  Outstanding Bytes per SID Cluster section in the Common
  Radio Frequency Interface Encodings Annex."
 ::= { docsQosServiceFlowEntry 14 }

docsQosServiceFlowMaxTotBytesReqPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bytes"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "This attribute specifies the maximum total number of
  bytes a CM can have requested using a given SID Cluster
  before it must switch to a different SID Cluster to make
  further requests. A value of 0 indicates there is no
  limit.
  This attribute only applies to upstream Service Flows
  in 3.0 operation, in other cases it is reported as 0."
REFERENCE
  "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
  Specification CM-SP-MULPIv3.0-I08-080522, Maximum Total
  Bytes Requested per SID Cluster section in the
  Common Radio Frequency Interface Encodings Annex."
 ::= { docsQosServiceFlowEntry 15 }

docsQosServiceFlowMaxTimeInSidCluster OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS       "milliseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "This attribute specifies the maximum time in

```

milliseconds that a CM may use a particular SID Cluster before it must switch to a different SID Cluster to make further requests.

A value of 0 indicates there is no limit.

This attribute only applies to upstream Service Flows in 3.0 operation, in other cases it is reported as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Maximum Time in the SID Cluster section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosServiceFlowEntry 16 }

**docsQosServiceFlowBufferSize OBJECT-TYPE**

SYNTAX Unsigned32 (0..4294967295)

UNITS "bytes"

MAX-ACCESS read-only

STATUS current

**DESCRIPTION**

"This attribute specifies the buffer size for the service flow. For the CM this attribute only applies to upstream Service Flows, for the CMTS this attribute only applies to downstream Service Flows, in other cases it is reported as 0."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I15-110210, Buffer Control section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosServiceFlowEntry 17 }

**docsQosServiceFlowStatsTable OBJECT-TYPE**

SYNTAX SEQUENCE OF DocsQosServiceFlowStatsEntry

MAX-ACCESS not-accessible

STATUS current

**DESCRIPTION**

"This object describes statistics associated with the Service Flows in a managed device."

::= { docsQosMibObjects 4}

**docsQosServiceFlowStatsEntry OBJECT-TYPE**

SYNTAX DocsQosServiceFlowStatsEntry

MAX-ACCESS not-accessible

STATUS current

**DESCRIPTION**

"The conceptual row of docsQosServiceFlowStatsTable. The ifIndex key corresponds to the MAC Domain interface of the service flow."

INDEX { ifIndex,  
        docsQosServiceFlowId  
      }

::= { docsQosServiceFlowStatsTable 1 }

DocsQosServiceFlowStatsEntry ::= SEQUENCE {  
    docsQosServiceFlowPkts  
        Counter64,  
    docsQosServiceFlowOctets  
        Counter64,  
    docsQosServiceFlowTimeCreated  
        TimeStamp,  
    docsQosServiceFlowTimeActive  
        Counter32,  
    docsQosServiceFlowPHSUnknowns

```

        Counter32,
docsQosServiceFlowPolicedDropPkts
        Counter32,
docsQosServiceFlowPolicedDelayPkts
        Counter32
}

docsQosServiceFlowPkts OBJECT-TYPE
SYNTAX      Counter64
UNITS      "packets"
MAX-ACCESS  read-only
STATUS     current
DESCRIPTION
    "For outgoing Service Flows, this attribute counts
the number of Packet Data PDUs forwarded to this Service
Flow. For incoming upstream CMTS service flows,
this attribute counts the number of Packet Data PDUs
actually received on the Service Flow identified by
the SID for which the packet was scheduled. CMs not classifying
downstream packets may report this attribute's
value as 0 for downstream Service Flows. This
attribute does not count MAC-specific management
messages.

Particularly for UGS flows, packets sent on the primary
Service Flow in violation of the UGS grant size should
be counted only by the instance of this attribute
that is associated with the primary service flow.

Unclassified upstream user data packets (i.e., non-
MAC-management) forwarded to the primary upstream
Service Flow should be counted by the instance of this
attribute that is associated with the primary service
flow.

This attribute does include packets counted by
ServiceFlowPolicedDelayPkts, but does not include packets
counted by ServiceFlowPolicedDropPkts and
ServiceFlowPHSUnknowns.

This counter's last discontinuity is the
ifCounterDiscontinuityTime for of the associated MAC Domain
interface index."
::= { docsQosServiceFlowStatsEntry 1 }

docsQosServiceFlowOctets OBJECT-TYPE
SYNTAX      Counter64
UNITS      "bytes"
MAX-ACCESS  read-only
STATUS     current
DESCRIPTION
    "This attribute indicates the count of the number of
octets from the byte after the MAC header HCS to the end
of the CRC for all packets counted in the ServiceFlowPkts
attribute for this row. Note that this counts
the octets after payload header suppression and before
payload header expansion have been applied.

This counter's last discontinuity is the
ifCounterDiscontinuityTime for of the associated MAC Domain
interface index."
::= { docsQosServiceFlowStatsEntry 2 }

```

```

docsQosServiceFlowTimeCreated OBJECT-TYPE
  SYNTAX      TimeStamp
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the value of sysUpTime when
     the service flow was created."
  ::= { docsQosServiceFlowStatsEntry 3 }

docsQosServiceFlowTimeActive OBJECT-TYPE
  SYNTAX      Counter32
  UNITS      "seconds"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the number of seconds that
     the service flow has been active.

    This counter's last discontinuity is the
    ifCounterDiscontinuityTime for of the associated MAC Domain
    interface index."
  ::= { docsQosServiceFlowStatsEntry 4 }

docsQosServiceFlowPHSUnknowns OBJECT-TYPE
  SYNTAX      Counter32
  UNITS      "packets"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "For incoming upstream CMDS service flows, this attribute
     counts the number of packets received with an
     unknown payload header suppression index.

    The service flow is identified by the SID for which the
     packet was scheduled.

    On a CM, only this attribute's instance for the primary
     downstream service flow counts packets received
     with an unknown payload header suppression index. All
     other downstream service flows on CM report this attributes
     value as 0.

    All outgoing service flows report this attribute's
     value as 0.

    This counter's last discontinuity is the
    ifCounterDiscontinuityTime for of the associated MAC Domain
    interface index."
  ::= { docsQosServiceFlowStatsEntry 5 }

docsQosServiceFlowPolicedDropPkts OBJECT-TYPE
  SYNTAX      Counter32
  UNITS      "packets"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "For outgoing service flows, this attribute counts
     the number of Packet Data PDUs classified to this service
     flow dropped due to:
      (1) exceeding the selected Buffer Size for the service flow; or

      (2) UGS packets dropped due to exceeding the Unsolicited
          Grant Size with a Request/Transmission policy
          that requires such packets to be dropped.

```

Classified packets dropped due to other reasons must be counted in ifOutDiscards for the interface of this service flow. This attribute reports 0 for incoming service flows.

This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index."

#### REFERENCE

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I15-110210, Buffer Control section and Request/Transmission Policy section."  
 ::= { docsQosServiceFlowStatsEntry 6 }

docsQosServiceFlowPolicedDelayPkts OBJECT-TYPE

SYNTAX Counter32

UNITS "packets"

MAX-ACCESS read-only

STATUS current

#### DESCRIPTION

"This attribute counts only outgoing packets delayed in order to maintain the Maximum Sustained Traffic Rate. This attribute will always report a value of 0 for UGS flows because the Maximum Sustained Traffic Rate does not apply. This attribute is 0 for incoming service flows.

This counter's last discontinuity is the ifCounterDiscontinuityTime for of the associated MAC Domain interface index."

::= { docsQosServiceFlowStatsEntry 7 }

docsQosUpstreamStatsTable OBJECT-TYPE

SYNTAX SEQUENCE OF DocsQosUpstreamStatsEntry

MAX-ACCESS not-accessible

STATUS current

#### DESCRIPTION

"This object describes statistics associated with upstream service flows. All counted frames must be received without a Frame Check Sequence (FCS) error."  
 ::= { docsQosMibObjects 5 }

docsQosUpstreamStatsEntry OBJECT-TYPE

SYNTAX DocsQosUpstreamStatsEntry

MAX-ACCESS not-accessible

STATUS current

#### DESCRIPTION

"The conceptual row of docsQosUpstreamStatsTable. The ifIndex key corresponds to the upstream logical channel interface of the service flow. A DOCSIS 3.0 CMTS populates entries in the docsQosUpstreamStatsTable with information for Pre-3.0 DOCSIS devices. Devices operating in Multiple Transmit Channel mode will not be recorded in the docsQosUpstreamStatsTable and will instead be recorded in the docsQosServiceFlowCcfStatsTable."  
 INDEX { ifIndex,  
       docsQosSID  
       }  
 ::= { docsQosUpstreamStatsTable 1 }

DocsQosUpstreamStatsEntry ::= SEQUENCE {  
 docsQosSID  
 Unsigned32,

```

docsQosUpstreamFragments
    Counter32,
docsQosUpstreamFragDiscards
    Counter32,
docsQosUpstreamConcatBursts
    Counter32
}

docsQosSID OBJECT-TYPE
SYNTAX      Unsigned32 (1..16383)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key identifies a service ID for an admitted
     or active upstream service flow."
 ::= { docsQosUpstreamStatsEntry 1 }

docsQosUpstreamFragments OBJECT-TYPE
SYNTAX      Counter32
UNITS      "fragments"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the number of fragmentation
     headers received on an upstream service flow, regardless
     of whether the fragment was correctly reassembled
     into a valid packet.

    This counter's last discontinuity is the
    ifCounterDiscontinuityTime for of the associated MAC Domain
    interface index."
 ::= { docsQosUpstreamStatsEntry 2 }

docsQosUpstreamFragDiscards OBJECT-TYPE
SYNTAX      Counter32
UNITS      "fragments"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the number of upstream fragments
     discarded and not assembled into a valid upstream
     packet.

    This counter's last discontinuity is the
    ifCounterDiscontinuityTime for of the associated MAC Domain
    interface index."
 ::= { docsQosUpstreamStatsEntry 3 }

docsQosUpstreamConcatBursts OBJECT-TYPE
SYNTAX      Counter32
UNITS      "headers"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the number of concatenation
     headers received on an upstream service flow.

    This counter's last discontinuity is the
    ifCounterDiscontinuityTime for of the associated MAC Domain
    interface index."
 ::= { docsQosUpstreamStatsEntry 4 }

docsQosDynamicServiceStatsTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosDynamicServiceStatsEntry
MAX-ACCESS  not-accessible

```

```
STATUS      current
DESCRIPTION
    "This object describes statistics associated with
    the Dynamic Service Flows, Dynamic Channel Changes
    and Dynamic Bonding Changes in a managed device within
    a MAC Domain.
    For each MAC Domain there are two instances for the for
    the upstream and downstream
    direction.
    On the CMTS, the downstream direction instance indicates
    messages transmitted or transactions originated
    by the CMTS. The upstream direction instance indicates
    messages received or transaction originated
    by the CM.
    On the CM, the downstream direction instance indicates
    messages received or transactions originated by
    the CMTS. The upstream direction instance indicates
    messages transmitted by the CM or transactions originated
    by the CM."
 ::= { docsQosMibObjects 6}

docsQosDynamicServiceStatsEntry OBJECT-TYPE
SYNTAX      DocsQosDynamicServiceStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosDynamicServiceStatsTable.
    The ifIndex key corresponds to the MAC Domain interface
    of the service flow."
INDEX { ifIndex,
        docsQosIfDirection
    }
 ::= { docsQosDynamicServiceStatsTable 1 }

DocsQosDynamicServiceStatsEntry ::= SEQUENCE {
    docsQosIfDirection
        IfDirection,
    docsQosDSAreqs
        Counter32,
    docsQosDSArsp
        Counter32,
    docsQosDSAacks
        Counter32,
    docsQosDSCreqs
        Counter32,
    docsQosDSCRsp
        Counter32,
    docsQosDSCAcks
        Counter32,
    docsQosDSDreqs
        Counter32,
    docsQosDSDRsp
        Counter32,
    docsQosDynamicAdds
        Counter32,
    docsQosDynamicAddFails
        Counter32,
    docsQosDynamicChanges
        Counter32,
    docsQosDynamicChangeFails
        Counter32,
    docsQosDynamicDeletes
        Counter32,
```

```

docsQosDynamicDeleteFails
    Counter32,
docsQosDCCReqs
    Counter32,
docsQosDCCRsp
    Counter32,
docsQosDCCAck
    Counter32,
docsQosDCCS
    Counter32,
docsQosDCCFails
    Counter32,
docsQosDCCRspDeparts
    Counter32,
docsQosDCCRspArrives
    Counter32,
docsQosDbcReqs
    Counter32,
docsQosDbcRsp
    Counter32,
docsQosDbcAck
    Counter32,
docsQosDbcSuccesses
    Counter32,
docsQosDbcFails
    Counter32,
docsQosDbcPartial
    Counter32
}

docsQosIfDirection OBJECT-TYPE
    SYNTAX      IfDirection
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This attribute indicates the interface direction
         for the instance the statistics are collected."
    ::= { docsQosDynamicServiceStatsEntry 1 }

docsQosDSAReqs OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the number of Dynamic Service
         Addition Requests, including retries.
         Discontinuities in the value of this counter can occur
         at reinitialization of the managed system, and at
         other times as indicated by the value of
         ifCounterDiscontinuityTime of the associated MAC Domain
         interface index."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
         Addition section; [RFC 2863]."
    ::= { docsQosDynamicServiceStatsEntry 2 }

docsQosDSARsp
    OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of Dynamic Service Addition Responses,

```

including retries.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Addition section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 3 }

docsQosDSAACKs OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The number of Dynamic Service Addition Acknowledgements, including retries.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
REFERENCE  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Addition section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 4 }

docsQosDSCReqs OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The number of Dynamic Service Change Requests, including retries.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
REFERENCE  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Change section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 5 }

docsQosDSCRspns OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The number of Dynamic Service Change Responses, including retries.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
REFERENCE  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service

```

    Change section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 6 }

docsQosDSCAcks OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of Dynamic Service Change Acknowledgements,
     including retries.
    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
     Change section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 7 }

docsQosDSDReqs OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of Dynamic Service Delete Requests, including
     retries.
    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
     Delete section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 8 }

docsQosDSDRsps OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of Dynamic Service Delete Responses, including
     retries.
    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
     Delete section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 9 }

docsQosDynamicAddrs OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of successful Dynamic Service Addition

```

transactions.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Addition section; [RFC 2863]."  
::= { docsQosDynamicServiceStatsEntry 10 }

**docsQosDynamicAddFails** OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"The number of failed Dynamic Service Addition transactions.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
**REFERENCE**  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Addition section; [RFC 2863]."  
::= { docsQosDynamicServiceStatsEntry 11 }

**docsQosDynamicChanges** OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"The number of successful Dynamic Service Change transactions.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
**REFERENCE**  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service Change section; [RFC 2863]."  
::= { docsQosDynamicServiceStatsEntry 12 }

**docsQosDynamicChangeFails** OBJECT-TYPE  
SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current  
**DESCRIPTION**  
"The number of failed Dynamic Service Change transactions.  
Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."  
**REFERENCE**  
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service

```

    Change section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 13 }

docsQosDynamicDeletes OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of successful Dynamic Service Delete transactions.

    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
    Delete section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 14 }

docsQosDynamicDeleteFails OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of failed Dynamic Service Delete transactions.

    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Service
    Delete section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 15 }

docsQosDCCReqs OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The number of Dynamic Channel Change Request messages
    traversing an interface. This count is nonzero
    only on downstream direction rows. This count should
    include the number of retries.
    Discontinuities in the value of this counter can occur
    at reinitialization of the managed system, and at
    other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream
    and/or Upstream Channel Changes section; [RFC 2863]."
::= { docsQosDynamicServiceStatsEntry 16 }

docsQosDCCRspns OBJECT-TYPE
  SYNTAX      Counter32
  MAX-ACCESS  read-only
  STATUS      current

```

**DESCRIPTION**

"The number of Dynamic Channel Change Response messages traversing an interface. This count is nonzero only on upstream direction rows. This count should include the number of retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 17 }

docsQosDCCAcks OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"The number of Dynamic Channel Change Acknowledgement messages traversing an interface. This count is nonzero only on downstream direction rows. This count should include the number of retries. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 18 }

docsQosDCCCs OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"The number of successful Dynamic Channel Change transactions. This count is nonzero only on downstream direction rows. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 19 }

docsQosDCCFails OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"The number of failed Dynamic Channel Change transactions. This count is nonzero only on downstream direction rows.

Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 20 }

**docsQosDCCRspDeparts** OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"This attribute contains the number of Dynamic Channel Change Response (depart) messages. It only applies to upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 21 }

**docsQosDCCRspArrives** OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"This attribute contains the number of Dynamic Channel Change Response (arrive) messages and should include retries. It only applies to the upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Downstream and/or Upstream Channel Changes section; [RFC 2863]."  
 ::= { docsQosDynamicServiceStatsEntry 22 }

**docsQosDbcReqs** OBJECT-TYPE

SYNTAX Counter32  
MAX-ACCESS read-only  
STATUS current

**DESCRIPTION**

"This attribute contains the number of Dynamic Bonding Change Requests, including retries. It only applies to the upstream direction. Discontinuities in the value of this counter can occur at reinitialization of the managed system, and at other times as indicated by the value of ifCounterDiscontinuityTime of the associated MAC Domain interface index."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding

```
Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 23 }

docsQosDbcRsp OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
DESCRIPTION
    "This attribute contains the number of Dynamic Bonding
     Change Responses, including retries. It only applies
     to the upstream direction. Discontinuities
     in the value of this counter can occur at reinitialization
     of the managed system, and at other times as indicated
     by the value of ifCounterDiscontinuityTime
     of the associated MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding
     Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 24 }

docsQosDbcAcks OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
DESCRIPTION
    "This attribute contains the number of Dynamic Bonding
     Change Acknowledgements, including retries.
     It only applies to the downstream direction. Discontinuities
     in the value of this counter can occur at reinitialization
     of the managed system, and at other times
     as indicated by the value of ifCounterDiscontinuityTime
     of the associated MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding
     Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 25 }

docsQosDbcSuccesses OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
DESCRIPTION
    "This attribute contains the number of fully successful
     Dynamic Bonding Change transactions. It only
     applies to the downstream direction and does not include
     DBC transactions that result in Partial Service.
     Discontinuities in the value of this counter can occur
     at reinitialization of the managed system, and
     at other times as indicated by the value of
     ifCounterDiscontinuityTime of the associated MAC Domain
     interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding
     Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 26 }

docsQosDbcFails OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
```

```

DESCRIPTION
    "This attribute contains the number of failed Dynamic
    Bonding Change transactions. It only applies to
    the downstream direction. Note that Partial Service
    is not considered a failed transaction. Discontinuities
    in the value of this counter can occur at reinitialization
    of the managed system, and at other times
    as indicated by the value of ifCounterDiscontinuityTime
    of the associated MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding
    Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 27 }

docsQosDbcPartial OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of unsuccessful
    Dynamic Bonding Change transactions that result
    in Partial Service. IT only applies to the downstream
    direction. Discontinuities in the value of this counter
    can occur at reinitialization of the managed system,
    and at other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC
    Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Dynamic Bonding
    Change (DBC) section; [RFC 2863]."
 ::= { docsQosDynamicServiceStatsEntry 28 }

docsQosServiceFlowLogTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosServiceFlowLogEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object contains a log of the disconnected Service
    Flows in a managed device."
 ::= { docsQosMibObjects 7}

docsQosServiceFlowLogEntry OBJECT-TYPE
SYNTAX      DocsQosServiceFlowLogEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosServiceFlowLogTable."
INDEX { docsQosServiceFlowLogIndex }
 ::= { docsQosServiceFlowLogTable 1 }

DocsQosServiceFlowLogEntry ::= SEQUENCE {
    docsQosServiceFlowLogIndex
        Unsigned32,
    docsQosServiceFlowLogIfIndex
        InterfaceIndex,
    docsQosServiceFlowLogSFID
        Unsigned32,
    docsQosServiceFlowLogCmMac
        MacAddress,
    docsQosServiceFlowLogPkts
        Counter64,
}

```

```
docsQosServiceFlowLogOctets
    Counter64,
docsQosServiceFlowLogTimeDeleted
    TimeStamp,
docsQosServiceFlowLogTimeCreated
    TimeStamp,
docsQosServiceFlowLogTimeActive
    Counter32,
docsQosServiceFlowLogDirection
    IfDirection,
docsQosServiceFlowLogPrimary
    TruthValue,
docsQosServiceFlowLogServiceClassName
    SnmpAdminString,
docsQosServiceFlowLogPolicedDropPkts
    Counter32,
docsQosServiceFlowLogPolicedDelayPkts
    Counter32,
docsQosServiceFlowLogControl
    INTEGER
}

docsQosServiceFlowLogIndex OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key indicates an unique index for a logged service
flow."
::= { docsQosServiceFlowLogEntry 1 }

docsQosServiceFlowLogIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the MAC Domain Interface
index where the service flow was present."
::= { docsQosServiceFlowLogEntry 2 }

docsQosServiceFlowLogSFID OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the identifier assigned
to the service flow."
::= { docsQosServiceFlowLogEntry 3 }

docsQosServiceFlowLogCmMac OBJECT-TYPE
SYNTAX      MacAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the MAC address of the cable
modem associated with the service flow."
::= { docsQosServiceFlowLogEntry 4 }

docsQosServiceFlowLogPkts OBJECT-TYPE
SYNTAX      Counter64
UNITS      "packets"
MAX-ACCESS  read-only
STATUS      current
```

```

DESCRIPTION
    "This attribute indicates the final value of the Pkts
     attribute in the ServiceFlowStats object for the
     service flow."
 ::= { docsQosServiceFlowLogEntry 5 }

docsQosServiceFlowLogOctets OBJECT-TYPE
    SYNTAX      Counter64
    UNITS       "bytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the final value of the Pkts
         attribute in the ServiceFlowStats object for the
         service flow."
 ::= { docsQosServiceFlowLogEntry 6 }

docsQosServiceFlowLogTimeDeleted OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the value of sysUpTime when
         the service flow was deleted."
 ::= { docsQosServiceFlowLogEntry 7 }

docsQosServiceFlowLogTimeCreated OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the value of sysUpTime when
         the service flow was created."
 ::= { docsQosServiceFlowLogEntry 8 }

docsQosServiceFlowLogTimeActive OBJECT-TYPE
    SYNTAX      Counter32
    UNITS       "seconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the total time that the service
         flow was active."
 ::= { docsQosServiceFlowLogEntry 9 }

docsQosServiceFlowLogDirection OBJECT-TYPE
    SYNTAX      IfDirection
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the value of Service Flow
         direction for the service flow."
 ::= { docsQosServiceFlowLogEntry 11 }

docsQosServiceFlowLogPrimary OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "If set to 'true', this attribute indicates that the
         Service Flow in the log was a Primary Service Flow, otherwise,
         a Secondary Service Flow."
 ::= { docsQosServiceFlowLogEntry 12 }

```

```

docsQosServiceFlowLogServiceClassName OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..15))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the value of ServiceClassName
         for the provisioned QOS Parameter Set of the service
         flow."
    ::= { docsQosServiceFlowLogEntry 13 }

docsQosServiceFlowLogPolicedDropPkts OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "packets"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the final value of PolicedDropPkts
         attribute of the ServiceFlowStats object
         for the service flow."
    ::= { docsQosServiceFlowLogEntry 14 }

docsQosServiceFlowLogPolicedDelayPkts OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "packets"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the final value of PolicedDelayPkts
         attribute of the ServiceFlowStats object
         for the service flow."
    ::= { docsQosServiceFlowLogEntry 15 }

docsQosServiceFlowLogControl OBJECT-TYPE
    SYNTAX      INTEGER {
                    active(1),
                    destroy(6)
                }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute when set to 'destroy' removes this
         instance from the object.
        Reading this attribute returns the value 'active'."
    ::= { docsQosServiceFlowLogEntry 16 }

docsQosServiceClassTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosServiceClassEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object describes a provisioned service class
         on a CMTS.
        Each object instance defines a template for certain
         DOCSIS QOS Parameter Set values. When a CM creates or
         modifies an Admitted QOS Parameter Set for a Service
         Flow, it may reference a Service Class Name instead of
         providing explicit QOS Parameter
         Set values. In this case, the CMTS populates the QOS Parameter
         Set with the applicable
         corresponding values from the named Service Class.
         Subsequent changes to a Service Class row do not affect

```

the QOS Parameter Set values of any service flows already admitted.

A service class template applies to only a single direction, as indicated in the ServiceClassDirection attribute."

```
 ::= { docsQosMibObjects 8}

docsQosServiceClassEntry OBJECT-TYPE
  SYNTAX      DocsQosServiceClassEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsQosServiceClassTable."
  INDEX { docsQosServiceClassName }
  ::= { docsQosServiceClassTable 1 }

DocsQosServiceClassEntry ::= SEQUENCE {
  docsQosServiceClassName
    SnmpAdminString,
  docsQosServiceClassStatus
    RowStatus,
  docsQosServiceClassPriority
    Unsigned32,
  docsQosServiceClassMaxTrafficRate
    BitRate,
  docsQosServiceClassMaxTrafficBurst
    Unsigned32,
  docsQosServiceClassMinReservedRate
    BitRate,
  docsQosServiceClassMinReservedPkt
    Unsigned32,
  docsQosServiceClassMaxConcatBurst
    Unsigned32,
  docsQosServiceClassNomPollInterval
    Unsigned32,
  docsQosServiceClassTolPollJitter
    Unsigned32,
  docsQosServiceClassUnsolicitGrantSize
    Unsigned32,
  docsQosServiceClassNomGrantInterval
    Unsigned32,
  docsQosServiceClassTolGrantJitter
    Unsigned32,
  docsQosServiceClassGrantsPerInterval
    Unsigned32,
  docsQosServiceClassMaxLatency
    Unsigned32,
  docsQosServiceClassActiveTimeout
    Unsigned32,
  docsQosServiceClassAdmittedTimeout
    Unsigned32,
  docsQosServiceClassSchedulingType
    SchedulingType,
  docsQosServiceClassRequestPolicy
    OCTET STRING,
  docsQosServiceClassTosAndMask
    OCTET STRING,
  docsQosServiceClassTosOrMask
    OCTET STRING,
  docsQosServiceClassDirection
    IfDirection,
  docsQosServiceClassStorageType
    StorageType,
```

```

docsQosServiceClassDSCPOverwrite
    DscpOrAny,
docsQosServiceClassRequiredAttrMask
    AttributeMask,
docsQosServiceClassForbiddenAttrMask
    AttributeMask,
docsQosServiceClassAttrAggrRuleMask
    AttrAggrRuleMask,
docsQosServiceClassAppId
    Unsigned32,
docsQosServiceClassMultiplierContentionReqWindow
    Unsigned32,
docsQosServiceClassMultiplierBytesReq
    Unsigned32,
docsQosServiceClassMaxReqPerSidCluster
    Unsigned32,
docsQosServiceClassMaxOutstandingBytesPerSidCluster
    Unsigned32,
docsQosServiceClassMaxTotBytesReqPerSidCluster
    Unsigned32,
docsQosServiceClassMaxTimeInSidCluster
    Unsigned32,
docsQosServiceClassPeakTrafficRate
    Unsigned32,
docsQosServiceClassDsResequencing
    INTEGER,
docsQosServiceClassMinimumBuffer
    Unsigned32,
docsQosServiceClassTargetBuffer
    Unsigned32,
docsQosServiceClassMaximumBuffer
    Unsigned32
}

docsQosServiceClassName OBJECT-TYPE
    SYNTAX     SnmpAdminString (SIZE(1..15))
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "This key indicates the Service Class Name associated
         with this object instance. DOCSIS specifies
         that the maximum size is 16 ASCII characters including
         a terminating zero. The terminating zero is not
         represented in this SnmpAdminString syntax attribute."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Service Class
         Name section in the Common Radio Frequency Interface
         Encodings Annex."
    ::= { docsQosServiceClassEntry 1 }

docsQosServiceClassStatus OBJECT-TYPE
    SYNTAX     RowStatus
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
        "The conceptual row status of this object."
    ::= { docsQosServiceClassEntry 3 }

docsQosServiceClassPriority OBJECT-TYPE
    SYNTAX     Unsigned32 (0..7)
    MAX-ACCESS read-create
    STATUS     current

```

```

DESCRIPTION
    "This attribute is the template for the Priority attribute
    of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 4 }

docsQosServiceClassMaxTrafficRate OBJECT-TYPE
SYNTAX      BitRate
UNITS       "bps"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MaxTrafficRate
    attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 5 }

docsQosServiceClassMaxTrafficBurst OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MaxTrafficBurst
    attribute of the QoS Parameter Set."
DEFVAL { 3044 }
 ::= { docsQosServiceClassEntry 6 }

docsQosServiceClassMinReservedRate OBJECT-TYPE
SYNTAX      BitRate
UNITS       "bps"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MinReservedRate
    attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 7 }

docsQosServiceClassMinReservedPkt OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MinReservedPkt
    attribute of the QoS Parameter Set."
 ::= { docsQosServiceClassEntry 8 }

docsQosServiceClassMaxConcatBurst OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MaxConcatBurst
    attribute of the QoS Parameter Set."
DEFVAL { 1522 }
 ::= { docsQosServiceClassEntry 9 }

docsQosServiceClassNomPollInterval OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "microseconds"

```

```
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the NomPollInterval
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 10 }

docsQosServiceClassTolPollJitter OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "microseconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the TolPolJitter
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 11 }

docsQosServiceClassUnsolicitGrantSize OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the UnsolicitGrantSize
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 12 }

docsQosServiceClassNomGrantInterval OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "microseconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the NomGrantInterval
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 13 }

docsQosServiceClassTolGrantJitter OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "microseconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the TolGrantJitter
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 14 }

docsQosServiceClassGrantsPerInterval OBJECT-TYPE
SYNTAX      Unsigned32 (0..127)
UNITS       "dataGrants"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the GrantsPerInterval
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 15 }
```

```

docsQosServiceClassMaxLatency OBJECT-TYPE
  SYNTAX      Unsigned32
  UNITS      "microseconds"
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the MaxLatency
     attribute of the QoS Parameter Set."
  DEFVAL { 0 }
  ::= { docsQosServiceClassEntry 16 }

docsQosServiceClassActiveTimeout OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  UNITS      "seconds"
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the ActiveTimeout
     attribute of the QoS Parameter Set."
  DEFVAL { 0 }
  ::= { docsQosServiceClassEntry 17 }

docsQosServiceClassAdmittedTimeout OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  UNITS      "seconds"
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the AdmitedTimeout
     attribute of the QoS Parameter Set."
  DEFVAL { 200 }
  ::= { docsQosServiceClassEntry 18 }

docsQosServiceClassSchedulingType OBJECT-TYPE
  SYNTAX      SchedulingType
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the SchedulingType
     attribute of the QoS Parameter Set."
  DEFVAL { bestEffort }
  ::= { docsQosServiceClassEntry 19 }

docsQosServiceClassRequestPolicy OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE(4))
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the ReqPolicyOct
     attribute of the QoS Parameter Set."
  DEFVAL { '00000000'H }
  ::= { docsQosServiceClassEntry 20 }

docsQosServiceClassTosAndMask OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE(1))
  MAX-ACCESS  read-create
  STATUS     current
  DESCRIPTION
    "This attribute is the template for the TosAndMask
     attribute of the QoS Parameter Set."
  ::= { docsQosServiceClassEntry 21 }

docsQosServiceClassTosOrMask OBJECT-TYPE

```

```

SYNTAX      OCTET STRING (SIZE(1))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the TosOrMask attribute
     of the QoS Parameter Set."
 ::= { docsQosServiceClassEntry 22 }

docsQosServiceClassDirection OBJECT-TYPE
SYNTAX      IfDirection
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the Direction attribute
     of the QoS Parameter Set."
DEFVAL { upstream }
 ::= { docsQosServiceClassEntry 23 }

docsQosServiceClassStorageType OBJECT-TYPE
SYNTAX      StorageType
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute defines whether this row is kept in
     volatile storage and lost upon reboot or whether
     it is backed up by non-volatile or permanent storage.
     'permanent' entries need not allow writable access to
     any instance attribute."
DEFVAL { nonVolatile }
 ::= { docsQosServiceClassEntry 24 }

docsQosServiceClassDSCPOverwrite OBJECT-TYPE
SYNTAX      DscpOrAny
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute allows the overwrite of the DSCP field
     per RFC 3260.
     If this attribute is -1, then the corresponding TosAndMask
     value is set to be 'FF'H and TosOrMask is set to
     '00'H. Otherwise, this attribute is in the range of
0..63,
     and the corresponding TosAndMask value is '03'H
     and TosOrMask value is this attribute value shifted
     left by two bit positions."
DEFVAL { -1 }
 ::= { docsQosServiceClassEntry 25 }

docsQosServiceClassRequiredAttrMask OBJECT-TYPE
SYNTAX      AttributeMask
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the RequiredAttrMask
     attribute of the QoS Parameter Set."
DEFVAL { '00000000'H }
 ::= { docsQosServiceClassEntry 26 }

docsQosServiceClassForbiddenAttrMask OBJECT-TYPE
SYNTAX      AttributeMask
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION

```

```

    "This attribute is the template for the ForbiddenAttrMask
     attribute of the QoS Parameter Set."
DEFVAL { '00000000'H }
 ::= { docsQosServiceClassEntry 27 }

docsQosServiceClassAttrAggrRuleMask OBJECT-TYPE
SYNTAX      AttrAggrRuleMask
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the AttrAggregationMask
     attribute of the QoS Parameter Set."
DEFVAL { '00000000'H }
 ::= { docsQosServiceClassEntry 28 }

docsQosServiceClassAppId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the AppId attribute
     of the QoS Parameter Set."
 ::= { docsQosServiceClassEntry 29 }

docsQosServiceClassMultiplierContentionReqWindow OBJECT-TYPE
SYNTAX      Unsigned32 (4..12)
UNITS       "eighths"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MultiplierContentionReqWindow
     attribute of the QoS Parameter
     Set."
DEFVAL { 8 }
 ::= { docsQosServiceClassEntry 30 }

docsQosServiceClassMultiplierBytesReq OBJECT-TYPE
SYNTAX      Unsigned32 (1 | 2 | 4 | 8 | 16)
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MultiplierBytesReq
     attribute of the QoS Parameter Set."
DEFVAL { 4 }
 ::= { docsQosServiceClassEntry 31 }

docsQosServiceClassMaxReqPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
UNITS       "requests"
MAX-ACCESS  read-create
STATUS      deprecated
DESCRIPTION
    "This attribute is the template for the MaxReqPerSidCluster
     attribute of the QoS Parameter Set.

    This attribute has been deprecated and replaced with
    docsQosServiceFlowMaxReqPerSidCluster in the
    docsQosServiceFlowTable."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 32 }

docsQosServiceClassMaxOutstandingBytesPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32

```

```
UNITS      "bytes"
MAX-ACCESS read-create
STATUS     deprecated
DESCRIPTION
    "This attribute is the template for the MaxOutstandingBytesPerSidCluster
     attribute of the QoS Parameter Set.

    This attribute has been deprecated and replaced with
    docsQosServiceFlowMaxOutstandingBytesPerSidCluster in the
    docsQosServiceFlowTable."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 33 }

docsQosServiceClassMaxTotBytesReqPerSidCluster OBJECT-TYPE
SYNTAX      Unsigned32
UNITS      "bytes"
MAX-ACCESS read-create
STATUS     deprecated
DESCRIPTION
    "This attribute is the template for the MaxTotBytesReqPerSidCluster
     attribute of the QoS Parameter Set.

    This attribute has been deprecated and replaced with
    docsQosServiceFlowMaxTotBytesReqPerSidCluster in the
    docsQosServiceFlowTable."

DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 34 }

docsQosServiceClassMaxTimeInSidCluster OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS      "milliseconds"
MAX-ACCESS read-create
STATUS     deprecated
DESCRIPTION
    "This attribute is the template for the MaxTimeInSidCluster
     attribute of the QoS Parameter Set.

    This attribute has been deprecated and replaced with
    docsQosServiceFlowMaxTimeInSidCluster in the
    docsQosServiceFlowTable."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 35 }

docsQosServiceClassPeakTrafficRate OBJECT-TYPE
SYNTAX      Unsigned32
UNITS      "bps"
MAX-ACCESS read-create
STATUS     current
DESCRIPTION
    "This attribute is the template for the PeakTrafficRate
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 36 }

docsQosServiceClassDsResequencing OBJECT-TYPE
SYNTAX      INTEGER {
                resequencingDsid(0),
                noResequencingDsid(1)
            }
MAX-ACCESS read-create
STATUS     current
DESCRIPTION
    "This attribute is the template for the DsResequencing
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        attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 37 }

docsQosServiceClassMinimumBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MinimumBuffer
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 38 }

docsQosServiceClassTargetBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the TargetBuffer
     attribute of the QoS Parameter Set."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 39 }

docsQosServiceClassMaximumBuffer OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS       "bytes"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute is the template for the MaximumBuffer
     attribute of the QoS Parameter Set."
DEFVAL { 4294967295 }
 ::= { docsQosServiceClassEntry 40 }

docsQosPHSTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosPHSEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object describes the set of payload header suppression
     of Service Flows."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Payload Header
     Suppression section in the Common Radio Frequency Interface
     Encodings Annex."
 ::= { docsQosMibObjects 10 }

docsQosPHSEntry OBJECT-TYPE
SYNTAX      DocsQosPHSEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosPHSTable.
     The ifIndex key corresponds to the MAC Domain interface
     of the service flow of the classifier that includes this
     PHS rule."
INDEX { ifIndex,

```

```

        docsQosServiceFlowId,
        docsQosPktClassId
    }
 ::= { docsQosPHSTable 1 }

DocsQosPHSEntry ::= SEQUENCE {
    docsQosPHSField
        OCTET STRING,
    docsQosPHSMask
        OCTET STRING,
    docsQosPHSSize
        Unsigned32,
    docsQosPHSVerify
        TruthValue,
    docsQosPHSIndex
        Unsigned32
}

docsQosPHSField OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (0..255))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the Payload Header suppression
     field defines the bytes of the header that must
     be suppressed/restored by the sending/receiving
     device.
    The number of octets in this attribute should be the same
     as the value of PHSSize."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Payload Header
     Suppression Field (PHSF) section in the Common Radio
     Frequency Interface Encodings Annex."
 ::= { docsQosPHSEntry 2 }

docsQosPHSMask OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE (0..32))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute defines the bit mask that is used in
     combination with the PHSField. It defines which bytes
     in the header must be suppressed/restored by the sending
     or receiving device.

    Each bit of this bit mask corresponds to a byte in the PHSField,
    with the least
    significant bit corresponding to the first byte of the
    PHSField.

    Each bit of the bit mask specifies whether the corresponding
    byte should be suppressed in the packet. A bit
    value of '1' indicates that the byte should be suppressed
    by the sending device and restored by the receiving
    device.
    A bit value of '0' indicates that the byte should not be
    suppressed by the sending device or restored by the
    receiving device.
    If the bit mask does not contain a bit for each byte in the
    PHSField, then the bit mask is extended with bit values
    of '1' to be the necessary length."
REFERENCE

```

```

    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Payload Header
    Suppression Mask (PHSM) section in the Common Radio Frequency
    Interface Encodings Annex."
 ::= { docsQosPHSEntry 3 }

docsQosPHSSize OBJECT-TYPE
    SYNTAX      Unsigned32 (0..255)
    UNITS       "bytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute specifies the number of bytes in the
        header to be suppressed and restored.
        The value of this attribute matches the number of bytes
        in the Field attribute."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Payload Header Suppression
        Size (PHSS) section in the Common Radio Frequency Interface
        Encodings Annex."
 ::= { docsQosPHSEntry 4 }

docsQosPHSVerify OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "If 'true', this attribute indicates that the sender
        must verify that the PHS Field
        is the same as the content in the packet to be suppressed."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Payload Header
        Suppression Verification (PHSV) section in the Common Radio
        Frequency Interface Encodings Annex."
 ::= { docsQosPHSEntry 5 }

docsQosPHSIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..255)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute uniquely references the PHS rule for
        a given service flow."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Payload Header
        Suppression Index (PHSI) section in the Common Radio
        Frequency Interface Encodings Annex."
 ::= { docsQosPHSEntry 7 }

docsQosCmtsMacToSrvFlowTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosCmtsMacToSrvFlowEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object provides the mapping of unicast service
        flows with the cable modem the service flows belongs
        to."
 ::= { docsQosMibObjects 11}

docsQosCmtsMacToSrvFlowEntry OBJECT-TYPE

```

```

SYNTAX      DocsQosCmtsMacToSrvFlowEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosCmtsMacToSrvFlowTable."
INDEX {
    docsQosCmtsCmMac,
    docsQosCmtsServiceFlowId
}
 ::= { docsQosCmtsMacToSrvFlowTable 1 }

DocsQosCmtsMacToSrvFlowEntry ::= SEQUENCE {
    docsQosCmtsCmMac
        MacAddress,
    docsQosCmtsServiceFlowId
        Unsigned32,
    docsQosCmtsIfIndex
        InterfaceIndex
}

docsQosCmtsCmMac OBJECT-TYPE
SYNTAX      MacAddress
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the MAC address for the referenced
    CM."
 ::= { docsQosCmtsMacToSrvFlowEntry 1 }

docsQosCmtsServiceFlowId OBJECT-TYPE
SYNTAX      Unsigned32 (1..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the identifier of the Service
    Flow."
 ::= { docsQosCmtsMacToSrvFlowEntry 2 }

docsQosCmtsIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the interface index of
    the MAC domain of the Service Flow and where the CableModem
    is registered."
 ::= { docsQosCmtsMacToSrvFlowEntry 3 }

docsQosServiceFlowSidClusterTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosServiceFlowSidClusterEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines the SID clusters associated with
    an upstream service flow."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Service Flow SID
    Cluster Assignments section in the Common Radio Frequency
    Interface Encodings Annex."
 ::= { docsQosMibObjects 12}

docsQosServiceFlowSidClusterEntry OBJECT-TYPE

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SYNTAX      DocsQosServiceFlowSidClusterEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosServiceFlowSidClusterTable.
     The ifIndex key corresponds to the MAC Domain interface
     of the service flow."
INDEX { ifIndex,
        docsQosServiceFlowId,
        docsQosServiceFlowSidClusterId,
        docsQosServiceFlowSidClusterUcid
    }
 ::= { docsQosServiceFlowSidClusterTable 1 }

DocsQosServiceFlowSidClusterEntry ::= SEQUENCE {
    docsQosServiceFlowSidClusterId
        Unsigned32,
    docsQosServiceFlowSidClusterUcid
        ChId,
    docsQosServiceFlowSidClusterSid
        Unsigned32
}

docsQosServiceFlowSidClusterId OBJECT-TYPE
SYNTAX      Unsigned32 (0..7)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the SID Cluster ID of the SID Cluster."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, SID Cluster ID
     section in the Common Radio Frequency Interface Encodings
     Annex."
 ::= { docsQosServiceFlowSidClusterEntry 1 }

docsQosServiceFlowSidClusterUcid OBJECT-TYPE
SYNTAX      ChId (1..255)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the upstream Channel ID mapped
     to the corresponding SID."
 ::= { docsQosServiceFlowSidClusterEntry 2 }

docsQosServiceFlowSidClusterSid OBJECT-TYPE
SYNTAX      Unsigned32 (1..16383)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the SID assigned to the
     upstream channel in this SID Cluster."
 ::= { docsQosServiceFlowSidClusterEntry 3 }

docsQosGrpServiceFlowTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosGrpServiceFlowEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object provides extensions to the service flow
     information for Group Service Flows (GSFs)."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface

```

```

Specification CM-SP-MULPIv3.0-I08-080522, QoS Support
for Joined IP Multicast Traffic section."
 ::= { docsQosMibObjects 13}

docsQosGrpServiceFlowEntry OBJECT-TYPE
  SYNTAX      DocsQosGrpServiceFlowEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsQosGrpServiceFlowTable.
     The ifIndex key corresponds to the MAC Domain interface
     of the group service flow."
  INDEX { ifIndex,
          docsQosServiceFlowId
        }
  ::= { docsQosGrpServiceFlowTable 1 }

DocsQosGrpServiceFlowEntry ::= SEQUENCE {
  docsQosGrpServiceFlowIsDef
    TruthValue,
  docsQosGrpServiceFlowQosConfigId
    Unsigned32,
  docsQosGrpServiceFlowNumSess
    Unsigned32,
  docsQosGrpServiceFlowSrcAddr
    InetAddress,
  docsQosGrpServiceFlowGrpAddr
    InetAddress
}

docsQosGrpServiceFlowIsDef OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates whether the GSF QoS Parameter
     Set corresponds to the Default Group Service Flow."
  REFERENCE
    "DOCSIS 3.0 Operations Support System Interface Specification
     CM-SP-OSSIv3.0-I07-080522, Multicast Requirements Annex."
  ::= { docsQosGrpServiceFlowEntry 1 }

docsQosGrpServiceFlowQosConfigId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the Group QoS Configuration
     (GQC) identifier used of the creation of this GSF.
     The value zero indicates that the Service Flow is using
     the default service flow."
  REFERENCE
    "DOCSIS 3.0 Operations Support System Interface Specification
     CM-SP-OSSIv3.0-I07-080522, Multicast Requirements Annex."
  ::= { docsQosGrpServiceFlowEntry 2 }

docsQosGrpServiceFlowNumSess OBJECT-TYPE
  SYNTAX      Unsigned32 (1..65535)
  UNITS      "sessions"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute indicates the number of sessions that

```

are configured in an aggregated Service Flow. If this is a single session replication, the value of this attribute is 1."

**REFERENCE**

"DOCSIS 3.0 Operations Support System Interface Specification CM-SP-OSSIV3.0-I07-080522, Multicast Requirements Annex."

::= { docsQosGrpServiceFlowEntry 3 }

**docsQosGrpServiceFlowSrcAddr OBJECT-TYPE**

**SYNTAX** InetAddress

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the specific multicast Source Address that is configured in a single session Service Flow. If this is an aggregate Service Flow (NumSess attribute reports a value greater than 1) this attribute returns one of the multicast source addresses for the session. For the case of Any Source Multicast (ASM), this attribute reports a value of 0.0.0.0 for IPv4 or 0::0 for IPv6."

::= { docsQosGrpServiceFlowEntry 4 }

**docsQosGrpServiceFlowGrpAddr OBJECT-TYPE**

**SYNTAX** InetAddress

**MAX-ACCESS** read-only

**STATUS** current

**DESCRIPTION**

"This attribute specifies the specific Multicast Group Address that is configured in a single session Service Flow. If this is an aggregate Service Flow (NumSess attribute reports a value greater than 1) this attribute returns the multicast group address associated with the SrcAddr for the session."

::= { docsQosGrpServiceFlowEntry 5 }

**docsQosGrpPktClassTable OBJECT-TYPE**

**SYNTAX** SEQUENCE OF DocsQosGrpPktClassEntry

**MAX-ACCESS** not-accessible

**STATUS** current

**DESCRIPTION**

"This object provides additional packet classification information for Group Classifier References (GCRs) in a Group Service Flow (GSF)."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIV3.0-I08-080522, QoS Support for Joined IP Multicast Traffic section."

::= { docsQosMibObjects 14}

**docsQosGrpPktClassEntry OBJECT-TYPE**

**SYNTAX** DocsQosGrpPktClassEntry

**MAX-ACCESS** not-accessible

**STATUS** current

**DESCRIPTION**

"The conceptual row of docsQosGrpPktClassTable. The ifIndex key corresponds to the MAC Domain interface of the service flow of this group classifier."

**INDEX** { ifIndex,

docsQosServiceFlowId,

docsQosPktClassId

}

::= { docsQosGrpPktClassTable 1 }

```

DocsQosGrpPktClassEntry ::= SEQUENCE {
    docsQosGrpPktClassGrpConfigId
        Unsigned32
}

docsQosGrpPktClassGrpConfigId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the GC identifier used of
         the creation of this GSF."
    REFERENCE
        "DOCSIS 3.0 Operations Support System Interface Specification
         CM-SP-OSSIv3.0-I07-080522, Multicast Requirements Annex."
    ::= { docsQosGrpPktClassEntry 1 }

docsQosUpChCounterExtTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosUpChCounterExtEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object provides extensions for service flow
         statistics for fragmentation for channel bonding."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Channel
         Bonding section."
    ::= { docsQosMibObjects 15 }

docsQosUpChCounterExtEntry OBJECT-TYPE
    SYNTAX      DocsQosUpChCounterExtEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsQosUpChCounterExtTable.
         The ifIndex key corresponds to the upstream Channel Interface
         of the service flow."
    INDEX { ifIndex }
    ::= { docsQosUpChCounterExtTable 1 }

DocsQosUpChCounterExtEntry ::= SEQUENCE {
    docsQosUpChCounterExtSgmtValids
        Counter32,
    docsQosUpChCounterExtSgmtDiscards
        Counter32
}

docsQosUpChCounterExtSgmtValids OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "segments"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the total number segments
         processed on this channel. Discontinuities in the
         value of this counter can occur at reinitialization
         of the managed system, and at other times as indicated
         by the value of ifCounterDiscontinuityTime of the
         associated MAC Domain interface index."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
         Specification CM-SP-MULPIv3.0-I08-080522, Upstream and
         Downstream"

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Downstream Common Aspects section; [RFC 2863]."
 ::= { docsQosUpChCounterExtEntry 1 }

docsQosUpChCounterExtSgmtDiscards OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "segments"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute represents the total number of discarded
        segments on this channel due to segment HCS problems.
        Discontinuities in the value of this counter
        can occur at reinitialization of the managed system,
        and at other times as indicated by the value of
        ifCounterDiscontinuityTime of the associated MAC Domain
        interface index."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Continuous
        Concatenation and Fragmentation section;[RFC 2863]."
 ::= { docsQosUpChCounterExtEntry 2 }

docsQosServiceFlowCcfStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosServiceFlowCcfStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object provides upstream service flow statistics
        for Continuous Concatenation and Fragmentation
        (CCF).
        The CMTS may choose to not instantiate this object for service flows
        that do not use CCF or return a zero value for the individual
        counter statistics."
    REFERENCE
        "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, Continuous
        Concatenation and Fragmentation section."
 ::= { docsQosMibObjects 16}

docsQosServiceFlowCcfStatsEntry OBJECT-TYPE
    SYNTAX      DocsQosServiceFlowCcfStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsQosServiceFlowCcfStatsTable.
        The ifIndex key corresponds to the MAC Domain interface
        of the service flow."
    INDEX { ifIndex,
            docsQosServiceFlowId
        }
 ::= { docsQosServiceFlowCcfStatsTable 1 }

DocsQosServiceFlowCcfStatsEntry ::= SEQUENCE {
    docsQosServiceFlowCcfStatsSgmtValids
        Counter32,
    docsQosServiceFlowCcfStatsSgmtLost
        Counter32
}

docsQosServiceFlowCcfStatsSgmtValids OBJECT-TYPE
    SYNTAX      Counter32
    UNITS      "segments"
    MAX-ACCESS  read-only

```

```

STATUS      current
DESCRIPTION
    "This attribute contains the number of segments counted
    on this service flow regardless of whether the
    fragment was correctly reassembled into valid packets.
    This attribute only gathers information for Segment
    Header On service flows. Discontinuities in the value of this
    counter can occur at reinitialization of the managed system,
    and other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Continuous
    Concatenation and Fragmentation section; [RFC 2863]."
::= { docsQosServiceFlowCcfStatsEntry 1 }

docsQosServiceFlowCcfStatsSgmtLost OBJECT-TYPE
SYNTAX      Counter32
UNITS       "segments"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of segments which
    the CMTS segment reassembly function determines were
    lost. This attribute only gathers information for Segment
    Header On service flows. Discontinuities in the value of this
    counter can occur at reinitialization of the managed system,
    and at other times as indicated by the value of
    ifCounterDiscontinuityTime of the associated MAC Domain
    interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Continuous
    Concatenation and Fragmentation section; [RFC 2863]."
::= { docsQosServiceFlowCcfStatsEntry 2 }

docsQosCmServiceUsStatsTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosCmServiceUsStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines DOCSIS MAC services primitive
    statistics of upstream service flows. In pre-3.0 DOCSIS
    devices this statistics exists per SID for either
    Cos or Qos services in the SNMP table docsIfCmServiceTable.

    A 3.0 CM with CoS configuration (DOCSIS 1.0 mode) reports
    the statistics defined in the SNMP table docsIfCmServiceTable.
    A 3.0 CM with QoS configuration reports
    this object regardless of whether Multiple Transmit
    Channel is enabled or disabled."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Upstream Data
    Transmission section."
::= { docsQosMibObjects 17}

docsQosCmServiceUsStatsEntry OBJECT-TYPE
SYNTAX      DocsQosCmServiceUsStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION

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"The conceptual row of docsQosCmServiceUsStatsTable.
The ifIndex key corresponds to the MAC Domain interface
of the service flow."
INDEX { ifIndex,
         docsQosServiceFlowId
       }
 ::= { docsQosCmServiceUsStatsTable 1 }

DocsQosCmServiceUsStatsEntry ::= SEQUENCE {
    docsQosCmServiceUsStatsTxSlotsImmed
        Counter32,
    docsQosCmServiceUsStatsTxSlotsDed
        Counter32,
    docsQosCmServiceUsStatsTxRetries
        Counter32,
    docsQosCmServiceUsStatsTxExceededs
        Counter32,
    docsQosCmServiceUsStatsRqRetries
        Counter32,
    docsQosCmServiceUsStatsRqExceededs
        Counter32,
    docsQosCmServiceUsStatsSgmts
        Counter32
}

docsQosCmServiceUsStatsTxSlotsImmed OBJECT-TYPE
SYNTAX      Counter32
UNITS      "mini-slots"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of upstream mini-slots
     which have been used to transmit data PDUs in
     immediate (contention) mode. This includes only those
     PDUs that are presumed to have arrived at the head-end
     (i.e., those which were explicitly acknowledged.)
     It does not include retransmission attempts or
     mini-slots used by Requests. Discontinuities in the
     value of this counter can occur at reinitialization
     of the managed system, and at other times as indicated
     by the value of ifCounterDiscontinuityTime of the
     associated MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Upstream
     Bandwidth Allocation section; [RFC 2863]."
 ::= { docsQosCmServiceUsStatsEntry 1 }

docsQosCmServiceUsStatsTxSlotsDed OBJECT-TYPE
SYNTAX      Counter32
UNITS      "mini-slots"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of upstream mini-slots
     which have been used to transmit data PDUs in
     dedicated mode (i.e., as a result of a unicast Data Grant).
     Discontinuities in the value of this counter
     can occur at reinitialization of the managed system,
     and at other times as indicated by the value of
     ifCounterDiscontinuityTime of the associated MAC Domain
     interface index."
REFERENCE

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```
"DOCSIS 3.0 MAC and Upper Layer Protocols Interface
Specification CM-SP-MULPIv3.0-I08-080522, Upstream Data
Transmission section; [RFC 2863]."
 ::= { docsQosCmServiceUsStatsEntry 2 }

docsQosCmServiceUsStatsTxRetries OBJECT-TYPE
SYNTAX      Counter32
UNITS       "attempts"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of attempts to
    transmit data PDUs containing requests for acknowledgment
    that did not result in acknowledgment. Discontinuities
    in the value of this counter can occur at
    reinitialization of the managed system, and at other
    times as indicated by the value of ifCounterDiscontinuityTime
    for the associated MAC Domain interface
    index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Upstream Bandwidth
    Allocation section; [RFC 2863]."
 ::= { docsQosCmServiceUsStatsEntry 3 }

docsQosCmServiceUsStatsTxExceedededs OBJECT-TYPE
SYNTAX      Counter32
UNITS       "attempts"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of attempts to
    transmit bandwidth requests which did not result in
    acknowledgment. Discontinuities in the value of this
    counter can occur at reinitialization of the managed
    system, and at other times as indicated by the value
    of ifCounterDiscontinuityTime of the associated
    MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Upstream Bandwidth
    Allocation section; [RFC 2863]."
 ::= { docsQosCmServiceUsStatsEntry 4 }

docsQosCmServiceUsStatsRqRetries OBJECT-TYPE
SYNTAX      Counter32
UNITS       "attempts"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute contains the number of attempts to
    transmit bandwidth requests which did not result in
    acknowledgment. Discontinuities in the value of this
    counter can occur at reinitialization of the managed
    system, and at other times as indicated by the value
    of ifCounterDiscontinuityTime of the associated
    MAC Domain interface index."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, Upstream
    Bandwidth Allocation section; [RFC 2863]."
 ::= { docsQosCmServiceUsStatsEntry 5 }
```

```

docsQosCmServiceUsStatsRqExceededs OBJECT-TYPE
  SYNTAX      Counter32
  UNITS      "attempts"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute contains the number of requests for
     bandwidth which failed due to excessive retries without
     acknowledgment. Discontinuities in the value
     of this counter can occur at reinitialization of the
     managed system, and at other times as indicated by the
     value of ifCounterDiscontinuityTime of the associated
     MAC Domain interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Upstream Bandwidth
     Allocation section; [RFC 2863]."
  ::= { docsQosCmServiceUsStatsEntry 6 }

docsQosCmServiceUsStatsSgmts OBJECT-TYPE
  SYNTAX      Counter32
  UNITS      "segments"
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute contains the number of segments sent
     on this service flow. Discontinuities in the value
     of this counter can occur at reinitialization of the
     managed system, and at other times as indicated by the
     value of ifCounterDiscontinuityTime of the associated
     MAC Domain interface index."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Upstream and
     Downstream Common Aspects section; RFC 2863."
  ::= { docsQosCmServiceUsStatsEntry 7 }

docsQosCmtsDsidTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsQosCmtsDsidEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object describes DSID information stored in
     the CMTS.
     The CMTS reports the current status of existing DSIDs.
     When a DSID is created during the registration process
     or a DBC transaction, a corresponding object instance
     is created. If a DSID is deleted or changed via
     a DBC message the corresponding object instance is deleted
     or updated respectively."
  ::= { docsQosMibObjects 18}

docsQosCmtsDsidEntry OBJECT-TYPE
  SYNTAX      DocsQosCmtsDsidEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsQosCmtsDsidTable.
     The ifIndex key corresponds to the MAC Domain interface
     of the DSID."
  INDEX { ifIndex,
          docsQosCmtsDsidDsid
        }

```

```

 ::= { docsQosCmtsDsidTable 1 }

DocsQosCmtsDsidEntry ::= SEQUENCE {
    docsQosCmtsDsidDsid
        Dsid,
    docsQosCmtsDsidUsage
        BITS,
    docsQosCmtsDsidDsChSet
        ChSetId,
    docsQosCmtsDsidReseqWaitTime
        Unsigned32,
    docsQosCmtsDsidReseqWarnThrshld
        Unsigned32,
    docsQosCmtsDsidStatusHloffTimerSeqOutOfRng
        Unsigned32,
    docsQosCmtsDsidCurrentSeqNum
        Unsigned32
}

docsQosCmtsDsidDsid OBJECT-TYPE
    SYNTAX      Dsid
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the DSID."
    ::= { docsQosCmtsDsidEntry 1 }

docsQosCmtsDsidUsage OBJECT-TYPE
    SYNTAX      BITS {
        resequencing(0),
        multicastCapable(1),
        multicastReplication(2),
        bonding(3)
    }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the properties of the DSID.
        The bits are defined as follows:
        'resequencing' This bit is set to 1 for a Resequencing
        DSID.
        'multicastCapable' This bit is set to 1 for a DSID that
        is capable of transporting multicast traffic (i.e.,
        the DSID has multicast forwarding attributes).
        'multicastReplication' This bit is set to 1 for a DSID
        that is used for transporting a multicast replication
        (i.e., there is a corresponding instance of the MulticastRepl
        object).
        'bonding' This bit is set to a 1 for a DSID that is associated
        with a bonding group."
    REFERENCE
        "DOCSIS 3.0 Operations Support System Interface Specification
        CM-SP-OSSIv3.0-I07-080522, Multicast Requirements Annex.
        DOCSIS 3.0 MAC and Upper Layer Protocols Interface
        Specification CM-SP-MULPIv3.0-I08-080522, DSID Encodings section
        in the Common Radio Frequency Interface Encodings Annex."
    ::= { docsQosCmtsDsidEntry 2 }

docsQosCmtsDsidDsChSet OBJECT-TYPE
    SYNTAX      ChSetId
    MAX-ACCESS  read-only
    STATUS      current

```

```

DESCRIPTION
    "This attribute represents the Downstream Channel
    Set over which the DSID is being resequenced."
::= { docsQosCmtsDsidEntry 3 }

docsQosCmtsDsidReseqWaitTime OBJECT-TYPE
SYNTAX      Unsigned32 (1..180)
UNITS       "hundredMicroseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the DSID Resequencing
    Wait Time that is used for this DSID. This attribute is
    only valid when the Usage attribute has the resequencing
    bit set to 1. This attribute returns a value of 0
    when the Usage attribute has the resequencing bit set
    to 0."
::= { docsQosCmtsDsidEntry 4 }

docsQosCmtsDsidReseqWarnThrshld OBJECT-TYPE
SYNTAX      Unsigned32 (0..179)
UNITS       "hundredMicroseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the DSID Resequencing
    Warning Threshold that is used for this DSID. The value
    of 0 indicates that the threshold warnings are disabled.
    This attribute is only valid when the Usage attribute
    has the resequencing bit set to 1. This attribute
    returns a value of 0 when the Usage attribute has
    the resequencing bit set to 0."
::= { docsQosCmtsDsidEntry 5 }

docsQosCmtsDsidStatusHldoffTimerSeqOutOfRng OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
UNITS       "20milliseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the hold-off timer for
    reporting Out-of-Range Events via the CM-STATUS MAC
    Management message. This attribute is only valid when
    the Usage attribute has the resequencing bit set
    to 1. This attribute returns a value of 0 when the Usage
    attribute has the resequencing bit set to 0."
::= { docsQosCmtsDsidEntry 6 }

docsQosCmtsDsidCurrentSeqNum OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute reports the value of the most recent
    sequence number assigned by the CMTS for this DSID.
    This attribute is only valid when the Usage attribute
    has the resequencing bit set to 1. This attribute returns
    a value of 0 when the Usage attribute has the resequencing
    bit set to 0."
::= { docsQosCmtsDsidEntry 7 }

docsQosCmtsDebugDsidTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsQosCmtsDebugDsidEntry

```

```
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
    "The CMTS Debug DSID object contains the control of
    DSID debug statistics reporting
    An instance in this object defines the DSID and MAC domain
    to which the CmtsDebugDsidStats collects statistics
    for the downstream channel associated with that
    DSID and MAC Domain. The deletion of an instance stops
    the reporting of statistics for the specified DSID.

    This object supports instance creation and deletion.

    The CMTS MUST support at least one instance of this object."
::= { docsQosMibObjects 19}

docsQosCmtsDebugDsidEntry OBJECT-TYPE
    SYNTAX      DocsQosCmtsDebugDsidEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The conceptual row of docsQosCmtsDebugDsidTable.
        The ifIndex key corresponds to the MAC Domain interface
        of the DSID."
    INDEX { ifIndex,
            docsQosCmtsDebugDsidDsid
        }
    ::= { docsQosCmtsDebugDsidTable 1 }

DocsQosCmtsDebugDsidEntry ::= SEQUENCE {
    docsQosCmtsDebugDsidDsid
        Dsid,
    docsQosCmtsDebugDsidRowStatus
        RowStatus
}

docsQosCmtsDebugDsidDsid OBJECT-TYPE
    SYNTAX      Dsid
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "This attribute represents the DSID value to be debugged,
        identified by the IfIndex attribute of this object."
    ::= { docsQosCmtsDebugDsidEntry 1 }

docsQosCmtsDebugDsidRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
        "The conceptual row status of this object."
    ::= { docsQosCmtsDebugDsidEntry 2 }

docsQosCmtsDebugDsidStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosCmtsDebugDsidStatsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The CMTS Debug DSID Stats object describes statistics
        at the CMTS for the forwarding of DSID-labeled downstream
        packets.
        The CMTS creates an instance for every combination of
        MAC Domain, DSID value, and downstream channel on which
```

```

packets labeled with that DSID are transmitted.
The CMTS does not delete such instances while the corresponding
CmtsDebug object control instance exists."
 ::= { docsQosMibObjects 20}

docsQosCmtsDebugDsidStatsEntry OBJECT-TYPE
SYNTAX      DocsQosCmtsDebugDsidStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosCmtsDebugDsidStatsTable.
    The ifIndex key corresponds to the MAC Domain interface
    of the DSID."
INDEX { ifIndex,
        docsQosCmtsDebugDsidDsid,
        docsQosCmtsDebugDsidStatsDsIfIndex
    }
 ::= { docsQosCmtsDebugDsidStatsTable 1 }

DocsQosCmtsDebugDsidStatsEntry ::= SEQUENCE {
    docsQosCmtsDebugDsidStatsDsIfIndex
        InterfaceIndex,
    docsQosCmtsDebugDsidStatsDsidPackets
        Counter64,
    docsQosCmtsDebugDsidStatsDsidOctets
        Counter64
}

docsQosCmtsDebugDsidStatsDsIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents an interface index of a downstream
    channel that belongs to the DSID"
 ::= { docsQosCmtsDebugDsidStatsEntry 1 }

docsQosCmtsDebugDsidStatsDsidPackets OBJECT-TYPE
SYNTAX      Counter64
UNITS      "packets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute is a counter which contains the number
    of packets transmitted by the CMTS which are labeled
    with the DSID on the downstream channel. Discontinuities in
    the value of this counter can occur as indicated by the value
    of ifCounterDiscontinuityTime of the associated Downstream
    interface index."
 ::= { docsQosCmtsDebugDsidStatsEntry 2 }

docsQosCmtsDebugDsidStatsDsidOctets OBJECT-TYPE
SYNTAX      Counter64
UNITS      "octets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of bytes transmitted
    by the CMTS which are labeled with the DSID on the
    downstream interface. Discontinuities in the value of
    this counter can occur as indicated by the value of
    ifCounterDiscontinuityTime of the associated Downstream
    interface index."

```

```

 ::= { docsQosCmtsDebugDsidStatsEntry 3 }

docsQosCmDsidTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsQosCmDsidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "When a DSID is created, during the registration process
         or a DBC transaction,. The CM reports the current
         status of existing DSID, for example, if a DSID is deleted
         or changed via DBC messages the corresponding
         object instance is deleted or updated respectively."
 ::= { docsQosMibObjects 21}

docsQosCmDsidEntry OBJECT-TYPE
    SYNTAX      DocsQosCmDsidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsQosCmDsidTable
         The ifIndex key corresponds to the MAC Domain interface
         of the DSID."
    INDEX { ifIndex,
            docsQosCmDsidDsid
        }
 ::= { docsQosCmDsidTable 1 }

DocsQosCmDsidEntry ::= SEQUENCE {
    docsQosCmDsidDsid
        Dsid,
    docsQosCmDsidUsage
        BITS,
    docsQosCmDsidNumReseqChs
        Unsigned32,
    docsQosCmDsidReseqChList
        ChannelList,
    docsQosCmDsidReseqWaitTime
        Unsigned32,
    docsQosCmDsidReseqWarnThrshld
        Unsigned32,
    docsQosCmDsidStatusHldoffTimerSeqOutOfRng
        Unsigned32,
    docsQosCmDsidOutOfRangeDiscards
        Unsigned32,
    docsQosCmDsidNextExpectedSeqNum
        Unsigned32,
    docsQosCmDsidCmInterfaceMask
        DocsL2vpnIfList,
    docsQosCmDsidFwdCmInterfaceMask
        DocsL2vpnIfList
}

docsQosCmDsidDsid OBJECT-TYPE
    SYNTAX      Dsid
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the DSID."
 ::= { docsQosCmDsidEntry 1 }

docsQosCmDsidUsage OBJECT-TYPE
    SYNTAX      BITS {

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            resequencing(0),
            multicastCapable(1)
        }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the properties of the DSID.
     The bits are defined as follows:
     'resequencing' : This bit is set to 1 for a Resequencing
     DSID.
     'multicastCapable' : This bit is set to 1 for a DSID that
     is capable of transporting multicast traffic (e.g.,
     the DSID has multicast forwarding attributes)."
::= { docsQosCmDsidEntry 2 }

docsQosCmDsidNumReseqChs OBJECT-TYPE
SYNTAX      Unsigned32 (0 | 1..65535)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the number of channels
     in the downstream resequencing channel list for this
     DSID. When a DSID is used only for a non-bonded
     Multicast replication, this object returns a value of 0."
::= { docsQosCmDsidEntry 3 }

docsQosCmDsidReseqChList OBJECT-TYPE
SYNTAX      ChannelList (SIZE (0 | 2..255))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the Downstream Channel
     Set over which the DSID is being resequenced."
::= { docsQosCmDsidEntry 4 }

docsQosCmDsidReseqWaitTime OBJECT-TYPE
SYNTAX      Unsigned32 (0 | 1..180)
UNITS       "hundredMicroseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the DSID Resequencing
     Wait Time that is used for this DSID. This attribute is
     only valid when the Usage attribute has the resequencing
     bit set to 1. This attribute returns a value of 0
     when the Usage attribute has the resequencing bit set
     to 0."
::= { docsQosCmDsidEntry 5 }

docsQosCmDsidReseqWarnThrshld OBJECT-TYPE
SYNTAX      Unsigned32 (0..179)
UNITS       "hundredMicroseconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the DSID Resequencing
     Warning Threshold that is used for this DSID. The value
     of 0 indicates that the threshold warnings are disabled.
     This attribute is only valid when the Usage attribute
     has the resequencing bit set to 1. This attribute
     returns a value of 0 when the Usage attribute has
     the resequencing bit set to 0."
::= { docsQosCmDsidEntry 6 }

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docsQosCmDsidStatusHldoffTimerSeqOutOfRng OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    UNITS      "20milliseconds"
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute represents the hold-off timer for
         reporting Out-of-Range Events via the CM-STATUS MAC
         Management message. This attribute is only valid when
         the Usage attribute has the resequencing bit set
         to 1. This attribute returns a value of 0 when the Usage
         attribute has the resequencing bit set to 0."
    ::= { docsQosCmDsidEntry 7 }

docsQosCmDsidOutOfRangeDiscards OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute represents the current count of out-of-range
         packets discarded by the CM for a given resequencing context
         since an in-range packet was received. When this count exceeds
         1000 and more than two minutes have elapsed since an in-range
         packet was received, the CM will reacquire sequence numbers for
         this resequencing context."
    ::= { docsQosCmDsidEntry 8 }

docsQosCmDsidNextExpectedSeqNum OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute represents the Next Expected Packet
         Sequence Number for a given resequencing context.
         This attribute is only valid when the Usage attribute
         has the resequencing bit set to 1. This attribute returns
         a value of 0 when the Usage attribute has the resequencing
         bit set to 0."
    ::= { docsQosCmDsidEntry 9 }

docsQosCmDsidCmInterfaceMask OBJECT-TYPE
    SYNTAX      DocsL2vpnIfList
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute represents the bitmap of the interfaces
         communicated to the CM in a Multicast DSID encoding."
    ::= { docsQosCmDsidEntry 10 }

docsQosCmDsidFwdCmInterfaceMask OBJECT-TYPE
    SYNTAX      DocsL2vpnIfList
    MAX-ACCESS  read-only
    STATUS     current
    DESCRIPTION
        "This attribute represents the bitmap of the interfaces
         to which the CM forwards multicast traffic: a logical
         OR of interfaces identified in CmInterfaceMask
         and interfaces associated with the client MAC addresses
         identified in the instances for this DSID."
    ::= { docsQosCmDsidEntry 11 }

docsQosCmDsidStatsTable OBJECT-TYPE

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```

SYNTAX      SEQUENCE OF DocsQosCmDsidStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object defines a set of statistics the CM collects
     per Dsid."
 ::= { docsQosMibObjects 22}

docsQosCmDsidStatsEntry OBJECT-TYPE
SYNTAX      DocsQosCmDsidStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsQosCmDsidStatsTable."
INDEX { docsQosCmDsidStatsDsid }
 ::= { docsQosCmDsidStatsTable 1 }

DocsQosCmDsidStatsEntry ::= SEQUENCE {
    docsQosCmDsidStatsDsid
        Dsid,
    docsQosCmDsidStatsSeqNumMissing
        Counter32,
    docsQosCmDsidStatsSkewThreshExceeds
        Counter32,
    docsQosCmDsidStatsOutOfRangePackets
        Counter32,
    docsQosCmDsidStatsNumPackets
        Counter64
}

docsQosCmDsidStatsDsid OBJECT-TYPE
SYNTAX      Dsid
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the interface index of the MAC
     Domain associated with the DSID."
 ::= { docsQosCmDsidStatsEntry 1 }

docsQosCmDsidStatsSeqNumMissing OBJECT-TYPE
SYNTAX      Counter32
UNITS      "packets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of times the Next Expected
     Packet Sequence Number is declared lost. In this case one or
     more data packets are lost. This is generally caused by
     downstream packet loss."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I08-080522, Downstream
     Sequencing section."
 ::= { docsQosCmDsidStatsEntry 2 }

docsQosCmDsidStatsSkewThreshExceeds OBJECT-TYPE
SYNTAX      Counter32
UNITS      "packets"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts in-range sequenced packets
     which were successfully received by the CM after a wait

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time longer than the Resequencing Warning Threshold."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Skew Requirements section."

::= { docsQosCmDsidStatsEntry 3 }

**docsQosCmDsidStatsOutOfRangePackets OBJECT-TYPE**

SYNTAX Counter32  
 UNITS "packets"  
 MAX-ACCESS read-only  
 STATUS current  
**DESCRIPTION**

"This attribute counts the number of packets Counter received in a DSID reassembly context where the sequence number which is out of range."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, Receive Channels section."

::= { docsQosCmDsidStatsEntry 4 }

**docsQosCmDsidStatsNumPackets OBJECT-TYPE**

SYNTAX Counter64  
 UNITS "packets"  
 MAX-ACCESS read-only  
 STATUS current  
**DESCRIPTION**

"This attribute counts the total number of data packets of a DSID context forwarded for further processing."

::= { docsQosCmDsidStatsEntry 5 }

**docsQosCmDsidClientTable OBJECT-TYPE**

SYNTAX SEQUENCE OF DocsQosCmDsidClientEntry  
 MAX-ACCESS not-accessible  
 STATUS current  
**DESCRIPTION**

"This object contains the client MAC addresses that the CMTS requests that the CM uses to replicate Multicast DSIDs during registration or during a DBC transaction.

When a DSID is created that includes client MAC addresses, or when client MAC addresses are added to a DSID, new rows are created to indicate the added client MAC addresses. When a Client MAC address is deleted from a DSID, the corresponding row is deleted. When a DSID is deleted, all corresponding rows are deleted, too."

**REFERENCE**

"DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification CM-SP-MULPIv3.0-I08-080522, DSID Encodings section in the Common Radio Frequency Interface Encodings Annex."

::= { docsQosMibObjects 23 }

**docsQosCmDsidClientEntry OBJECT-TYPE**

SYNTAX DocsQosCmDsidClientEntry  
 MAX-ACCESS not-accessible  
 STATUS current  
**DESCRIPTION**

"The conceptual row of docsQosCmDsidClientTable."

INDEX { docsQosCmDsidClientDsid,  
 docsQosCmDsidClientClientMacId  
 }

```

 ::= { docsQosCmDsidClientTable 1 }

DocsQosCmDsidClientEntry ::= SEQUENCE {
    docsQosCmDsidClientDsid
        Dsid,
    docsQosCmDsidClientClientMacId
        Unsigned32,
    docsQosCmDsidClientClientMacAddr
        MacAddress
}

docsQosCmDsidClientDsid OBJECT-TYPE
    SYNTAX      Dsid
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key defines the DSID that the client MAC addresses
         are associated with."
    ::= { docsQosCmDsidClientEntry 1 }

docsQosCmDsidClientClientMacId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key defines a uniquely identified Client Mac
         Addresses associated with the DSID."
    ::= { docsQosCmDsidClientEntry 2 }

docsQosCmDsidClientClientMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute defines a client MAC address to which
         Multicast traffic labeled with this DSID should be
         forwarded."
    ::= { docsQosCmDsidClientEntry 3 }

docsQosMibConformance OBJECT IDENTIFIER ::= { docsQosMib 2 }
docsQosMibCompliances OBJECT IDENTIFIER ::= { docsQosMibConformance 1 }
docsQosMibGroups          OBJECT IDENTIFIER ::= { docsQosMibConformance 2 }

docsQosCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement of managed objects common for Cable Modem
     Termination Systems (CMTS) and Cable Modems (CM)."

    MODULE -- this MODULE
MANDATORY-GROUPS {
    docsQosBaseGroup
}

GROUP docsQosCmtsGroup
DESCRIPTION
    "This group is mandatory for Cable Modem Termination
     Systems (CMTS) and is not implemented for Cable Modems
     (CM)."

GROUP docsQosCmGroup
DESCRIPTION
    "This group is mandatory for Cable Modems (CM)TS) and is

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```
not implemented for Cable Modems Termination Systems (CMTS)."  
 ::= { docsQosMibCompliances 1 }  
  
docsQosBaseGroup OBJECT-GROUP  
OBJECTS {  
    docsQosPktClassDirection,  
    docsQosPktClassPriority,  
    docsQosPktClassIpTosLow,  
    docsQosPktClassIpTosHigh,  
    docsQosPktClassIpTosMask,  
    docsQosPktClassIpProtocol,  
    docsQosPktClassIpSourceAddr,  
    docsQosPktClassIpSourceMask,  
    docsQosPktClassIpDestAddr,  
    docsQosPktClassIpDestMask,  
    docsQosPktClassSourcePortStart,  
    docsQosPktClassSourcePortEnd,  
    docsQosPktClassDestPortStart,  
    docsQosPktClassDestPortEnd,  
    docsQosPktClassDestMacAddr,  
    docsQosPktClassDestMacMask,  
    docsQosPktClassSourceMacAddr,  
    docsQosPktClassEnetProtocolType,  
    docsQosPktClassEnetProtocol,  
    docsQosPktClassUserPriLow,  
    docsQosPktClassUserPriHigh,  
    docsQosPktClassVlanId,  
    docsQosPktClassState,  
    docsQosPktClassPkts,  
    docsQosPktClassBitMap,  
    docsQosPktClassIpAddrType,  
    docsQosPktClassFlowLabel,  
    docsQosPktClassCmInterfaceMask,  
    docsQosPktClassIcmpTypeLow,  
    docsQosPktClassIcmpTypeHigh,  
    docsQosParamSetServiceClassName,  
    docsQosParamSetPriority,  
    docsQosParamSetMaxTrafficRate,  
    docsQosParamSetMaxTrafficBurst,  
    docsQosParamSetMinReservedRate,  
    docsQosParamSetMinReservedPkt,  
    docsQosParamSetActiveTimeout,  
    docsQosParamSetAdmittedTimeout,  
    docsQosParamSetMaxConcatBurst,  
    docsQosParamSetSchedulingType,  
    docsQosParamSetNomPollInterval,  
    docsQosParamSetTolPollJitter,  
    docsQosParamSetUnsolicitGrantSize,  
    docsQosParamSetNomGrantInterval,  
    docsQosParamSetTolGrantJitter,  
    docsQosParamSetGrantsPerInterval,  
    docsQosParamSetTosAndMask,  
    docsQosParamSetTosOrMask,  
    docsQosParamSetMaxLatency,  
    docsQosParamSetRequestPolicyOct,  
    docsQosParamSetRequiredAttrMask,  
    docsQosParamSetForbiddenAttrMask,  
    docsQosParamSetAttrAggrRuleMask,  
    docsQosParamSetAppId,  
    docsQosParamSetMultiplierContentionReqWindow,  
    docsQosParamSetMultiplierBytesReq,  
    docsQosParamSetPeakTrafficRate,
```

```
docsQosParamSetDsResequencing,
docsQosParamSetBitMap,
docsQosParamSetMinimumBuffer,
docsQosParamSetTargetBuffer,
docsQosParamSetMaximumBuffer,
docsQosServiceFlowSID,
docsQosServiceFlowDirection,
docsQosServiceFlowPrimary,
docsQosServiceFlowParamSetTypeStatus,
docsQosServiceFlowChSetId,
docsQosServiceFlowAttrAssignSuccess,
docsQosServiceFlowDsid,
docsQosServiceFlowMaxReqPerSidCluster,
docsQosServiceFlowMaxOutstandingBytesPerSidCluster,
docsQosServiceFlowMaxTotBytesReqPerSidCluster,
docsQosServiceFlowMaxTimeInSidCluster,
docsQosServiceFlowBufferSize,
docsQosServiceFlowPkts,
docsQosServiceFlowOctets,
docsQosServiceFlowTimeCreated,
docsQosServiceFlowTimeActive,
docsQosServiceFlowPHSUnknowns,
docsQosServiceFlowPolicedDropPkts,
docsQosServiceFlowPolicedDelayPkts,
docsQosDSAReqs,
docsQosDSARsp,
docsQosDSAAcks,
docsQosDSCReq,
docsQosDSCRsp,
docsQosDSCAck,
docsQosDSDReq,
docsQosDSDRsp,
docsQosDynamicAdd,
docsQosDynamicAddFail,
docsQosDynamicChange,
docsQosDynamicChangeFail,
docsQosDynamicDelete,
docsQosDynamicDeleteFail,
docsQosDCCReq,
docsQosDCCRsp,
docsQosDCCAck,
docsQosDCC,
docsQosDCCFail,
docsQosDCCRspDepart,
docsQosDCCRspArrive,
docsQosDCCRspDepart,
docsQosDCCRspArrive,
docsQosDbcReq,
docsQosDbcRsp,
docsQosDbcAck,
docsQosDbcSuccess,
docsQosDbcFail,
docsQosDbcPartial,
docsQosPHSField,
docsQosPHSMask,
docsQosPHSSize,
docsQosPHSVerify,
docsQosPHSIndex,
docsQosServiceFlowSidClusterSid
}
STATUS      current
DESCRIPTION
    "Group of objects implemented in both CM and CMTS."
```

```
::= { docsQosMibGroups 1 }

docsQosCmtsGroup OBJECT-GROUP
OBJECTS {
    docsQosUpstreamFragments,
    docsQosUpstreamFragDiscards,
    docsQosUpstreamConcatBursts,
    docsQosServiceFlowLogIfIndex,
    docsQosServiceFlowLogSFID,
    docsQosServiceFlowLogCmMac,
    docsQosServiceFlowLogPkts,
    docsQosServiceFlowLogOctets,
    docsQosServiceFlowLogTimeDeleted,
    docsQosServiceFlowLogTimeCreated,
    docsQosServiceFlowLogTimeActive,
    docsQosServiceFlowLogDirection,
    docsQosServiceFlowLogPrimary,
    docsQosServiceFlowLogServiceClassName,
    docsQosServiceFlowLogPolicedDropPkts,
    docsQosServiceFlowLogPolicedDelayPkts,
    docsQosServiceFlowLogControl,
    docsQosServiceClassStatus,
    docsQosServiceClassPriority,
    docsQosServiceClassMaxTrafficRate,
    docsQosServiceClassMaxTrafficBurst,
    docsQosServiceClassMinReservedRate,
    docsQosServiceClassMinReservedPkt,
    docsQosServiceClassMaxConcatBurst,
    docsQosServiceClassNomPollInterval,
    docsQosServiceClassTolPollJitter,
    docsQosServiceClassUnsolicitGrantSize,
    docsQosServiceClassNomGrantInterval,
    docsQosServiceClassTolGrantJitter,
    docsQosServiceClassGrantsPerInterval,
    docsQosServiceClassMaxLatency,
    docsQosServiceClassActiveTimeout,
    docsQosServiceClassAdmittedTimeout,
    docsQosServiceClassSchedulingType,
    docsQosServiceClassRequestPolicy,
    docsQosServiceClassTosAndMask,
    docsQosServiceClassTosOrMask,
    docsQosServiceClassDirection,
    docsQosServiceClassStorageType,
    docsQosServiceClassDSCPOverwrite,
    docsQosServiceClassRequiredAttrMask,
    docsQosServiceClassForbiddenAttrMask,
    docsQosServiceClassAttrAggrRuleMask,
    docsQosServiceClassAppId,
    docsQosServiceClassMultiplierContentionReqWindow,
    docsQosServiceClassMultiplierBytesReq,
    docsQosServiceClassPeakTrafficRate,
    docsQosServiceClassDsResequencing,
    docsQosServiceClassMinimumBuffer,
    docsQosServiceClassTargetBuffer,
    docsQosServiceClassMaximumBuffer,
    docsQosCmtsIfIndex,
    docsQosGrpServiceFlowIsDef,
    docsQosGrpServiceFlowQosConfigId,
    docsQosGrpServiceFlowNumSess,
    docsQosGrpServiceFlowSrcAddr,
    docsQosGrpServiceFlowGrpAddr,
    docsQosGrpPktClassGrpConfigId,
    docsQosUpChCounterExtSgmtValids,
```

```

docsQosUpChCounterExtSgmtDiscards,
docsQosServiceFlowCcfStatsSgmtValids,
docsQosServiceFlowCcfStatsSgmtLost,
docsQosCmtsDsidUsage,
docsQosCmtsDsidDsChSet,
docsQosCmtsDsidReseqWaitTime,
docsQosCmtsDsidReseqWarnThrshld,
docsQosCmtsDsidStatusHldoffTimerSeqOutOfRng,
docsQosCmtsDsidCurrentSeqNum,
docsQosCmtsDebugDsidRowStatus,
docsQosCmtsDebugDsidStatsDsidPackets,
docsQosCmtsDebugDsidStatsDsidOctets
}
STATUS      current
DESCRIPTION
  "Group of objects implemented in the CMTS only."
 ::= { docsQosMibGroups 2 }

docsQosCmGroup OBJECT-GROUP
OBJECTS {
  docsQosCmServiceUsStatsTxSlotsImmed,
  docsQosCmServiceUsStatsTxSlotsDed,
  docsQosCmServiceUsStatsTxRetries,
  docsQosCmServiceUsStatsTxExceededs,
  docsQosCmServiceUsStatsRqRetries,
  docsQosCmServiceUsStatsRqExceededs,
  docsQosCmServiceUsStatsSgmts,
  docsQosCmDsidUsage,
  docsQosCmDsidNumReseqChs,
  docsQosCmDsidReseqChList,
  docsQosCmDsidReseqWaitTime,
  docsQosCmDsidReseqWarnThrshld,
  docsQosCmDsidStatusHldoffTimerSeqOutOfRng,
  docsQosCmDsidOutOfRangeDiscards,
  docsQosCmDsidNextExpectedSeqNum,
  docsQosCmDsidCmInterfaceMask,
  docsQosCmDsidFwdCmInterfaceMask,
  docsQosCmDsidStatsSeqNumMissing,
  docsQosCmDsidStatsSkewThreshExceeds,
  docsQosCmDsidStatsOutOfRangePackets,
  docsQosCmDsidStatsNumPackets,
  docsQosCmDsidClientClientMacAddr
}
STATUS      current
DESCRIPTION
  "Group of objects implemented in the CM only."
 ::= { docsQosMibGroups 3 }
END

```

## Q.8 CLAB-TOPO-MIB<sup>393</sup>

```

CLAB-TOPO-MIB DEFINITIONS ::= BEGIN
IMPORTS
  MODULE-IDENTITY,
  OBJECT-TYPE
    FROM SNMPv2-SMI          -- RFC 2578
  TEXTUAL-CONVENTION,
  RowStatus
    FROM SNMPv2-TC           -- RFC 2579
  OBJECT-GROUP,

```

<sup>393</sup> Revised per OSSIV3.0-N-08.0700-4 by JS on 1/12/09.

```

MODULE-COMPLIANCE
    FROM SNMPv2-CONF          -- RFC 2580
SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB -- RFC 3411
InterfaceIndex
    FROM IF-MIB                -- RFC 2863
clabCommonMibs
    FROM CLAB-DEF-MIB;

clabTopoMib MODULE-IDENTITY
LAST-UPDATED      "200901210000Z" -- January 21, 2009
ORGANIZATION     "Cable Television Laboratories, Inc."
CONTACT-INFO
"
Postal: Cable Television Laboratories, Inc.
858 Coal Creek Circle
Louisville, Colorado 80027-9750
U.S.A.
Phone: +1 303-661-9100
Fax:   +1 303-661-9199
E-mail: mibs@cablelabs.com"
DESCRIPTION
"This MIB module contains the management objects for the
management of fiber nodes in the Cable plant."
REVISION        "200901210000Z" -- January 21, 2009
DESCRIPTION
"Revised Version includes ECNs
OSSIv3.0-N-08.0651-3
OSSIv3.0-N-08.0700-4
and published as I08"
REVISION        "200612071700Z" -- Dec 7, 2006
DESCRIPTION
"Initial version, published as part of the CableLabs
OSSIv3.0 specification CM-SP-OSSIv3.0-I01-061207
Copyright 1999-2009 Cable Television Laboratories, Inc.
All rights reserved."
::= { clabCommonMibs 2 }

-- Textual Conventions

NodeName ::= TEXTUAL-CONVENTION
STATUS      current
DESCRIPTION
"This data type is a human readable string that represents
the name of a fiber node. Internationalization is supported
by conforming to the SNMP textual convention SnmpAdminString.
The US-ASCII control characters (0x00 - 0x1F), the DEL
Character (0x7F), and the double-quote mark (0x22) are
prohibited within the syntax of this data type."
REFERENCE
"RFC 3411."
SYNTAX      OCTET STRING (SIZE(0..64))

-- Object Definitions
clabTopoMibObjects OBJECT IDENTIFIER ::= { clabTopoMib 1 }

clabTopoFiberNodeCfgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF ClabTopoFiberNodeCfgEntry
MAX-ACCESS not-accessible
STATUS      current
DESCRIPTION
"This object defines the cable HFC plant Fiber Nodes

```

```

known at a CMTS.
This object supports the creation and deletion of multiple
instances."
 ::= { clabTopoMibObjects 1}

clabTopoFiberNodeCfgEntry OBJECT-TYPE
  SYNTAX      ClabTopoFiberNodeCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of clabTopoFiberNodeCfg.
     The CMTS persists all instances of FiberNodeCfg
     across reinitializations."
  INDEX {
    clabTopoFiberNodeCfgNodeName
  }
 ::= { clabTopoFiberNodeCfgTable 1 }

ClabTopoFiberNodeCfgEntry ::= SEQUENCE {
  clabTopoFiberNodeCfgNodeName
    NodeName,
  clabTopoFiberNodeCfgNodeDescr
    SnmpAdminString,
  clabTopoFiberNodeCfgRowStatus
    RowStatus
}

clabTopoFiberNodeCfgNodeName OBJECT-TYPE
  SYNTAX      NodeName (SIZE (1..64))
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents a human-readable name for a fiber
     node."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I01-060804, RF Topology
     Configuration section."
 ::= { clabTopoFiberNodeCfgEntry 1 }

clabTopoFiberNodeCfgNodeDescr OBJECT-TYPE
  SYNTAX      SnmpAdminString
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "Administratively configured human-readable description
     of the fiber node"
  DEFVAL { ''H }
 ::= { clabTopoFiberNodeCfgEntry 2 }

clabTopoFiberNodeCfgRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "The status of this instance."
 ::= { clabTopoFiberNodeCfgEntry 3 }

clabTopoChFnCfgTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF ClabTopoChFnCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION

```

```

"This object defines the RF topology by defining the
connectivity of a CMTS's downstream and upstream channels
to the fiber nodes. Each instance of this object
describes connectivity of one downstream or upstream
channel with a single fiber node.
This object supports the creation and deletion of multiple
instances."
 ::= { clabTopoMibObjects 2}

clabTopoChFnCfgEntry OBJECT-TYPE
  SYNTAX      ClabTopoChFnCfgEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of clabTopoChFnCfg.
     The CMTS persists all instances of ChFnCfg
     across reinitializations."
  INDEX {
    clabTopoFiberNodeCfgNodeName,
    clabTopoChFnCfgChIfIndex
  }
 ::= { clabTopoChFnCfgTable 1 }

ClabTopoChFnCfgEntry ::= SEQUENCE {
  clabTopoChFnCfgChIfIndex
    InterfaceIndex,
  clabTopoChFnCfgRowStatus
    RowStatus
}

clabTopoChFnCfgChIfIndex OBJECT-TYPE
  SYNTAX      InterfaceIndex
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This key represents the interface index of an upstream
     or downstream channel associated with this fiber
     node. In the upstream direction, only ifIndices
     docsCableUpstream channels are reflected."
  ::= { clabTopoChFnCfgEntry 1 }

clabTopoChFnCfgRowStatus OBJECT-TYPE
  SYNTAX      RowStatus
  MAX-ACCESS  read-create
  STATUS      current
  DESCRIPTION
    "The status of this instance."
  ::= { clabTopoChFnCfgEntry 2 }

-- Conformance Definitions
clabTopoMibConformance OBJECT IDENTIFIER ::= { clabTopoMib 2 }
clabTopoMibCompliances OBJECT IDENTIFIER
  ::= { clabTopoMibConformance 1 }
clabTopoMibGroups      OBJECT IDENTIFIER
  ::= { clabTopoMibConformance 2 }

clabTopoCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
  "The compliance statement for devices that implement the
   CableLabs Topology MIB."

MODULE -- this MODULE

```

```

MANDATORY-GROUPS {
    clabTopoGroup
}
 ::= { clabTopoMibCompliances 1 }

clabTopoGroup OBJECT-GROUP
    OBJECTS {
        clabTopoFiberNodeCfgNodeDescr,
        clabTopoFiberNodeCfgRowStatus,
        clabTopoChFnCfgRowStatus
    }
    STATUS      current
    DESCRIPTION
        "Group of objects implemented in the CMTS."
    ::= { clabTopoMibGroups 1 }
END

```

## Q.9 DOCS-LOADBAL3-MIB<sup>394</sup>

```

DOCS-LOADBAL3-MIB DEFINITIONS ::= BEGIN
    IMPORTS
        MODULE-IDENTITY,
        OBJECT-TYPE,
        Unsigned32,
        Counter32
            FROM SNMPv2-SMI          -- [RFC2578]
        TEXTUAL-CONVENTION,
        RowStatus,
        TruthValue,
        MacAddress,
        TimeStamp,
        RowPointer
            FROM SNMPv2-TC          -- [RFC2579]
        OBJECT-GROUP,
        MODULE-COMPLIANCE
            FROM SNMPv2-CONF         -- [RFC2580]
        InterfaceIndexOrZero,
        InterfaceIndex,
        ifIndex
            FROM IF-MIB              -- [RFC2863]
        SnmpAdminString
            FROM SNMP-FRAMEWORK-MIB -- RFC 3411
        SnmpTagList
            FROM SNMP-TARGET-MIB    -- [RFC 3413]
        RcpId,
        ChannelList,
        docsIf3CmtsCmRegStatusEntry
            FROM DOCS-IF3-MIB
        NodeName
            FROM CLAB-TOPO-MIB
        clabProjDocsis
            FROM CLAB-DEF-MIB;

docsLoadbal3Mib MODULE-IDENTITY
    LAST-UPDATED      "201001150000Z" -- January 15, 2010
    ORGANIZATION     "Cable Television Laboratories, Inc."
    CONTACT-INFO
        "
        Postal: Cable Television Laboratories, Inc.
        858 Coal Creek Circle

```

<sup>394</sup> Section added per OSSIV3.0-N-07.0522-7 by ab on 11/5/07 and revised per OSSIV3.0-N-08.0645-4 on 5/1/08 by KN and per OSSIV3.0-N-09.0775-3 on 5/9/09 by JB. Revised per OSSIV3.0-N-09.0871-4 on 1/5/10 by JB.

Louisville, Colorado 80027-9750  
U.S.A.  
Phone: +1 303-661-9100  
Fax: +1 303-661-9199  
E-mail: mibs@cablelabs.com"

**DESCRIPTION**  
"This MIB module contains the management objects for the DOCSIS 3.0 CMTS Load Balancing operation.  
Copyright 1999-2009 Cable Television Laboratories, Inc.  
All rights reserved."

**REVISION** "201001150000Z" -- January 15, 2010

**DESCRIPTION**  
"Revised Version includes ECNs  
OSSIv3.0-N-09.0871-4  
and published as I11"

**REVISION** "200905290000Z" -- May 29, 2009

**DESCRIPTION**  
"Revised Version includes ECNs  
OSSIv3.0-N-09.0773-1  
OSSIv3.0-N-09.0775-3  
OSSIv3.0-N-09.0777-2  
and published as I09"

**REVISION** "200901210000Z" -- January 21, 2009

**DESCRIPTION**  
"Revised Version includes ECNs  
OSSIv3.0-N-08.0651-3  
OSSIv3.0-N-08.0700-4  
and published as I08"

**REVISION** "200805220000Z" -- May 22, 2008

**DESCRIPTION**  
"Revised Version includes ECN OSSIv3.0-N-08.0645-4  
and published as I07"

**REVISION** "200712060000Z" -- December 6, 2007

**DESCRIPTION**  
"Initial version, published as part of the CableLabs  
OSSIv3.0 specification CM-SP-OSSIv3.0-I05-071206 via  
ECN OSSIv3.0-N-07.0522-7"  
::= { clabProjDocsis 22}

-- Textual Conventions

ChChgInitTechMap ::= TEXTUAL-CONVENTION  
STATUS current  
**DESCRIPTION**  
"This data type enumerates the allowed initialization  
techniques for Dynamic Channel Change (DCC) and Dynamic  
Bonding Change (DBC) operations. The techniques are represented  
by the 5 most significant bits (MSB). Bits 0 through 4 map to  
initialization techniques 0 through 4.  
  
Each bit position represents the internal associated technique  
as described below:  
  
'reinitializeMac' Reinitialize the MAC  
'broadcastInitRanging'  
    Perform Broadcast initial  
    ranging on new channel before  
    normal operation  
'unicastInitRanging'  
    Perform unicast ranging on new  
    channel before normal operation  
'initRanging'

```

    Perform either broadcast or
    unicast ranging on new channel before
    normal operation
'direct'
    Use the new channel(s) directly
    without re-initializing or ranging

    Multiple bits may be set to 1 to allow the CMTS to select the
    most suitable technique in a proprietary manner.
    An empty value or a value with all bits in '0' means no channel
    changes allowed"
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocol Specification,
    CM-SP-MULPIv3.0-I08-080522, Channel Assignment During
    Registration section."
SYNTAX BITS {
    reinitializeMac(0),
    broadcastInitRanging(1),
    unicastInitRanging(2),
    initRanging(3),
    direct(4)
}

docsLoadbal3MibObjects OBJECT IDENTIFIER ::= { docsLoadbal3Mib 1 }

docsLoadbal3System OBJECT IDENTIFIER ::= { docsLoadbal3MibObjects 1 }

docsLoadbal3SystemEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
DESCRIPTION
    "This attribute when set to 'true' enables Autonomous
    Load Balancing operation on the CMTS, otherwise
    Autonomous Load Balancing is disabled. A failure to
    enable Autonomous Load Balancing operation is registered
    in the EnableError attribute.
    When Autonomous Load Balancing is enabled, the CMTS
    may reject Externally-Directed Load Balancing operations.
    However, even when Autonomous Load Balancing
    is disabled, the CMTS is required to assign load balancing
    parameters to CMs as provisioned in the configuration
    file and/or RestrictCM object.
    This attribute value persists after system reinitialization.
    There might be cases where this attribute
    reports a failure and Load Balancing is enabled, for
    example after system reinitialization where Load
    Balancing was previously set to enabled but there are
    issues with the CMTS configuration."
REFERENCE
    "DOCSIS 3.0 Operations Support System Interface
    Specification CM-SP-OSSIv3.0-I07-080522 Externally-Directed
    Load Balancing section."
DEFVAL { true }
::= { docsLoadbal3System 1 }

docsLoadbal3SystemEnableError OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-write
    STATUS      current
DESCRIPTION
    "This attribute represents a text message that describes
    a failure to enable load balancing due configuration

```

```
errors, or other considerations. The zero-length
string indicates no errors occurred during the
last Autonomous Load Balancing activation."
 ::= { docsLoadbal3System 2 }

docsLoadbal3ChgOverGroup OBJECT IDENTIFIER ::= { docsLoadbal3MibObjects 2 }

docsLoadbal3ChgOverGroupMacAddress OBJECT-TYPE
  SYNTAX      MacAddress
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute represents the MAC address of the cable
     modem that the CMTS instructs to move to a new downstream
     and/or upstream channel set."
  DEFVAL { '000000000000' }
  ::= { docsLoadbal3ChgOverGroup 1 }

docsLoadbal3ChgOverGroupInitTech OBJECT-TYPE
  SYNTAX      ChChgInitTechMap
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute represents the initialization technique
     that the cable modem is instructed to use when
     performing multiple-channel change-over operation.
     The value of this attribute applies to all upstream
     channels in the channel set."
  ::= { docsLoadbal3ChgOverGroup 2 }

docsLoadbal3ChgOverGroupForceUCC OBJECT-TYPE
  SYNTAX      TruthValue
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute when set to 'true' indicates that the CMTS
     forces UCC messages instead of DCC messages in those scenarios
     that are allowed as defined in the Upstream Channel Change
     Request (UCC-REQ) section of MULPI. In some cases
     the CMTS may still use UCC commands even though this
     attribute value is 'false', for example in an upstream-only
     change-over operation directed to a CM that the CMTS is
     aware is only capable of UCC, but the operator is not aware
     of the CM capabilities. This attribute value is ignored when
     the target CM for the change-over operation is in MRC mode,
     or the UsChSet attribute is the zero-length string, or the
     operation includes changes for downstream channels."
  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
     Specification CM-SP-MULPIv3.0-I12-100115, section 6.4.10
     Upstream Channel Change Request (UCC-REQ)."
  DEFVAL { false }
  ::= { docsLoadbal3ChgOverGroup 3 }

docsLoadbal3ChgOverGroupdownFrequency OBJECT-TYPE
  SYNTAX      Unsigned32
  MAX-ACCESS  read-write
  STATUS      current
  DESCRIPTION
    "This attribute represents a single-downstream frequency
     to which the cable modem is instructed to move
     using a DCC request. The value zero indicates that
     this attribute is ignored during a commit operation."
```

```

DEFVAL { 0 }
 ::= { docsLoadbal3ChgOverGroup 4 }

docsLoadbal3ChgOverGroupMdIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute describes the MAC Domain Interface
    index of the triplet: Mac Domain, RCP-ID and RCC Status
    Index of the RccStatus object that represents the
    RCC used in the change-over operation. This MAC Domain
    Interface Index is also used to provide context for
    the UsChSet and ServiceFlowInfo attributes."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, CM Receive Channel
    (RCP/RCC) Encodings section and DOCSIS 3.0 Operations Support
    System Interface Specification CM-SP-OSSIv3.0-I05-071206, RCC
    Status Objects section."
DEFVAL { 0 }
 ::= { docsLoadbal3ChgOverGroup 5 }

docsLoadbal3ChgOverGroupRcpId OBJECT-TYPE
SYNTAX      RcpId
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute describes the RCP-ID of the triplet:
    Mac Domain, RCP-ID and RCC Status Index of the RccStatus
    object that represents the RCC used in the change-over
    operation."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522 CM Receive Channel
    (RCP/RCC) Encodings section and DOCSIS 3.0 Operations Support
    System Interface Specification CM-SP-OSSIv3.0-I05-071206,
    RCC Status Objects
    section."
DEFVAL { '0000000000'H }
 ::= { docsLoadbal3ChgOverGroup 6 }

docsLoadbal3ChgOverGroupRccId OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute describes the RCC Status Index of the
    triplet: Mac Domain, RCP-ID and RCC Status Index of
    the RccStatus object that represents the RCC used in
    the change-over operation."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocols Interface
    Specification CM-SP-MULPIv3.0-I08-080522, CM Receive
    Channel (RCP/RCC) Encodings section and DOCSIS 3.0
    Operations Support System Interface Specification
    CM-SP-OSSIv3.0-I05-071206 RCC Status Objects section."
DEFVAL { 0 }
 ::= { docsLoadbal3ChgOverGroup 7 }

docsLoadbal3ChgOverGroupUsChSet OBJECT-TYPE
SYNTAX      ChannelList

```

```

MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute describes the Channel list (within
  the context of the MAC domain identified by MdIfIndex)
  that represents the final TCS expected from the change-over
  operation.
  When the operation is intended for an RCC-only, this
  attribute is set to zero and the attribute InitTech is
  ignored."
DEFVAL { ''H }
 ::= { docsLoadbal3ChgOverGroup 8 }

docsLoadbal3ChgOverGroupServiceFlowInfo OBJECT-TYPE
SYNTAX      OCTET STRING (SIZE(0..128))
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute provides a list of Service Flow ID-Channel
  Set ID pairs used to control Service Flow assignment
  in the change-over operation. This is intended
  as an override to the normal assignment based on SF
  attributes. This attribute is encoded as a series of
  32-bit pairs as follows:
  - The first four bytes correspond to the value of the Service
  Flow ID (attribute Id of the ServiceFlow object
  of the DOCSIS QOS objects.
  - The last four bytes correspond to the value of the attribute
  ChSetId of the UsChSet or DsChSet object of the
  CMTS Bonding Objects.

  If this attribute does not include tuples for some of
  the CM's Service Flows, the CMTS determines the respective
  channels based on SF attributes. Service Flow
  ID-Channel Set ID pairs matching upstream service
  flows are ignored if the change-over operation does
  not affect the TCC of the CM. Similarly, Service Flow
  ID-Channel Set ID pairs matching downstream service
  flows are ignored if the change-over operation does
  not affect the RCC of the CM."
DEFVAL { ''H }
 ::= { docsLoadbal3ChgOverGroup 9 }

docsLoadbal3ChgOverGroupTransactionId OBJECT-TYPE
SYNTAX      Unsigned32 (0..65535)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "This attribute represents an operator identifier
  for the change-over operation to be used to correlate
  logged information in the ChangeOver3 Status object.
  The CMTS uses this value as the Transaction ID in
  the DBC-REQ or DCC-REQ message transmitted in association
  with this operation. If this value is set to zero
  the CMTS defines its own MAC message Transaction ID
  value."
DEFVAL { 0 }
 ::= { docsLoadbal3ChgOverGroup 10 }

docsLoadbal3ChgOverGroupCommit OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-write
STATUS      current

```

**DESCRIPTION**

"This attribute when set to 'true' triggers the change-over operation for Externally-Directed Load Balancing.

Setting this attribute to 'true' is known as a commit operation. A commit operation is considered successful if the CMTS considers that the entered information is valid and the transaction can be initiated. It does not imply that the channel-change operation itself (i.e., UCC, DCC, DBC transaction) reports success or completion. A commit operation is considered unsuccessful if the CMTS determines that there are invalid attributes values in the ChangeOver object such that the change-over operation cannot be initiated.

Some examples for a change-over that cannot be initiated are:

- Attempt to send a DBC for MRC that does not fit the CM RCP.
  - Attempt to send a DCC while a previous one is still in progress.
  - Attempt to send a UCC to a channel ID that is not defined.
- After system initialization all ChangeOver object parameters are set to default values. After a successful commit operation all ChangeOver object parameters are set to default values with the exception of this attribute (commit) that is set to 'true'. An unsuccessful commit operation is rejected and this attribute reports false in subsequent value queries.

After a successful commit operation, the CMTS initiates the change-over transaction using the most appropriate technique. The potential techniques are:

- UCC - For upstream-channel-only changes on CMs not operating in MRC mode.
  - DCC - For upstream and/or downstream channel changes on CMs not operating in MRC mode.
  - DCC followed by channel assignment in REG-RSP-MP - For MAC Domain re-assignment on CMs operating in MRC mode, as well as upstream only change for CMs operating in MRC mode but with no TCS conveyed during registration.
- In this case, the change-over command might only include a downstream frequency, or might include an RCC defined in the target MAC domain. The upstream channel set may or may not be provided. The only applicable Initialization Technique for this operation is 'reinitializeMAC'.
- DBC - For change in the TCS and/or RCS on CMs operating in MRC mode."

**DEFVAL { false }**

**::= { docsLoadbal3ChgOverGroup 11 }**

**docsLoadbal3ChgOverGroupLastCommit OBJECT-TYPE**

**SYNTAX TimeStamp**

**MAX-ACCESS read-only**

**STATUS current**

**DESCRIPTION**

"The value of sysUpTime when the attribute Commit was last set to true. Zero if never set."

**::= { docsLoadbal3ChgOverGroup 12 }**

**docsLoadbal3ChgOverStatusTable OBJECT-TYPE**

**SYNTAX SEQUENCE OF DocsLoadbal3ChgOverStatusEntry**

```

MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
  "This object reports the status of cable modems instructed
  to move to a new downstream and/or upstream channel
  or channel sets when commanded either by an operation
  in the ChgOver object. An instance in this object
  is created for each change-over operation committed
  successfully. If the instance value attribute
  is not final (the change-over operation is still pending
  completion), this instance is expected to be updated
  at some point later to reflect the final state
  of the change-over operation."
 ::= { docsLoadbal3MibObjects 3}

docsLoadbal3ChgOverStatusEntry OBJECT-TYPE
  SYNTAX DocsLoadbal3ChgOverStatusEntry
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "The conceptual row of docsLoadbal3ChgOverStatus."
  INDEX { docsLoadbal3ChgOverStatusId }
  ::= { docsLoadbal3ChgOverStatusTable 1 }

DocsLoadbal3ChgOverStatusEntry ::= SEQUENCE {
  docsLoadbal3ChgOverStatusId
    Unsigned32,
  docsLoadbal3ChgOverStatusMacAddr
    MacAddress,
  docsLoadbal3ChgOverStatusInitTech
    ChChgInitTechMap,
  docsLoadbal3ChgOverStatusDownFrequency
    Unsigned32,
  docsLoadbal3ChgOverStatusMdIfIndex
    InterfaceIndex,
  docsLoadbal3ChgOverStatusRcpId
    RcpId,
  docsLoadbal3ChgOverStatusRccId
    Unsigned32,
  docsLoadbal3ChgOverStatusUsChSet
    ChannelList,
  docsLoadbal3ChgOverStatusServiceFlowInfo
    OCTET STRING,
  docsLoadbal3ChgOverStatusCmd
    INTEGER,
  docsLoadbal3ChgOverStatusTransactionId
    Unsigned32,
  docsLoadbal3ChgOverStatusValue
    INTEGER,
  docsLoadbal3ChgOverStatusUpdate
    TimeStamp
}

docsLoadbal3ChgOverStatusId OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
    "This key represents a monotonically increasing value
    for the record that stores the status of the change-over
    operation. When the ChOverStatus object exceeds
    the size limit of this object the lowest Id value
    instances are removed so that the total number of entries

```

```

no longer exceeds the size limit allowing the CMTS
to maintain the most current entries."
 ::= { docsLoadbal3ChgOverStatusEntry 1 }

docsLoadbal3ChgOverStatusMacAddr OBJECT-TYPE
SYNTAX      MacAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the Mac address set in the
     ChgOver object commit operation."
 ::= { docsLoadbal3ChgOverStatusEntry 2 }

docsLoadbal3ChgOverStatusInitTech OBJECT-TYPE
SYNTAX      ChChgInitTechMap
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The initialization technique set in change-over
     operation."
 ::= { docsLoadbal3ChgOverStatusEntry 3 }

docsLoadbal3ChgOverStatusDownFrequency OBJECT-TYPE
SYNTAX      Unsigned32 (0..1000000000)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the new downstream frequency
     to which the cable modem is instructed to move.
     The value 0 indicates that the CMTS does not create a
     TLV for the downstream frequency in the DCC-REQ message.
     This object has no meaning when executing UCC operations."
 ::= { docsLoadbal3ChgOverStatusEntry 4 }

docsLoadbal3ChgOverStatusMdIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndex
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the MAC Domain Interface
     index set in the ChgOver3 object commit operation,
     or zero."
 ::= { docsLoadbal3ChgOverStatusEntry 5 }

docsLoadbal3ChgOverStatusRcpId OBJECT-TYPE
SYNTAX      RcpId
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the RCP-ID set in the MultipleChChgOver
     object commit operation, or all zeros
     RCP-ID."
 ::= { docsLoadbal3ChgOverStatusEntry 6 }

docsLoadbal3ChgOverStatusRccId OBJECT-TYPE
SYNTAX      Unsigned32 (0..255)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the RCC Status Index set
     in the ChgOver3 object commit operation, or zero."

```

```

 ::= { docsLoadbal3ChgOverStatusEntry 7 }

docsLoadbal3ChgOverStatusUsChSet OBJECT-TYPE
  SYNTAX      ChannelList
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the Upstream Channel Set
     ID in the ChgOver3 object commit operation, or zero."
 ::= { docsLoadbal3ChgOverStatusEntry 8 }

docsLoadbal3ChgOverStatusServiceFlowInfo OBJECT-TYPE
  SYNTAX      OCTET STRING (SIZE(0..484))
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the list of Service Flow-Channel
     Set ID pairs set in the ChgOver object commit
     operation, or zero-length string."
 ::= { docsLoadbal3ChgOverStatusEntry 9 }

docsLoadbal3ChgOverStatusCmd OBJECT-TYPE
  SYNTAX      INTEGER {
    ucc(1),
    dcc(2),
    dbc(3),
    crossMD(4)
  }
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The load balancing MAC Management Message exchange
     type used by the CMTS for the change-over operation
     in the ChgOver object commit operation.
    - 'ucc' indicates the usage of Upstream Channel Change
     (UCC) messages exchange.
    - 'dcc' indicates the usage of Dynamic Channel Change
     (DCC) messages exchange.
    - 'dbc' indicates the usage of Dynamic Bonding Change
     (DCC) messages exchange
    - 'crossMD' although this term does not correspond to
     a MAC Management Message type, it indicates the movement
     of a CM to a different MAC Domain that includes a
     sequence of different MAC Management Messages types
     (i.e., DCC to move the CM to the correct MAC Domain, followed
     by channel assignment in REG-RSP-MP)."
 ::= { docsLoadbal3ChgOverStatusEntry 10 }

docsLoadbal3ChgOverStatusTransactionId OBJECT-TYPE
  SYNTAX      Unsigned32 (0..65535)
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "This attribute represents the transaction Id value
     used in the change-over operation."
 ::= { docsLoadbal3ChgOverStatusEntry 11 }

docsLoadbal3ChgOverStatusValue OBJECT-TYPE
  SYNTAX      INTEGER {
    messageSent(1),

```

```

        noOpNeeded(2),
        modemDeparting(3),
        waitToSendMessage(4),
        cmOperationRejected(5),
        cmtsOperationRejected(6),
        timeOutT13(7),
        timeOutT15(8),
        rejectInit(9),
        success(10),
        dbcTimeout(11)
    }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the status of the specified
change-over operation. The enumerations are:

Change-over using DCC message exchange:
'modemDeparting'
The cable modem has responded with a change-over response
of either a DCC-RSP with a confirmation code of
depart(180) or a UCC-RSP.
'timeOutT13'
Failure due to no DCC-RSP with confirmation code depart(180)
received prior to expiration of the T13 timer.

'timeOutT15'
T15 timer timed out prior to the arrival of a bandwidth
request, RNG-REQ message, or DCC-RSP message with
confirmation code of arrive(181) from the cable modem.

Change-over using DBC message exchange:
'dbcTimeout'
The number of DBC-REQ retries was exceeded and no DBC-RSP
was received
Change-over CMTS verifications:
'messageSent'
The CMTS has sent a DOCSIS MAC message request to instruct
the CM to do the change-over operation.
'noOpNeed'
A change-over operation was requested in which neither
the DS and US channels where the CM is operational
changed.
'waitToSendMessage'
The specified operation is active and CMTS is waiting
to send the channel change message with channel info
to the cable modem.
'cmOperationRejected'
Channel Change operation was rejected by the cable modem.

'cmtsOperationRejected'
Channel Change operation was rejected by the Cable Modem
Termination System.
'rejectInit'
Operation rejected due to unsupported initialization
tech requested.
'success'
CMTS received an indication that the CM successfully
completed the change-over operation. e.g., If an initialization
technique of re-initialize the MAC is
used, success is indicated by the receipt of a DCC-RSP
message with a confirmation code of depart(180) or
DBC confirmation code ok/success. In all other DCC

```

```

cases, success is indicated by: (1) the CMTS received
a DCC-RSP message with confirmation code of arrive(181)
or (2) the CMTS internally confirms the presence
of the CM on the new channel(s)."
 ::= { docsLoadbal3ChgOverStatusEntry 12 }

docsLoadbal3ChgOverStatusUpdate OBJECT-TYPE
  SYNTAX      TimeStamp
  MAX-ACCESS  read-only
  STATUS      current
  DESCRIPTION
    "The value of sysUpTime when the attribute value of
     this instance was last updated."
 ::= { docsLoadbal3ChgOverStatusEntry 13 }

```

```

docsLoadbal3CmtsCmParamsTable OBJECT-TYPE
  SYNTAX      SEQUENCE OF DocsLoadbal3CmtsCmParamsEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "This object represents the autonomous load balancing
     parameters provisioned for cable modem. The CMTS
     selects the cable modem Load Balancing Group (GrpId
     attribute of this object) from multiple sources by
     following the rules and sequence described below:

```

The CMTS selects the assignment of the CM to a Load Balancing Group by determining first if the CM is in a Restricted Load Balancing Group or in its absence to the General Load Balancing group that corresponds to the MD-CM-SG of the CM. The selection of the Restricted Load Balancing group is achieved by first matching the CM in the RestrictCmCfg Object and if no match is found, by selecting the best match within the ResGrpCfg object.

The best match within the ResGrpCfg follows the MULPI requirements on precedences of the CM signaled TLVs: ServiceType ID and Load Balancing Group ID (for backward compatibility of provisioned Group IDs)."

```

  REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocol Specification,
     CM-SP-MULPIv3.0-I08-080522, Channel Assignment During
     Registration section."
 ::= { docsLoadbal3MibObjects 4}

```

```

docsLoadbal3CmtsCmParamsEntry OBJECT-TYPE
  SYNTAX      DocsLoadbal3CmtsCmParamsEntry
  MAX-ACCESS  not-accessible
  STATUS      current
  DESCRIPTION
    "The conceptual row of docsLoadbal3CmtsCmParams."
  AUGMENTS { docsIf3CmtsCmRegStatusEntry }
 ::= { docsLoadbal3CmtsCmParamsTable 1 }

```

```

DocsLoadbal3CmtsCmParamsEntry ::= SEQUENCE {
  docsLoadbal3CmtsCmParamsProvGrpId
    Unsigned32,
  docsLoadbal3CmtsCmParamsCurrentGrpId
    Unsigned32,
  docsLoadbal3CmtsCmParamsProvServiceTypeID
    SnmpAdminString,
  docsLoadbal3CmtsCmParamsCurrentServiceTypeID
    SnmpAdminString,

```

```

docsLoadbal3CmtsCmParamsPolicyId
    Unsigned32,
docsLoadbal3CmtsCmParamsPriority
    Unsigned32
}

docsLoadbal3CmtsCmParamsProvGrpId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute indicates the provisioned Load Balancing
     Group ID TLV the CM signaled to the CMTS during
     registration, or zero if not provisioned in the CM."
::= { docsLoadbal3CmtsCmParamsEntry 1 }

docsLoadbal3CmtsCmParamsCurrentGrpId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute references the Load Balancing Group
     Identifier (Id attribute from the GrpStatus object)
     associated with the cable modem after the CMTS validates
     the CM Load Balancing Group ID TLV, Service Type
     ID TLV and Restricted CM list. The value zero indicates
     that the Load Balancing Group is invalid, or the
     General Load Balancing Group is invalid due ambiguous
     topology resolution."
::= { docsLoadbal3CmtsCmParamsEntry 2 }

docsLoadbal3CmtsCmParamsProvServiceTypeID OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE(0..16))
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute indicates the provisioned Service
     Type ID TLV the CM signaled to the CMTS during registration,
     or the zero-length string if not provisioned
     in the CM."
::= { docsLoadbal3CmtsCmParamsEntry 3 }

docsLoadbal3CmtsCmParamsCurrentServiceTypeID OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE(0..16))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the Service Type ID the
     CMTS picked from the Restricted Group of Restricted
     CM list, or the Service Type Id TLV the CM signaled to the
     CMTS during registration, or the zero-length string
     if none was used."
::= { docsLoadbal3CmtsCmParamsEntry 4 }

docsLoadbal3CmtsCmParamsPolicyId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
    "This attribute references the Load Balancing Policy
     ID associated to the cable modem either from the configuration
     file or from the General or Restricted

```

```
Load Balancing Groups CMTS configuration."
 ::= { docsLoadbal3CmtsCmParamsEntry 5 }

docsLoadbal3CmtsCmParamsPriority OBJECT-TYPE
 SYNTAX      Unsigned32
 MAX-ACCESS  read-write
 STATUS      current
 DESCRIPTION
   "This attribute references the Load Balancing Priority
    associated to the cable modem either from the configuration
    file or from the General or Restricted
    Load Balancing Groups CMTS configuration."
 ::= { docsLoadbal3CmtsCmParamsEntry 6 }

docsLoadbal3GeneralGrpDefaults OBJECT IDENTIFIER ::= { docsLoadbal3MibObjects 5 }

docsLoadbal3GeneralGrpDefaultsEnable OBJECT-TYPE
 SYNTAX      TruthValue
 MAX-ACCESS  read-write
 STATUS      current
 DESCRIPTION
   "This attribute represents the default value for the
    Enable attribute of the GeneralLoadBalGrp object.

DEFVAL { true }
 ::= { docsLoadbal3GeneralGrpDefaults 1 }

docsLoadbal3GeneralGrpDefaultsPolicyId OBJECT-TYPE
 SYNTAX      Unsigned32
 MAX-ACCESS  read-write
 STATUS      current
 DESCRIPTION
   "This attribute represents the default value for the
    PolicyId attribute of the GeneralLoadBalGrp object.

DEFVAL { 0 }
 ::= { docsLoadbal3GeneralGrpDefaults 2 }

docsLoadbal3GeneralGrpDefaultsInitTech OBJECT-TYPE
 SYNTAX      ChChgInitTechMap
 MAX-ACCESS  read-write
 STATUS      current
 DESCRIPTION
   "This attribute represents the default value for the
    InitTechnique attribute of the GeneralLoadBalGrp
    object."
DEFVAL { 'F8'H }
 ::= { docsLoadbal3GeneralGrpDefaults 3 }

docsLoadbal3GeneralGrpCfgTable OBJECT-TYPE
 SYNTAX      SEQUENCE OF DocsLoadbal3GeneralGrpCfgEntry
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
   "This object provides the parameters for the General
    Load Balancing Groups of MD-CM-SGs associated with
    MAC Domain-Fiber Node pairs. This object allows configuration
    of load balancing parameters for General
    Load Balancing Groups by way of MAC Domain-Fiber
    Node pairs. In many deployments, a MAC Domain-Fiber
    Node pair will equate to an MD-CM-SG (which always equates
    to a GLBG). In the case where an MD-CM-SG spans multiple
    Fiber Nodes, there will be multiple instances
```

of this object that represent the General Load Balancing Group (MD-CM-SG). The CMTS enforces that such instances all have the same attribute values. Any time a fiber node is associated to a MAC Domain an instance of this object is defined by the CMTS and populated with either the same values as the other fiber nodes associated with the same MD-CM-SG (if any exist) or default values from the GeneralGrpDefaults object. Similarly when a fiber node is no longer paired with a MAC Domain the corresponding instance is deleted from the object."

```

 ::= { docsLoadbal3MibObjects 6}

docsLoadbal3GeneralGrpCfgEntry OBJECT-TYPE
    SYNTAX      DocsLoadbal3GeneralGrpCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsLoadbal3GeneralGrpCfg.
         The CMTS persists all instances of GeneralGrpCfg across reinitializations."
    INDEX { ifIndex,docsLoadbal3GeneralGrpCfgNodeName }
    ::= { docsLoadbal3GeneralGrpCfgTable 1 }

DocsLoadbal3GeneralGrpCfgEntry ::= SEQUENCE {
    docsLoadbal3GeneralGrpCfgNodeName
        NodeName,
    docsLoadbal3GeneralGrpCfgEnable
        TruthValue,
    docsLoadbal3GeneralGrpCfgPolicyId
        Unsigned32,
    docsLoadbal3GeneralGrpCfgInitTech
        ChChgInitTechMap
}
}

docsLoadbal3GeneralGrpCfgNodeName OBJECT-TYPE
    SYNTAX      NodeName
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the fiber node name being associated
         with a MAC Domain."
    ::= { docsLoadbal3GeneralGrpCfgEntry 1 }

docsLoadbal3GeneralGrpCfgEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute when set to 'true' enables Autonomous
         Load Balancing for the General Load Balancing Group
         associated with this instance. When set to 'false'
         Autonomous Load Balancing is disabled."
    ::= { docsLoadbal3GeneralGrpCfgEntry 2 }

docsLoadbal3GeneralGrpCfgPolicyId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute defines the default load balancing
         policy for the General Load Balancing Group associated
         with this instance."
    ::= { docsLoadbal3GeneralGrpCfgEntry 3 }

```

```

docsLoadbal3GeneralGrpCfgInitTech OBJECT-TYPE
    SYNTAX      ChChgInitTechMap
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "This attribute defines the load balancing initialization
         technique for the General Load Balancing Group
         associated with this instance."
    ::= { docsLoadbal3GeneralGrpCfgEntry 4 }

docsLoadbal3ResGrpCfgTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsLoadbal3ResGrpCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object represents the configuration of Restricted
         Load Balancing Groups."
    ::= { docsLoadbal3MibObjects 7 }

docsLoadbal3ResGrpCfgEntry OBJECT-TYPE
    SYNTAX      DocsLoadbal3ResGrpCfgEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of docsLoadbal3ResGrpCfg.
         The CMTS persists all instances of ResGrpCfg across reinitializations."
    INDEX { docsLoadbal3ResGrpCfgId }
    ::= { docsLoadbal3ResGrpCfgTable 1 }

DocsLoadbal3ResGrpCfgEntry ::= SEQUENCE {
    docsLoadbal3ResGrpCfgId
        Unsigned32,
    docsLoadbal3ResGrpCfgMdIfIndex
        InterfaceIndexOrZero,
    docsLoadbal3ResGrpCfgDsChList
        ChannelList,
    docsLoadbal3ResGrpCfgUsChList
        ChannelList,
    docsLoadbal3ResGrpCfgEnable
        TruthValue,
    docsLoadbal3ResGrpCfgInitTech
        ChChgInitTechMap,
    docsLoadbal3ResGrpCfgPolicyId
        Unsigned32,
    docsLoadbal3ResGrpCfgServiceTypeId
        SnmpTagList,
    docsLoadbal3ResGrpCfgStatus
        RowStatus
}

docsLoadbal3ResGrpCfgId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents a unique index assigned to the
         Restricted Load Balancing Group by the user for provisioning
         purposes. This value is unique within a CMTS
         and is matched with the CM signaled Load Balancing Group
         ID TLV value when determining the CM Load Balancing
         Group assignment based on such TLV value."
    REFERENCE

```

```

    "DOCSIS 3.0 MAC and Upper Layer Protocol Specification,
    CM-SP-MULPIv3.0-I08-080522, Channel Assignment During
    Registration section."
 ::= { docsLoadbal3ResGrpCfgEntry 1 }

docsLoadbal3ResGrpCfgMdIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndexOrZero
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the MAC domain where the
        Restricted Load balancing Group applies. The value
        zero is allowed to indicate that vendor-specific mechanisms
        are used to define the Restricted Load Balancing
        Group. For example, to provide Load Balancing
        Groups across MAC domains.
    "
 ::= { docsLoadbal3ResGrpCfgEntry 2 }

docsLoadbal3ResGrpCfgDsChList OBJECT-TYPE
    SYNTAX      ChannelList
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute contains the list of downstream channels
        of the Restricted Load Balancing Group."
    DEFVAL { ''H }
 ::= { docsLoadbal3ResGrpCfgEntry 3 }

docsLoadbal3ResGrpCfgUsChList OBJECT-TYPE
    SYNTAX      ChannelList
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute contains the list of upstream channels
        of the Restricted Load Balancing Group."
    DEFVAL { ''H }
 ::= { docsLoadbal3ResGrpCfgEntry 4 }

docsLoadbal3ResGrpCfgEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute when set to 'true' enables Autonomous
        Load Balancing on this Restricted Load Balancing
        Group. The value 'false' disables the load balancing
        operation on this group."
    DEFVAL { true }
 ::= { docsLoadbal3ResGrpCfgEntry 5 }

docsLoadbal3ResGrpCfgInitTech OBJECT-TYPE
    SYNTAX      ChChgInitTechMap
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the initialization techniques
        that the CMTS can use to load balance cable modems
        in the Load Balancing Group."
    DEFVAL { 'F8'H }
 ::= { docsLoadbal3ResGrpCfgEntry 6 }

docsLoadbal3ResGrpCfgPolicyId OBJECT-TYPE

```

```

SYNTAX      Unsigned32
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents the default load balancing
     policy of this Restricted Load Balancing Group.
     A policy is described by a set of conditions (rules)
     that govern the load balancing process for a cable modem.
     The CMTS assigns this Policy ID value to a cable modem
     associated with the group ID when the cable modem
     does not signal a Policy ID during registration.

    The Policy ID value is intended to be a numeric reference
    to an instance of the Policy object. However, It is
    not required to have an existing or active policy instance
    in which case it indicates no policy is associated
    with the Load Balancing Group.

    The Policy ID of value 0 is reserved to indicate no policy
    is associated with the load balancing group."
DEFVAL { 0 }
 ::= { docsLoadbal3ResGrpCfgEntry 7 }

docsLoadbal3ResGrpCfgServiceTypeId OBJECT-TYPE
SYNTAX      SnmpTagList
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represent a space separated list of
     ServiceType IDs that will be compared against the cable
     modem provisioned Service Type ID to determine
     the most appropriate Restricted Load Balancing Group."
REFERENCE
    "DOCSIS 3.0 MAC and Upper Layer Protocol Specification,
     CM-SP-MULPIv3.0-I08-080522, Channel Assignment During
     Registration section."
 ::= { docsLoadbal3ResGrpCfgEntry 8 }

docsLoadbal3ResGrpCfgStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "The conceptual row status of this object."
 ::= { docsLoadbal3ResGrpCfgEntry 9 }

docsLoadbal3GrpStatusTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsLoadbal3GrpStatusEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object represents the status of all General
     and Restricted Load Balancing Groups in this CMTS.
     This object summarizes the load balancing parameters
     that applies to CMTS system wide Load Balancing Groups.
     The Load Balancing Groups defined in this object
     include the configured Restricted Load Balancing
     Groups and the General Load Balancing Groups derived
     from the GeneralGrpCfg object."
 ::= { docsLoadbal3MibObjects 8 }

docsLoadbal3GrpStatusEntry OBJECT-TYPE
SYNTAX      DocsLoadbal3GrpStatusEntry

```

```

MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsLoadbal3GrpStatus."
INDEX { docsLoadbal3GrpStatusId }
::= { docsLoadbal3GrpStatusTable 1 }

DocsLoadbal3GrpStatusEntry ::= SEQUENCE {
    docsLoadbal3GrpStatusId
        Unsigned32,
    docsLoadbal3GrpStatusCfgIdOrZero
        Unsigned32,
    docsLoadbal3GrpStatusMdIfIndex
        InterfaceIndexOrZero,
    docsLoadbal3GrpStatusMdCmSgId
        Unsigned32,
    docsLoadbal3GrpStatusDsChList
        ChannelList,
    docsLoadbal3GrpStatusUsChList
        ChannelList,
    docsLoadbal3GrpStatusEnable
        TruthValue,
    docsLoadbal3GrpStatusInitTech
        ChChgInitTechMap,
    docsLoadbal3GrpStatusPolicyId
        Unsigned32,
    docsLoadbal3GrpStatusChgOverSuccess
        Counter32,
    docsLoadbal3GrpStatusChgOverFails
        Counter32
}

docsLoadbal3GrpStatusId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents an unique identifier of a Load
    Balancing Group in the CMTS."
::= { docsLoadbal3GrpStatusEntry 1 }

docsLoadbal3GrpStatusCfgIdOrZero OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute references the Id attribute of the
    instance of the ResGrpCfg this instance corresponds
    to. The value zero indicates that the instance corresponds
    to a General Load Balancing Group."
::= { docsLoadbal3GrpStatusEntry 2 }

docsLoadbal3GrpStatusMdIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute represents the MAC domain where the
    Load Balancing Group applies. The value zero is allowed
    to indicate that vendor-specific mechanisms are
    used in load balancing operations. For example, to
    provide Load Balancing Groups across MAC domains."

```

```
::= { docsLoadbal3GrpStatusEntry 3 }

docsLoadbal3GrpStatusMdCmSgId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute corresponds to the MD-CM-SG-ID that
         includes all the upstream and downstream channels
         of the Load Balancing Group. The value zero indicates
         that this instance corresponds to a Restricted Load
         Balancing Group. If there are vendor-specific Load
         Balancing Groups configuration ( e.g., MdIfIndex
         set to zero), this attribute value might not be meaningful."

::= { docsLoadbal3GrpStatusEntry 4 }

docsLoadbal3GrpStatusDsChList OBJECT-TYPE
    SYNTAX      ChannelList
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute contains the list of downstream channels
         of the Load Balancing Group. If there are vendor-specific
         Load Balancing Groups configuration (
         e.g., MdIfIndex set to zero), this attribute value might
         not be meaningful."
::= { docsLoadbal3GrpStatusEntry 5 }

docsLoadbal3GrpStatusUsChList OBJECT-TYPE
    SYNTAX      ChannelList
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute contains the list of the upstream channels
         of the Load Balancing Group. If there are vendor-specific
         Load Balancing Groups configuration
         ( e.g., MdIfIndex set to zero), this attribute value might
         not be meaningful."
::= { docsLoadbal3GrpStatusEntry 6 }

docsLoadbal3GrpStatusEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute when set to 'true' indicates that load
         balancing is enabled on this group, or disabled if
         set to 'false'."
::= { docsLoadbal3GrpStatusEntry 7 }

docsLoadbal3GrpStatusInitTech OBJECT-TYPE
    SYNTAX      ChChgInitTechMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This attribute indicates the initialization techniques
         that the CMTS can use when load balancing cable
         modems that are associated with the Load Balancing
         Group."
::= { docsLoadbal3GrpStatusEntry 8 }

docsLoadbal3GrpStatusPolicyId OBJECT-TYPE
```

```

SYNTAX      Unsigned32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute indicates the Policy that the CMTS
    can use when load balancing cable modems that are associated
    with the Load Balancing Group."
 ::= { docsLoadbal3GrpStatusEntry 9 }

docsLoadbal3GrpStatusChgOverSuccess OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of successful Autonomous
    Load Balancing operations associated with
    this Load Balancing Group.
    "
 ::= { docsLoadbal3GrpStatusEntry 10 }

docsLoadbal3GrpStatusChgOverFails OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This attribute counts the number of failed Autonomous
    load balancing operations associated with this
    Load Balancing Group."
 ::= { docsLoadbal3GrpStatusEntry 11 }

docsLoadbal3RestrictCmCfgTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsLoadbal3RestrictCmCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object describes the list of cable modems being
    statically provisioned at the CMTS to a Restricted
    Load Balancing Group.
    When a CM registers it is either assigned to
    "
 ::= { docsLoadbal3MibObjects 9 }

docsLoadbal3RestrictCmCfgEntry OBJECT-TYPE
SYNTAX      DocsLoadbal3RestrictCmCfgEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsLoadbal3RestrictCmCfg.
    The CMTS MUST persist all instances of RestrictCmCfg across
    reinitializations."
INDEX { docsLoadbal3RestrictCmCfgId }
 ::= { docsLoadbal3RestrictCmCfgTable 1 }

DocsLoadbal3RestrictCmCfgEntry ::= SEQUENCE {
    docsLoadbal3RestrictCmCfgId
        Unsigned32,
    docsLoadbal3RestrictCmCfgMacAddr
        MacAddress,
    docsLoadbal3RestrictCmCfgMacAddrMask
        MacAddress,
    docsLoadbal3RestrictCmCfgGrpId
        Unsigned32,
    docsLoadbal3RestrictCmCfgServiceTypeId

```

```

        OCTET STRING,
docsLoadbal3RestrictCmCfgStatus
        RowStatus
    }

docsLoadbal3RestrictCmCfgId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This key represents the unique identifier of an instance
        in this object.
        the CMTS maintains an unique instance per MAC Address/MAC
        Address Mask combination"
    ::= { docsLoadbal3RestrictCmCfgEntry 1 }

docsLoadbal3RestrictCmCfgMacAddr OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute represents the Mac Address of the cable
        modem within the Restricted Load Balancing Group."
    DEFVAL { '000000000000' }
    ::= { docsLoadbal3RestrictCmCfgEntry 2 }

docsLoadbal3RestrictCmCfgMacAddrMask OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This attribute corresponds to a bit mask acting as
        a wild card to associate a cable modem MAC addresses
        to a Restricted Load Balancing Group ID referenced by
        a restricted group Id or a Service Type ID.
        The cable modem matching criteria is performed by bit-Anded
        the cable modem MAC address with the MacAddrMask
        attribute and being compared with the bit-ANDed
        of attributes MacdAddr and MacAddrMask.

        A cable modem MAC address look up is performed first with
        instances containing this attribute value not null,
        if several entries match, the largest consecutive
        bit match from MSB to LSB is used."
    DEFVAL { 'FFFFFFFFFFFF' }
    ::= { docsLoadbal3RestrictCmCfgEntry 3 }

docsLoadbal3RestrictCmCfgGrpId OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The attribute represents the Restricted Load Balancing
        Group identifier of this entry associated with
        the cable modem MAC address - MAC address mask combination.
        The value zero indicates that the instance
        is matched only against the ServiceTypeId value."
    DEFVAL { 0 }
    ::= { docsLoadbal3RestrictCmCfgEntry 4 }

docsLoadbal3RestrictCmCfgServiceTypeId OBJECT-TYPE

```

```

SYNTAX      OCTET STRING (SIZE(0..16))
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute represents the Service Type Id associated
    with this cable modem MAC address - MAC Address
    mask combination.. The zero-length string indicates
    that the instance is matched only against the GrpId
    value, if both GrpId and this attribute are not present
    the instance is ignored for matching purposes."
DEFVAL { "" }
 ::= { docsLoadbal3RestrictCmCfgEntry 5 }

docsLoadbal3RestrictCmCfgStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "Indicates the status of this conceptual object.

    There is no restriction on setting columns in this table
    any time."
 ::= { docsLoadbal3RestrictCmCfgEntry 6 }

docsLoadbal3PolicyTable OBJECT-TYPE
SYNTAX      SEQUENCE OF DocsLoadbal3PolicyEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This object describes the set of load balancing policies.
    Instances from this object might be referenced
    by GrpStatus object. All the rules contained in a
    load balancing policy apply to an Autonomous Load Balancing
    operations. Load balancing rules are defined
    within this specification or can be vendor-defined
    as well."
 ::= { docsLoadbal3MibObjects 10}

docsLoadbal3PolicyEntry OBJECT-TYPE
SYNTAX      DocsLoadbal3PolicyEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The conceptual row of docsLoadbal3Policy.
    The CMTS MUST persist all instances of Policy object across
    reinitializations."
INDEX { docsLoadbal3PolicyId,docsLoadbal3PolicyRuleId }
 ::= { docsLoadbal3PolicyTable 1 }

DocsLoadbal3PolicyEntry ::= SEQUENCE {
    docsLoadbal3PolicyId
        Unsigned32,
    docsLoadbal3PolicyRuleId
        Unsigned32,
    docsLoadbal3PolicyPtr
        RowPointer,
    docsLoadbal3PolicyRowStatus
        RowStatus
}

docsLoadbal3PolicyId OBJECT-TYPE
SYNTAX      Unsigned32

```

```

MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents the identifier of a load balancing
     policy."
 ::= { docsLoadbal3PolicyEntry 1 }

docsLoadbal3PolicyRuleId OBJECT-TYPE
 SYNTAX      Unsigned32
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
    "This key represents a rule contained within a balancing
     policy."
 ::= { docsLoadbal3PolicyEntry 2 }

docsLoadbal3PolicyPtr OBJECT-TYPE
 SYNTAX      RowPointer
 MAX-ACCESS  read-create
 STATUS      current
 DESCRIPTION
    "This attribute represents a reference to an instance
     in a rule or other policy object like BasicRule object."
 ::= { docsLoadbal3PolicyEntry 3 }

docsLoadbal3PolicyRowStatus OBJECT-TYPE
 SYNTAX      RowStatus
 MAX-ACCESS  read-create
 STATUS      current
 DESCRIPTION
    "The conceptual row status of this object."
 ::= { docsLoadbal3PolicyEntry 4 }

docsLoadbal3BasicRuleTable OBJECT-TYPE
 SYNTAX      SEQUENCE OF DocsLoadbal3BasicRuleEntry
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
    "This object represents a basic ruleset applicable
     to a load balancing policy that references it.
     "
 ::= { docsLoadbal3MibObjects 11 }

docsLoadbal3BasicRuleEntry OBJECT-TYPE
 SYNTAX      DocsLoadbal3BasicRuleEntry
 MAX-ACCESS  not-accessible
 STATUS      current
 DESCRIPTION
    "The conceptual row of docsLoadbal3BasicRule.
     The CMTS MUST persist all instances of BasicRule object across
     reinitializations."
 INDEX { docsLoadbal3BasicRuleId }
 ::= { docsLoadbal3BasicRuleTable 1 }

DocsLoadbal3BasicRuleEntry ::= SEQUENCE {
    docsLoadbal3BasicRuleId
        Unsigned32,
    docsLoadbal3BasicRuleEnable
        INTEGER,
    docsLoadbal3BasicRuleDisStart
        Unsigned32,
    docsLoadbal3BasicRuleDisPeriod

```

```

        Unsigned32,
docsLoadbal3BasicRuleRowStatus
    RowStatus
}

docsLoadbal3BasicRuleId OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "This key represents a unique identifier for balancing
     ruleset of this object."
::= { docsLoadbal3BasicRuleEntry 1 }

docsLoadbal3BasicRuleEnable OBJECT-TYPE
SYNTAX      INTEGER {
                enabled(1),
                disabled(2),
                disabledPeriod(3)
            }
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute when set to 'enabled' enables Autonomous
     Load Balancing (independently of the load balancing
     group enable/disable state), the rule set is
     disabled if set to 'disabled', or is disabled during
     a period of time it set to 'disabledPeriod'."
DEFVAL { disabled }
::= { docsLoadbal3BasicRuleEntry 2 }

docsLoadbal3BasicRuleDisStart OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute disables load balancing from the time
     stated by this attribute when the attribute Enable
     is set to 'disablePeriod'. The time is defined in seconds
     since midnight."
DEFVAL { 0 }
::= { docsLoadbal3BasicRuleEntry 3 }

docsLoadbal3BasicRuleDisPeriod OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "This attribute disables load balancing until the
     time stated by this attribute when the attribute Enable
     is set to 'disablePeriod'. The time is defined in
     seconds of the wall clock since midnight.
    "
DEFVAL { 0 }
::= { docsLoadbal3BasicRuleEntry 4 }

docsLoadbal3BasicRuleRowStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
    "The conceptual row status of this object."

```

```
 ::= { docsLoadbal3BasicRuleEntry 5 }

docsLoadbal3MibConformance OBJECT IDENTIFIER ::= { docsLoadbal3Mib 2 }
docsLoadbal3MibCompliances OBJECT IDENTIFIER ::= { docsLoadbal3MibConformance 1 }
docsLoadbal3MibGroups      OBJECT IDENTIFIER ::= { docsLoadbal3MibConformance 2 }

docsLoadbal3Compliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION
    "The compliance statement for..."

    MODULE -- this MODULE
MANDATORY-GROUPS {
    docsLoadbal3Group
}
 ::= { docsLoadbal3MibCompliances 1 }
docsLoadbal3Group OBJECT-GROUP
    OBJECTS {
        docsLoadbal3SystemEnable,
        docsLoadbal3SystemEnableError,
        docsLoadbal3PolicyPtr,
        docsLoadbal3PolicyRowStatus,
        docsLoadbal3BasicRuleEnable,
        docsLoadbal3BasicRuleDisStart,
        docsLoadbal3BasicRuleDisPeriod,
        docsLoadbal3BasicRuleRowStatus,
        docsLoadbal3ChgOverGroupMacAddress,
        docsLoadbal3ChgOverGroupInitTech,
        docsLoadbal3ChgOverGroupForceUCC,
        docsLoadbal3ChgOverGroupdownFrequency,
        docsLoadbal3ChgOverGroupMdIfIndex,
        docsLoadbal3ChgOverGroupRcpId,
        docsLoadbal3ChgOverGroupRccId,
        docsLoadbal3ChgOverGroupUsChSet,
        docsLoadbal3ChgOverGroupServiceFlowInfo,
        docsLoadbal3ChgOverGroupTransactionId,
        docsLoadbal3ChgOverGroupCommit,
        docsLoadbal3ChgOverGroupLastCommit,
        docsLoadbal3ChgOverStatusMacAddr,
        docsLoadbal3ChgOverStatusInitTech,
        docsLoadbal3ChgOverStatusDownFrequency,
        docsLoadbal3ChgOverStatusMdIfIndex,
        docsLoadbal3ChgOverStatusRcpId,
        docsLoadbal3ChgOverStatusRccId,
        docsLoadbal3ChgOverStatusUsChSet,
        docsLoadbal3ChgOverStatusServiceFlowInfo,
        docsLoadbal3ChgOverStatusCmd,
        docsLoadbal3ChgOverStatusTransactionId,
        docsLoadbal3ChgOverStatusValue,
        docsLoadbal3ChgOverStatusUpdate,
        docsLoadbal3CmtsCmParamsProvGrpId,
        docsLoadbal3CmtsCmParamsCurrentGrpId,
        docsLoadbal3CmtsCmParamsProvServiceTypeID,
        docsLoadbal3CmtsCmParamsCurrentServiceTypeID,
        docsLoadbal3CmtsCmParamsPolicyId,
        docsLoadbal3CmtsCmParamsPriority,
        docsLoadbal3GeneralGrpDefaultsEnable,
        docsLoadbal3GeneralGrpDefaultsPolicyId,
        docsLoadbal3GeneralGrpDefaultsInitTech,
        docsLoadbal3GeneralGrpCfgEnable,
        docsLoadbal3GeneralGrpCfgPolicyId,
        docsLoadbal3GeneralGrpCfgInitTech,
        docsLoadbal3ResGrpCfgMdIfIndex,
```

```
docsLoadbal3ResGrpCfgDsChList,
docsLoadbal3ResGrpCfgUsChList,
docsLoadbal3ResGrpCfgEnable,
docsLoadbal3ResGrpCfgInitTech,
docsLoadbal3ResGrpCfgPolicyId,
docsLoadbal3ResGrpCfgServiceTypeId,
docsLoadbal3ResGrpCfgStatus,
docsLoadbal3GrpStatusCfgIdOrZero,
docsLoadbal3GrpStatusMdIfIndex,
docsLoadbal3GrpStatusMdCmSgId,
docsLoadbal3GrpStatusDsChList,
docsLoadbal3GrpStatusUsChList,
docsLoadbal3GrpStatusEnable,
docsLoadbal3GrpStatusInitTech,
docsLoadbal3GrpStatusPolicyId,
docsLoadbal3GrpStatusChgOverSuccess,
docsLoadbal3GrpStatusChgOverFails,
docsLoadbal3RestrictCmCfgMacAddr,
docsLoadbal3RestrictCmCfgMacAddrMask,
docsLoadbal3RestrictCmCfgGrpId,
docsLoadbal3RestrictCmCfgServiceTypeId,
docsLoadbal3RestrictCmCfgStatus
}
STATUS      current
DESCRIPTION
  "Group of objects implemented in"
 ::= { docsLoadbal3MibGroups 1 }
END
```

## Annex R IPDR Service Definition Schemas (Normative)

This Annex defines the DOCSIS 3.0 IPDR Service Definition schemas. Refer to Annex C for the global element definitions referenced in the Service Definition schema files.

### R.1 SAMIS Service Definition Schemas

Refer to Annex B for the SAMIS Service Definition schema definitions.

### R.2 Diagnostic Log Service Definition Schemas

The section defines the IPDR Service Definition schemas for the Diagnostic Log feature defined in Annex G.

#### R.2.1 DOCSIS-DIAG-LOG-TYPE\_3.5.1-A.2.xsd<sup>395</sup>

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG-TYPE"
    xmlns:DOCSIS-DIAG-LOG-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-TYPE"
    xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:DOCSIS-DIAG-
LOG="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
DIAG-LOG"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG/DOCSIS-DIAG-LOG_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
                for global element references.</documentation>
        </annotation>
    </include>
    <annotation>
        <documentation>DOCSIS-DIAG-LOG-TYPE is an IPDR Service Definition
            schema defining the CMTS Diagnostic Log Type IPDR data
            record which references the imported global elements.
            3.5.1-A.1 Initial version.
            3.5.1-A.2 Revised version includes ECN
            OSSIV3.0-N-10.0968-2 and published as I14.
        </documentation>
    </annotation>

```

<sup>395</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 and OSSIV3.0-N-10.0985-1 on 2/7/11 by JB.

```

        </documentation>
<documentation>
    <ipdr:reference>
        DOCSIS 3.0 Operations Support System Interface Specification
        CM-SP-OSSIv3.0-I14-110210, Annex G.
    </ipdr:reference>
</documentation>
</annotation>
<complexType name="DIAG-LOG-TYPE">
    <annotation>
        <documentation>The IPDR Record containing one diagnostic log entry representing
a single
        cable modem which has triggered at least one of the diagnostic
triggers.</documentation>
    </annotation>
    <complexContent>
        <extension base="ipdr:IPDRTypE">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName"/>
                <element ref="DOCSIS-CM:CmMacAddr"/>
                <element ref="DOCSIS-DIAG-LOG:LastUpdateTime"/>
                <element ref="DOCSIS-DIAG-LOG:CreateTime"/>
                <element ref="DOCSIS-DIAG-LOG:LastRegTime"/>
                <element ref="DOCSIS-DIAG-LOG:RegCount"/>
                <element ref="DOCSIS-DIAG-LOG:RangingRetryCount"/>
                <element ref="DOCSIS-REC:RecType"/>
            </sequence>
        </extension>
    </complexContent>
</complexType>
</schema>

```

## R.2.2 DOCSIS-DIAG-LOG-EVENT-TYPE\_3.5.1-A.2.xsd<sup>396</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG-EVENT-TYPE"
    xmlns:DOCSIS-DIAG-LOG-EVENT-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-EVENT-
TYPE"
        xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
        xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
        xmlns:DOCSIS-DIAG-
LOG="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG"
        xmlns:DOCSIS-DIAG-LOG-
DETAIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
DETAIL"
            xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
            version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>

```

<sup>396</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

```
<import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
<import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG/DOCSIS-DIAG-LOG_3.5.1-A.1.xsd"/>
<import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
<import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL/DOCSIS-DIAG-LOG-DETAIL_3.5.1-A.1.xsd"/>
<include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
<annotation>
<documentation>Import auxiliary schemas  
for global element references.  
3.5.1-A.1 Initial version.  
3.5.1-A.2 Revised version includes ECN  
OSSIv3.0-N-10.0968-2 and published as I14.  
</documentation>
</annotation>
</include>
<annotation>
<documentation>DOCSIS-DIAG-LOG-EVENT-TYPE is an IPDR Service Definition  
schema defining the CMTS Diagnostic Log Event Type IPDR data  
record which references the imported global elements.</documentation>
<documentation>
<ipdr:reference>  
DOCSIS 3.0 Operations Support System Interface Specification  
CM-SP-OSSIv3.0-I14-110210, Annex G.  
</ipdr:reference>
</documentation>
</annotation>
<complexType name="DIAG-LOG-EVENT-TYPE">
<annotation>
<documentation>The event-based IPDR Record containing only the required  
elements for updating  
the diagnostic log located outside of the exporter.</documentation>
</annotation>
<complexContent>
<extension base="ipdr:IPDRTypE">
<sequence>
<element ref="DOCSIS-CMTS:CmtsHostName" />
<element ref="DOCSIS-CM:CmMacAddr" />
<element ref="DOCSIS-CMTS:CmtsSysUpTime" />
<element ref="DOCSIS-DIAG-LOG:TriggerFlagValue" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:TypeValue" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:LastErrorText" />
<element ref="DOCSIS-REC:RecType" />
</sequence>
</extension>
</complexContent>
</complexType>
</schema>
```

### R.2.3 DOCSIS-DIAG-LOG-DETAIL-TYPE\_3.5.1-A.2.xsd <sup>397</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG-DETAIL-TYPE"
      xmlns:DOCSIS-DIAG-LOG-DETAIL-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL-
TYPE"
      xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
      xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
      xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
      xmlns:DOCSIS-DIAG-LOG-
DETAIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
DETAIL"
      xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
      version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
DIAG-LOG-DETAIL"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG-DETAIL/DOCSIS-DIAG-LOG-DETAIL_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
                for global element references.
                3.5.1-A.1 Initial version.
                3.5.1-A.2 Revised version includes ECN
                OSSIV3.0-N-10.0968-2 and published as I14.
            </documentation>
        </annotation>
    </include>
    <annotation>
        <documentation>DOCSIS-DIAG-LOG-DETAIL-TYPE is an IPDR Service Definition
            schema defining the CMTS Diagnostic Log Detail Type IPDR data
            record which references the imported global elements.</documentation>
        <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I14-110210, Annex G.
            </ipdr:reference>
        </documentation>
    </annotation>
    <complexType name="DIAG-LOG-DETAIL-TYPE">
        <annotation>

```

<sup>397</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 and OSSIV3.0-N-10.0985-1 on 2/7/11 by JB.

```

<documentation>The IPDR Record containing one diagnostic log detail entry
representing a single
cable modem which has triggered at least one of the diagnostic
triggers.</documentation>
</annotation>
<complexContent>
<extension base="ipdr:IPDRTypE">
<sequence>
<element ref="DOCSIS-CMTS:CmtsHostName" />
<element ref="DOCSIS-CM:CmMacAddr" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:TypeValue" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:Count" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:LastUpdate" />
<element ref="DOCSIS-DIAG-LOG-DETAIL:LastErrorText" />
<element ref="DOCSIS-REC:RecType" />
</sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

### R.3 Spectrum Measurement Service Definition Schema

The section defines the IPDR Service Definition schema for the Enhanced Signal Quality Monitoring feature defined in Annex J.

#### R.3.1 DOCSIS-SPECTRUM-MEASUREMENT-TYPE\_3.5.1-A.2.xsd<sup>398</sup>

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SPECTRUM-MEASUREMENT-TYPE"
    xmlns:DOCSIS-SPECTRUM-MEASUREMENT-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM-
MEASUREMENT-TYPE"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
            xmlns:DOCSIS-
SPECTRUM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM"
                xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                    version="3.5.1-A.1" elementFormDefault="qualified"
attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SPECTRUM"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SPECTRUM/DOCSIS-SPECTRUM_3.5.1-A.2.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
for global element references.</documentation>
        </annotation>
    </include>
<annotation>
    <documentation>DOCSIS-SPECTRUM-MEASUREMENT-TYPE is an IPDR Service
Definition schema defining the Enhanced Signal Quality

```

<sup>398</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

Monitoring Spectrum Measurement Type IPDR data record which references the imported global elements.

```

    3.5.1-A.1 Initial version.
    3.5.1-A.2 Revised version includes ECN
    OSSIV3.0-N-10.0968-2 and published as I14.
    </documentation>
<documentation>
    <ipdr:reference>
        DOCSIS 3.0 Operations Support System Interface Specification
        CM-SP-OSSIv3.0-I14-110210, Annex J.
    </ipdr:reference>
</documentation>
</annotation>
<complexType name="SPECTRUM-MEASUREMENT-TYPE">
    <annotation>
        <documentation>
            Frequency Span is derived from the SpectrumAnalysisCfgBinSpacing and
            the length of the SpectrumAnalysisMeasurementBinAmplitude
            string divided by two (i.e., the Number of Bins).
        </documentation>
    </annotation>
    <complexContent>
        <extension base="ipdr:IPDRTyPe">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasIfIndex" />
                <element ref="DOCSIS-SPECTRUM:ChId" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasChCenterFreq" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasFreqSpan" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasNumOfBins" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasResolutionBW" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasBinSpacing" />
                <element ref="DOCSIS-SPECTRUM:SpectrumAnalysisMeasAmplitude" />
            </sequence>
        </extension>
    </complexContent>
</complexType>
</schema>
```

## R.4 CMTS CM Registration Status Service Definition Schema

The section defines the IPDR Service Definition schema for the CMTS CM Registration Status information defined in Annex N.

### R.4.1 DOCSIS-CMTS-CM-REG-STATUS-TYPE\_3.5.1-A.3.xsd<sup>399</sup>

```

<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-REG-STATUS-TYPE"
    xmlns:DOCSIS-CMTS-CM-REG-STATUS-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-REG-
STATUS-TYPE"
    xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
```

<sup>399</sup> Section revised per OSSIV3.0-N-07.0447-2, #3 on 5/10/07, OSSIV3.0-N-08.0616-2 on 4/11/08 by KN and per OSSIV3.0-N-10.0937-4 on 9/24/10 by JB, OSSIV3.0-N-12.073-3 on 11/2/12 by PO, title and xsd file updated by OSSIV3.0-N-12.1083-5 on 3/20/13 by PO.

```
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
        xmlns:DOCSIS-CMTS-CM-NODE-
    CH="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH"
            xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                    version="3.5.1-A.3" attributeFormDefault="unqualified"
elementFormDefault="qualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.3.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-CM-NODE-CH"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-NODE-CH/DOCSIS-CMTS-CM-NODE-CH_3.5.1-A.2.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-CMTS-CM-REG-STATUS is an IPDR Service Definition Schema
            that defines the Registration status of the CM as perceived by
            the CMTS.
            Revision History:
            3.5.1-A.1: Initial version.
            3.5.1-A.2: Revised version includes ECN OSSIV3.0-N-12.1073-3
            and published as I20.
            3.5.1-A.3: Revised version includes ECN OSSIV3.0-N-12.1083
            and published as I21.
        </documentation>
        <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I21-130404, Annex N.
            </ipdr:reference>
        </documentation>
    </annotation>
<complexType name="CMTS-CM-REG-STATUS-TYPE">
    <annotation>
        <documentation>
            The IPDR Record containing one CM registration status instance
            representing a single cable modem that has registered with
            the CMTS.
        </documentation>
    </annotation>
    <complexContent>
        <extension base="ipdr:IPDRTypE">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                <element ref="DOCSIS-CMTS:CmtsMdIfName" />
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                <element ref="DOCSIS-CMTS-CM-NODE-CH:CmtsMdCmSgId" />
                <element ref="DOCSIS-CMTS-CM-NODE-CH:CmtsRcpId" />
                <element ref="DOCSIS-CMTS-CM-NODE-CH:CmtsRccStatusId" />
                <element ref="DOCSIS-CMTS-CM-NODE-CH:CmtsRcsId" />
            </sequence>
        </extension>
    </complexContent>
</complexType>
```

```

<element ref="DOCSIS-CMTS-CM-NODE-CH:CmtsTcsId" />
<element ref="DOCSIS-CM:CmMacAddr" />
<element ref="DOCSIS-CM:CmIpv4Addr" />
<element ref="DOCSIS-CM:CmIpv6Addr" />
<element ref="DOCSIS-CM:CmIpv6LinkLocalAddr" />
<element ref="DOCSIS-CM:CmQosVersion" />
<element ref="DOCSIS-CM:CmRegStatusValue" />
<element ref="DOCSIS-CM:CmLastRegTime" />
<element ref="DOCSIS-CM:CmEnergyMgtEnabled" />
<element ref="DOCSIS-CM:CmEnergyMgtOperStatus" />
<element ref="DOCSIS-CM:CmEnergyMgt1x1ModeTotalDuration" />
<element ref="DOCSIS-REC:RecType" />
<element ref="DOCSIS-REC:RecCreationTime" />
</sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

## R.5 CMTS CM Upstream Status Service Definition Schema

The section defines the IPDR Service Definition schema for the CMTS CM Upstream Status information defined in Annex N.

### R.5.1 DOCSIS-CMTS-CM-US-STATS-TYPE\_3.5.1-A.2.xsd<sup>400</sup>

```

<
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-US-STATS-TYPE"
    xmlns:DOCSIS-CMTS-CM-US-STATS-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US-STATS-
TYPE"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
        xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
        xmlns:DOCSIS-CMTS-CM-
US="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US"
        xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
        version="3.5.1-A.2" attributeFormDefault="unqualified"
elementFormDefault="qualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-CM-US" />

```

<sup>400</sup> Section revised per OSSIV3.0-N-07.0410-4, #12 on 5/8/07 by KN, per OSSIV3.0-N-10.0914-3 on 5/20/10 and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-US/DOCSIS-CMTS-CM-US_3.5.1-A.3.xsd"/>
<import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
<annotation>
    <documentation>
        DOCSIS-CMTS-CM-US-STATS is an IPDR Service Definition Schema
        that defines the Upstream Channel statistics. This definition
        supports multiple upstream channels.
        Revision History:
        3.5.1-A.1 Initial version.
        3.5.1-A.2 Revised version includes ECN
        OSSIV3.0-N-10.0914-3 and published as I12.           </documentation>
    <documentation>
        <ipdr:reference>
            DOCSIS 3.0 Operations Support System Interface Specification
            CM-SP-OSSIv3.0-I 12-100611, Annex N.
        </ipdr:reference>
    </documentation>
</annotation>
<complexType name="CMTS-CM-US-STATS-TYPE">
    <complexContent>
        <annotation>
            <documentation>
                The IPDR Record containing one upstream status instance
                representing a single cable modem.
            </documentation>
        </annotation>
        <extension base="ipdr:IPDRTypE">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                <element ref="DOCSIS-CMTS:CmtsMdIfName" />
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                <element ref="DOCSIS-CM:CmMacAddr" />
                <element ref="DOCSIS-CM:CmRegStatusId" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsChIfName" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsChIfIndex" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsChId" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsModulationType" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsRxPower" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsSignalNoise" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsMicroreflections" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsEqData" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsUnerroreds" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsCorrecteds" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsUncorrectables" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsHighResolutionTimingOffset" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsIsMuted" />
                <element ref="DOCSIS-CMTS-CM-US:CmtsCmUsRangingStatus" />
                <element ref="DOCSIS-REC:RecType" />
            </sequence>
        </extension>
    </complexContent>
</complexType>
</schema>

```

## R.6 CMTS Topology Service Definition Schema

The section defines the IPDR Service Definition schema for the CMTS Topology information defined in Annex O.

### R.6.1 DOCSIS-CMTS-TOPOLGY-TYPE\_3.5.1-A.2.xsd<sup>401</sup>

```

<
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
TOPOLGY-TYPE"
    xmlns:DOCSIS-CMTS-TOPOLGY-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-TOPOLGY-
TYPE"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
            xmlns:DOCSIS-MD-
NODE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE"
                xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                        version="3.5.1-A.2" attributeFormDefault="unqualified"
elementFormDefault="qualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
MD-NODE"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-
NODE/DOCSIS-MD-NODE_3.5.1-A.2.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-CMTS-TOPOLGY-TYPE is an IPDR Service Definition Schema
            that defines the RF topology information that shows the
            connectivities of downstream and upstream channels to the fiber
            nodes within the CMTS.
            Revision History:
            3.5.1-A.1 Initial version.
            3.5.1-A.2 Revised version includes ECN
            OSSIV3.0-N-10.0914-3 and published as I12.
        </documentation>
        <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I12-100611, Annex O.
            </ipdr:reference>
        </documentation>
    </annotation>
<complexType name="CMTS-TOPOLGY-TYPE">
    <complexContent>
        <annotation>
            <documentation>
                This IPDR record contains the association of upstream and
                downstream channels to each unique pair of MD-CM-SG and
                Fiber Node.
            </documentation>
        </annotation>
    </complexContent>

```

<sup>401</sup> Revised per OSSIV3.0-N-07.0506-3 by ab on 10/11/07, per OSSIV3.0-N-10.0914-3 on 5/20/10 and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

<extension base="ipdr:IPDRType">
  <sequence>
    <element ref="DOCSIS-CMTS:CmtsHostName" />
    <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
    <element ref="DOCSIS-CMTS:CmtsIpv4Addr" />
    <element ref="DOCSIS-CMTS:CmtsIpv6Addr" />
    <element ref="DOCSIS-CMTS:CmtsMdIfName" />
    <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
    <element ref="DOCSIS-MD-NODE:CmtsNodeName" />
    <element ref="DOCSIS-MD-NODE:CmtsMdCmSgId" />
    <element ref="DOCSIS-MD-NODE:CmtsMdDsSgId" />
    <element ref="DOCSIS-MD-NODE:CmtsMdUsSgId" />
    <element ref="DOCSIS-MD-NODE:CmtsMdDsSgChList" />
    <element ref="DOCSIS-MD-NODE:CmtsMdUsSgChList" />
    <element ref="DOCSIS-REC:RecType" />
  </sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

## R.7 CPE Service Definition Schema <sup>402</sup>

The section defines the IPDR Service Definition schemas for the CPE information defined in Annex C.

### R.7.1 DOCSIS-CPE-TYPE\_3.5.1-A.2.xsd

```

<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE-
TYPE"
  xmlns:DOCSIS-CPE-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE-TYPE"
  xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
  xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
  xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
  xmlns:DOCSIS-
CPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE"
  xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
  version="3.5.1-A.2" elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
  <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
  <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CM/DOCSIS-CM_3.5.1-A.1.xsd"/>
  <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
  <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CPE" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CPE/DOCSIS-CPE_3.5.1-A.2.xsd"/>
  <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">

```

<sup>402</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 and per OSSIV3.0-N-10.0937-4 on 9/24/10 by JB.

```

<annotation>
    <documentation>Import auxiliary schemas
    for global element references.</documentation>
</annotation>
</include>
<annotation>
    <documentation>DOCSIS-CPE-TYPE is an IPDR Service Definition
    schema defining the Customer Premise Equipment (CPE)
    Type IPDR data record which references the imported global elements.
    Revision History:
        3.5.1-A.1 Initial version.
        3.5.1-A.2 Revised version includes ECN
        OSSIV3.0-N-10.0914-3 and OSSIV3.0-N-10.0928-1 and published as I12.
    </documentation>
    <documentation>
        <ipdr:reference>
            DOCSIS 3.0 Operations Support System Interface Specification
            CM-SP-OSSIv3.0-I12-100611, Annex P.
        </ipdr:reference>
    </documentation>
</annotation>
<complexType name="CPE-TYPE">
    <complexContent>
        <extension base="ipdr:IPDRType">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                <element ref="DOCSIS-CMTS:CmtsMdIfName" />
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                <element ref="DOCSIS-CM:CmMacAddr" />
                <element ref="DOCSIS-REC:RecType" />
                <element ref="DOCSIS-CPE:CpeMacAddr" />
                <element ref="DOCSIS-CPE:CpeIpv4AddrList" />
                <element ref="DOCSIS-CPE:CpeIpv6AddrList" />
                <element ref="DOCSIS-CPE:CpeFqdn" />
            </sequence>
        </extension>
    </complexContent>
</complexType>
</schema>

```

## R.8 CMTS Utilization Statistics Service Definition Schema<sup>403</sup>

The section defines the IPDR Service Definition schemas for the CMTS utilization statistics.

### R.8.1 CMTS Utilization Attribute List <sup>404</sup>

A DOCSIS CMTS Utilization Statistics IPDR record is constructed from a number of attributes that describe the IPDR itself, the CMTS, the CMTS MAC Domain, a channel identifier, and the upstream or downstream utilization attributes and counters. The attributes are defined in Annex C.

The following CMTS attributes are included in the CMTS Utilization Statistics IPDR record:

- CmtsHostName
- CmtsSysUpTime
- CmtsMdIfIndex

<sup>403</sup> Section added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN. Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

<sup>404</sup> Revised per OSSIV3.0-N-10.0914-3 on 5/20/10 and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

The following IPDR record attributes are included in the CMTS Utilization Statistics IPDR record:

- RecType

The following attributes are specific to the CMTS upstream logical interfaces and are included in the CMTS Upstream Utilization Statistics IPDR record:

- UsIfIndex
- UsIfName
- UsChId
- UsUtilInterval
- UsUtilIndexPercentage
- UsUtilTotalMslots
- UsUtilUcastGrantedMslots
- UsUtilUsedCtnMslots
- UsUtilCollCtnMslots
- UsUtilTotalCtnMslots
- UsUtilTotalCtnReqMslots
- UsUtilUsedCtnReqMslots
- UsUtilCollCtnReqMslots
- UsUtilTotalCtnReqDataMslots
- UsUtilUsedCtnReqDataMslots
- UsUtilCollCtnReqDataMslots
- UsUtilTotalCtnInitMaintMslots
- UsUtilUsedCtnInitMaintMslots
- UsUtilCollCtnInitMaintMslots

The following attributes are specific to the CMTS downstream interfaces and are included in the CMTS Downstream Utilization Statistics IPDR record:

- DsIfIndex
- DsIfName
- DsChId
- DsUtilInterval
- DsUtilIndexPercentage
- DsUtilTotalBytes
- DsUtilUsedBytes

#### R.8.2 DOCSIS-CMTS-US-UTIL-STATS-TYPE\_3.5.1-A.3.xsd<sup>405</sup>

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema">
```

<sup>405</sup> Revised per OSSIV3.0-N-10.0914-3 on 5/20/10 by JB. Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB. Revised per OSSIV3.0-N-12.1062-3 on 7/27/12 by JS.

```

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
US-UTIL-STATS-TYPE"
    xmlns:DOCSIS-CMTS-US-UTIL-STATS-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL-
STATS-TYPE"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
            xmlns:DOCSIS-CMTS-US-
UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL"
                xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
                        version="3.5.1-A.2" attributeFormDefault="unqualified"
elementFormDefault="qualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-US-UTIL"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
US-UTIL/DOCSIS-CMTS-US-UTIL_3.5.1-A.3.xsd"/>
    <import namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <annotation>
        <documentation>
            DOCSIS-CMTS-US-UTIL-STATS-TYPE is an IPDR Service
Definition Schema that defines upstream utilization
statistics for a specified upstream logical channel
interface for the specified CMTS.
            Revision History:
                3.5.1-A.1 Initial version.
                3.5.1-A.2 Revised version includes ECN
OSSIv3.0-N-10.0914-3 and OSSIv3.0-N-10.0928-1 and published as I12.
                3.5.1-A.3 Revised version includes ECN
OSSIv3.0-N-10.0968-2 and published as I14.
                3.5.1.A.4 Revised version includes ECN
OSSIv3.0-N-12.1062-3 and published as I19.
        </documentation>
        <documentation>
            <ipdr:reference>
                DOCSIS 3.0 Operations Support System Interface Specification
                CM-SP-OSSIv3.0-I19-120809, Annex O.
            </ipdr:reference>
        </documentation>
    </annotation>
<complexType name="CMTS-US-UTIL-STATS-TYPE">
    <complexContent>
        <annotation>
            <documentation>
                This IPDR record contains utilization statistics
for a specified upstream logical channel interface
on a specified CMTS.
            </documentation>
        </annotation>
        <extension base="ipdr:IPDRTypE">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
            </sequence>
        </extension>
    </complexContent>
</complexType>

```

```

<element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
<element ref="DOCSIS-CMTS-US-UTIL:UsIfIndex" />
<element ref="DOCSIS-CMTS-US-UTIL:UsIfName" />
<element ref="DOCSIS-CMTS-US-UTIL:UsChId" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilInterval" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilIndexPercentage" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilTotalMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilUcastGrantedMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilCollCtnMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnReqMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnReqMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilCollCtnReqMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnReqDataMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnReqDataMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilCollCtnReqDataMslots" />
<element ref="DOCSIS-CMTS-US-
UTIL:UsUtilTotalCtnInitMaintMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnInitMaintMslots" />
<element ref="DOCSIS-CMTS-US-UTIL:UsUtilCollCtnInitMaintMslots" />
<element ref="DOCSIS-REC:RecType" />
</sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

### R.8.3 DOCSIS-CMTS-DS-UTIL-STATS-TYPE\_3.5.1-A.3.xsd<sup>406</sup>

```

<
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
DS-UTIL-STATS-TYPE"
      xmlns:DOCSIS-CMTS-DS-UTIL-STATS-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL-
STATS-TYPE"
      xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
      xmlns:DOCSIS-CMTS-DS-
UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL"
      xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
      xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
      version="3.5.1-A.2" attributeFormDefault="unqualified"
elementFormDefault="qualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd" />
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-
UTIL" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-DS-UTIL/DOCSIS-CMTS-DS-UTIL_3.5.1-A.3.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"

```

<sup>406</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB. Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

```

schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
<annotation>
    <documentation>
        DOCSIS-CMTS-DS-UTIL-STATS-TYPE is an IPDR Service
        Definition Schema that defines downstream utilization
        statistics for a specified downstream interface for the
        specified CMTS.
        Revision History:
        3.5.1-A.1 Initial version.
        3.5.1-A.2 Revised version includes ECN
        OSSIV3.0-N-10.0914-3 and OSSIV3.0-N-10.0928-1 and published as I12.
        3.5.1-A.3 Revised version includes ECN
        OSSIV3.0-N-10.0968-2 and published as I14.
    </documentation>
    <documentation>
        <ipdr:reference>
            DOCSIS 3.0 Operations Support System Interface Specification
            CM-SP-OSSIv3.0-I14-110210, Annex O.
        </ipdr:reference>
    </documentation>
</annotation>
<complexType name="CMTS-DS-UTIL-STATS-TYPE">
    <complexContent>
        <annotation>
            <documentation>
                This IPDR record contains utilization statistics
                for a specified downstream interface on a specified
                CMTS.
            </documentation>
            </annotation>
            <extension base="ipdr:IPDRTypE">
                <sequence>
                    <element ref="DOCSIS-CMTS:CmtsHostName" />
                    <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                    <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsIfIndex" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsIfName" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsChId" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsUtilInterval" />
                    <element ref="DOCSIS-CMTS-DS-
UTIL:DsUtilIndexPercentage" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsUtilTotalBytes" />
                    <element ref="DOCSIS-CMTS-DS-UTIL:DsUtilUsedBytes" />
                    <element ref="DOCSIS-REC:RecType" />
                </sequence>
            </extension>
        </complexContent>
    </complexType>
</schema>

```

## R.9 CMTS CM Service Flow Definition Schema<sup>407</sup>

This section defines the IPDR Service Definition schemas for CMTS CM Service Flow information defined in Annex C.

### R.9.1 DOCSIS-CMTS-CM-SERVICE-FLOW\_3.5.1-A.1.xsd

```
<?xml version="1.0" encoding="UTF-8"?>
```

---

<sup>407</sup> Revised per OSSIV3.0-N-10.0923-5 on 9/23/10 by JB. Revised per OSSIV3.0-N-10.0967-3 on 1/21/11 by JB.

```
<schema xmlns="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-SERVICE-FLOW-TYPE"
    xmlns:DOCSIS-CMTS-CM-SERVICE-FLOW-
TYPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-SERVICE-
FLOW-TYPE" xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS" xmlns:DOCSIS-
SERVICE-FLOW="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SERVICE-
FLOW"
        xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS/DOCSIS-CMTS_3.5.1-A.1.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
QOS/DOCSIS-QOS_3.5.1-A.1.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SERVICE-
FLOW" schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SERVICE-FLOW/DOCSIS-SERVICE-FLOW_3.5.1-A.1.xsd"/>
    <import
namespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
REC/DOCSIS-REC_3.5.1-A.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd">
        <annotation>
            <documentation>Import auxiliary schemas
for global element references.</documentation>
        </annotation>
    </include>
    <annotation>
        <documentation>DOCSIS-CMTS-CM-SERVICE-FLOW is an IPDR Service Definition
schema defining details of service flows.
Revision History:
3.5.1-A.1 Initial version.</documentation>
        <documentation>
            <ipdr:reference>DOCSIS 3.0 Operations Support System Interface
Specification CM-SP-OSSIv3.0-I13-101008, Annex R.</ipdr:reference>
        </documentation>
    </annotation>
<complexType name="CMTS-CM-SERVICE-FLOW-TYPE">
    <complexContent>
        <extension base="ipdr:IPDRTYPE">
            <sequence>
                <element ref="DOCSIS-CMTS:CmtsHostName" />
                <element ref="DOCSIS-CMTS:CmtsSysUpTime" />
                <element ref="DOCSIS-CMTS:CmtsMdIfName" />
                <element ref="DOCSIS-CMTS:CmtsMdIfIndex" />
                <element ref="DOCSIS-REC:RecType" />
                <element ref="DOCSIS-REC:RecCreationTime" />
                <element ref="DOCSIS-QOS:ServiceFlowChSet" />
                <element ref="DOCSIS-QOS:ServiceAppId" />
                <element ref="DOCSIS-QOS:ServiceDsMulticast" />
                <element ref="DOCSIS-QOS:ServiceIdentifier" />
    </extension>
</complexContent>
</complexType>
```

```

<element ref="DOCSIS-QOS:ServiceGateId" />
<element ref="DOCSIS-QOS:ServiceClassName" />
<element ref="DOCSIS-QOS:ServiceDirection" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceTrafficPriority" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceMaxSustained" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceMinReservedRate" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceMinReservedPktSize" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceNomPollInterval" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceTolPollJitter" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceNomGrantInterval" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceTolGrantJitter" />
<element ref="DOCSIS-SERVICE-
FLOW:ServiceGrantsPerInterval" />
<element ref="DOCSIS-SERVICE-
FLOW:ServicePacketClassifiers" />
<sequence>
<element ref="DOCSIS-QOS:ServiceTimeCreated" />
</sequence>
</extension>
</complexContent>
</complexType>
</schema>

```

## R.10 IP Multicast Statistics Service Definition Schema<sup>408</sup>

The section defines the IPDR Service Definition schemas for the IP Multicast Statistics.

### R.10.1 IP Multicast Statistics Attribute List

A DOCSIS IP Multicast Statistics IPDR record is constructed from a number of attributes that describe the IPDR itself, the CMTS, the CMTS MAC Domain, a channel identifier, and the upstream or downstream utilization attributes and counters. The attributes are defined in Annex C.

The following CMTS attributes are included in the IP Multicast Statistics IPDR record:

- CmtsHostName
- CmtsMdIfIndex

The following CM attributes are included in the IP Multicast Statistics IPDR record:

- CmMacAddr

The following IPDR record attributes are included in the IP Multicast Statistics IPDR record:

- RecType
- RecCreationTime

---

<sup>408</sup> Section added per OSSlv3.0-N-14.1151-2 on 7/15/14 by PO.

The following attributes are specific to the IP Multicast session and are included in the IP Multicast Statistics IPDR record:

- Source Address
- Group Address
- Group Service Flow Id
- Downstream Service ID (DSID)
- Session Protocol Type
- CPE MAC Address List
- Join Time
- Leave Time

### R.10.2 DOCSIS-IP-MULTICAST-STATS-TYPE\_3.5.1-A.1.xsd<sup>409</sup>

```
<?xml version="1.0" encoding="UTF-8"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"

targetNamespace="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-
MULTICAST"
    xmlns:DOCSIS-
CPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST"
        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" version="3.5.1-A.1"
elementFormDefault="qualified" attributeFormDefault="unqualified">
    <import namespace="http://www.ipdr.org/namespaces/ipdr"
schemaLocation="http://www.ipdr.org/public/IPDRDoc3.5.1.xsd"/>
    <include schemaLocation="http://www.ipdr.org/public/IPDRTypes.xsd"/>
    <annotation>
        <documentation>DOCSIS-IP-MULTICAST_3.5.1-A.1 is an auxiliary schema
            which defines IP Multicast information.
            Revision History:
            3.5.1-A.1 Initial version.
        </documentation>
        <documentation>
            <ipdr:reference>Data-Over-Cable Service Interface Specifications: Operations
                Support System Interface Specification CM-SP-OSSIv3.0-I24-240729, Annex C.
            </ipdr:reference>
        </documentation>
    </annotation>
    <element name="IpMcastSrcIpv4Addr" type="ipdr:ipV4Addr">
        <annotation>
            <documentation>Contains the value of the IPv4 address of 'S' as the source
                address for a particular (S,G) IP multicast session. For the case of Any
                Source Multicast (ASM), this attribute reports a value of
0.0.0.0.</documentation>
        </annotation>
    </element>
    <element name="IpMcastSrcIpv6Addr" type="ipdr:ipV6Addr">
        <annotation>
            <documentation>Contains the value of the IPv6 address of 'S' as the source
                address for a particular (S,G) IP multicast session. For the case of Any
                Source Multicast (ASM), this attribute reports a value of
0::/0.</documentation>
        </annotation>
    </element>
    <element name="IpMcastGrpIpv4Addr" type="ipdr:ipV4Addr">
```

<sup>409</sup> Schema added per OSSIV3.0-N-14.1151-2 on 7/15/14 by PO.

```

<annotation>
    <documentation>Contains the value of the IPv4 address of 'G' as the group
    address for a particular (S,G) IP multicast session.</documentation>
</annotation>
</element>
<element name="IpMcastGrpIpv6Addr" type="ipdr:ipV6Addr">
    <annotation>
        <documentation>Contains The value of the IPv6 address of 'G' as the group
        address for a particular (S,G) IP multicast session.</documentation>
    </annotation>
</element>
<element name="IpMcastGsfd" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of the Group Service Flow Id. This
element
is associated with the ServiceIdentifier element from the SAMIS-TYPE-1 and
SAMIS-TYPE-2 Service Definition Schemas.</documentation>
    </annotation>
</element>
<element name="IpMcastDsid" type="unsignedInt">
    <annotation>
        <documentation>Contains the value of the Downstream Service ID (DSID)
label
with which the CMTS labels all packets of a particular (S,G) IP multicast
session.</documentation>
    </annotation>
</element>
<element name="IpMcastSessionProtocolType">
    <annotation>
        <documentation>Contains the value of the type of IP multicast session
        (IGMP, MLD or PIM).</documentation>
    </annotation>
    <simpleType>
        <restriction base="integer">
            <enumeration value="0">
                <annotation>
                    <documentation>
<ipdr:enumMeaning>reserved</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="1">
                <annotation>
                    <documentation>
<ipdr:enumMeaning>IGMP</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
            <enumeration value="2">
                <annotation>
                    <documentation>
<ipdr:enumMeaning>MLD</ipdr:enumMeaning>
                    </documentation>
                </annotation>
            </enumeration>
        </restriction>
    </simpleType>
</element>
<element name="IpMcastCpeMacAddrList" type="hexBinary">
    <annotation>

```

```
<documentation>The value of the list of CPE MAC addresses joining the  
(S,G) IP multicast session. The associated CPE IPv4 and IPv6 address  
information can be obtained with the CPE-TYPE Service Definition  
Schema.</documentation>  
</annotation>  
</element>  
<element name="IpMcastJoinTime" type="ipdr:dateTimeMsec">  
<annotation>  
<documentation>The value of the UTC time stamp "yyyy-mm-ddThh:mm:ssZ"  
at the time the IP multicast JOIN request from this CPE for this multicast  
session was processed by the CMTS. The compact representation of this  
attribute is the 64-bit Long value of milliseconds since Epoch  
Time.</documentation>  
</annotation>  
</element>  
<element name="IpMcastLeaveTime" type="ipdr:dateTimeMsec">  
<annotation>  
<documentation>The value of the UTC time stamp "yyyy-mm-ddThh:mm:ssZ"  
at the time the "LeaveMulticastSession" request from this CPE for this  
multicast session was processed by the CMTS or the CMTS determines that  
this CPE has left the IP multicast session. The compact representation of  
this attribute is the 64-bit Long value of milliseconds since Epoch Time.  
If the multicast session is active (i.e. the CMTS has yet to determine  
that  
the CPE has left the IP multicast session) when this record is generated,  
the compact representation of the IpMcastLeaveTime value MUST be set  
to 0.</documentation>  
</annotation>  
</element>  
</schema>
```

## **Appendix I      Business Process Scenarios For Subscriber Account Management (Informative)**

In order to develop a Subscriber Account Management Policy, it is necessary to consider high-level business processes common to cable operators and the associated operational scenarios. The following definitions represent a generalized view of key processes involved. It is understood that business process terminology varies among different cable operators, distinguished by unique operating environments and target market segments.

For the purpose of this specification, Subscriber Account Management refers to the following business processes and terms:

- Quality of Service Provisioning Processes, which are intrinsic to the automatic, dynamic provisioning and enforcement of subscribed policy-based service level agreements (SLAs)
- Usage-Based and Flat-Rate Billing Processes, which are involved in the processing of bills based on services rendered to and consumed by the paying subscriber

### **I.1      The Current Service Model: "One Traffic Class" and "Best Effort"**

The Internet strives to be an egalitarian society of sorts, where all Internet Protocol (IP) packets are treated reasonably equally. Given that all IP packets have approximately equal right-of-way over the Internet, it is a largely "first-come, first-served" type of service level arrangement. Such traffic parameters as response time and packet delivery are on a "best effort" basis only.

Unfortunately, while all IP packets are theoretically equal, certain classes of IP packets may need to be processed differently under certain conditions. When transmitting data packets, traffic congestion can cause unpredictable delays, packet loss and resulting customer frustrations with the service offering. However, in a convergent IP internetwork where best effort data packets are intermixed with those having delay, jitter or loss sensitivities, such as voice and streaming video, "best effort only" quality levels may be insufficient when the network becomes congested. While the addition of QoS to the service portfolio does mitigate some of these issues while the network is under stress, care must be taken in the design of the QoS policies given the added complexity in operating the network and the risk of over engineering the QoS architecture and under engineering capacity.

Certain applications require more guarantees than others and need to be carefully chosen before investing the time, effort and capital expense to architect network service level guarantees. QoS policies do not obviate the necessity of proper capacity planning and trend analysis in network behavior. QoS only allows a contingency plan for a very small number of flows for specific applications to be forwarded with acceptable performance metrics even when network capacity is largely consumed.

### **I.2      The Current Billing Model: "Flat Rate" Billing**

As DOCSIS services evolve from "dumb" pipes and best effort service delivery to more application-centric and customer-centric models, serious consideration must be given to the flexibility of the billing model. There will be scenarios where a fixed rate, flat fee is appropriate to the profile of the customer and the service being offered, while at other times it is more appropriate for both the operator and customer alike to operate on a usage based model. No single billing model will suite all customer or service profiles.

### **I.3      Flow Through Dynamic Provisioning**

"Back Office" usage-based accounting and subscriber billing is an increasingly important competitive differentiator in the emerging application-oriented data services. A customer may be provisioned to obtain an initial service profile a best effort data service at a given upstream and downstream speed (as is the case today in most operators). Classification of the customers traffic, however, may reveal certain trends and applications which might be better suited, for either the operator (for capacity management) or for the customer (for performance) to be provisioned dynamically to address the unique requirements of the customer's application traffic flows. For the purposes of simplification of the marketing of such advanced services, the "package" might contain a list of applications for which special treatment can be given as a value-add to boost the customer's experience. However, the enhancement of one application can render the performance of another less prioritized application to perform quite poorly.

### I.3.1 Integrating "front end" processes seamlessly with "back office" functions

A long-standing business axiom states that accountability exists only with the right measurements; business prospers only with the proper management of information. An effective subscriber account management strategy for DOCSIS ought to meet three (3) major requirements:

#### Automatic & Dynamic Flow-Through Provisioning

The first requirement is to integrate service orders through the billing system with provisioning of the CM with an appropriate initial profile and subsequently manage all services dynamically based on the session and application requirements, but within the limitations of the available channel capacity.

#### Semi-Guaranteed and Guaranteed Quality of Service

The second requirement is to offer differentiated classes of service for the subscriber's various applications, such as varying bit rates and performance guarantees to maintain a particular service level associated with that application or class and provision for minimum sustained, maximum sustained and burst capacity allocation.

#### Data Collection, Warehousing & Usage Billing

The third requirement is to capture a subscriber's actual usage patterns and calculate the bill based on the rate associated with the customer's subscribed service levels. The operator will also compare the service guarantees for the subscriber's traffic against the service level to which the customer has subscribed and if necessary (as with a true guarantee), adjust the rate on the bill to reflect an outage or packet loss in excess of the customer's service level agreement.

### I.3.2 Designing Classes of Service By Customer Type and Application

Designing the service classes leads directly to the intrinsic characteristics of the service offerings. While flexibility in service class definitions and their attendant billing models provides the customer with more choices, care must be taken to avoid undue complexity. The more varied and sophisticated the service classes, the more complex the packaging and communication of the service's attributes and limitations to customers in addition to complexities inherent in implementing such service classes into the operators' OSS/BSS systems. When designing different classes of service offerings, a cable operator might consider the following:

- Customer category, such as business vs. residential
  - Business/small office/home office accounts have a few overlapping and a few unique characteristics that might benefit from being separate classes in at least some markets along attributes such as capacity, time of day, Virtual Private Network services, pricing and bundling. A residential customer can be a business user by day and a purely residential customer by night, for example.
- Guaranteed and semi-guaranteed service levels for a particular application, such as for an operator provided voice or video conferencing service or a higher service level for data services. This class could be added to any customer profile alone or in combination with other classes.
- By time of day and/or day of week, as with customers who telecommute, splitting the bill between the subscriber and the subscriber's employer or employee service aggregator. Like the other classes of service, this class could be added alone or in combination with other classes onto any customer profile.
- "On Demand" as ordered or scheduled, including such operator promotions as a free high-tier try-out, which can be added to any customer profile alone or in combination with other classes.

#### I.3.2.1 Examples of Service Profiles

Service profiles define the characteristics of the CM configuration file (either static or dynamically generated by the provisioning server) and have the following characteristics:

- Either a specific upstream/downstream or a profile with unlimited upstream/downstream bit rate. The unlimited profile has certain benefits in terms of dynamic application of classes on top of the underlying profile. With classification controlling user experience and capacity, all CMs in the operator's network could, in theory, use exactly the same "uncapped" CM profile with the classes of service (a QoS application with or without guarantees) defining the actual service attributes such as speed, delivery and application prioritization.

- Commercial Small Business profile with or without upstream/downstream bandwidth limitations
- Residential Premium profile with or without upstream/downstream bandwidth limitations
- Residential Standard profile with or without upstream/downstream bandwidth limitations
- Configure the characteristics of the default primary service flow (assumes DOCSIS 1.1 or higher notion of QoS profiles), this is usually a best effort flow used by all unclassified traffic

### ***I.3.2.2 Classes of Service Examples***

Classes of service define the guaranteed and non-guaranteed bit rate, latency, jitter, packet loss granted to a particular Service Flow using DOCSIS QoS mechanisms. In particular, the use of these mechanisms to provide non-guaranteed variable bit rate services for data traffic (by setting a relatively low minimum sustained rate, a fairly low maximum sustained rate and a very high burst rate) provide opportunities to differentiate service without the cumbersome requirements of true bandwidth reservations, latency, jitter and packet loss. Such types of strict guarantees are best suited to applications that may require them during network congestion, such as VoIP.

The benefits to a strong commercial strategy include maximizing the use of network capacity during the residential off-peak hours. A large percentage of commercial customers can help flatten the typical off-peak to on-peak traffic rates in which on-peak is often observed to be three to four times higher than off-peak. Commercial customers primarily generate traffic during residential off-peak, rendering the overall network utilization relatively flat due to orthogonal customer class usage patterns.

The following is a sample of service classes that overlay the common service profile. These classes are mostly of an unguaranteed bit rate or packet delivery quality and heavily biased towards burst rates:

- Platinum Service for Business Accounts  
Business accounts subscribing to this service are guaranteed a minimum sustained data rate downstream of 6 Mbit/s, a sustained maximum downstream data rate of 15 Mbit/s and if excess channel or bonding group capacity is available, the customer is allowed to burst to 35 Mbit/s. The minimum sustained upstream data rate of 3 Mbit/s, a sustained maximum upstream rate of 10 Mbit/s and if channel or bonding group capacity is available, a burst of up to 25 Mbit/s (bursts will be between 250 ms to 750 ms duration, longer than the other classes).
  - PacketCable VoIP protocols are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue to reduce latency and jitter. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit symmetric per call session)
    - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line emergency phone service replacement
  - Layer 2 VPNs terminating within the operator are prioritized below voice services but above unclassified data traffic. Layer 3 VPNs operated by the customer are treated as normal, undifferentiated traffic
- Platinum Service for Residential Accounts  
Residential accounts subscribing to this service are guaranteed a minimum sustained data rate of 6 Mbit/s, a sustained maximum downstream rate of 13 Mbit/s and if excess channel or bonding group capacity is available, the customer is allowed to burst to 30 Mbit/s. The minimum sustained upstream data rate is 1.5 Mbit/s, a sustained maximum upstream rate of 8 Mbit/s and if channel or bonding group capacity is available, a burst of up to 25 Mbit/s (a short burst is defined as 250-500 ms duration).
  - PacketCable MGCP and SIP protocols are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue to reduce latency and jitter. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit symmetric per call session)
    - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line phone replacement
  - Layer 2 VPNs terminating within the operator are prioritized below voice services but above unclassified data traffic. Layer 3 VPNs operated by the customer are treated as normal, undifferentiated traffic.

- P2P traffic will be prioritized over unclassified data traffic within the customer's capacity allocation with further proxy and redirect functions controlling which nodes are visible to the P2P client software.
- Gold Service for SOHO Accounts

On a time of day basis, this class will receive different levels of service with regards to bit rates and prioritization. During business hours between 6:00 AM and 5:00 PM, this class receives a 5 Mbit/s minimum sustained downstream data rate, a maximum sustained downstream data rate of 8 Mbit/s and a burst rate of up to 25 Mbit/s. The minimum sustained upstream data rate of 1 Mbit/s, a sustained maximum upstream rate of 6 Mbit/s and if channel or bonding group capacity is available, a burst of up to 25 Mbit/s.

  - PacketCable MGCP and SIP protocols are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue to reduce latency and jitter. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit symmetric per call session)
    - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line phone replacement
  - Video conferencing through H.323 is prioritized above L2 VPN traffic, below SIP/MGCP traffic and above all unclassified data traffic.
  - Layer 2 VPNs terminating within the operator are prioritized below voice services but above unclassified data traffic. Layer 3 VPNs operated by the customer are treated as normal, undifferentiated traffic.
  - During residential peak-time between 5:00 PM and 6:00 AM, this class receives a 4 Mbit/s minimum sustained downstream data rate, a maximum sustained downstream data rate of 7 Mbit/s and a burst rate of up to 25 Mbit/s. The minimum sustained upstream data rate of 768 Kbit/s, a sustained maximum upstream rate of 5 Mbit/s and if channel or bonding group capacity is available, a burst of up to 25 Mbit/s.
    - PacketCable MGCP and SIP protocols are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue to reduce latency and jitter. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit symmetric per call session).
      - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line phone replacement
    - P2P traffic will be prioritized over unclassified data traffic within the customer's capacity allocation with further proxy and redirect functions controlling which nodes are visible to the P2P client software.
- Silver Service for Residential Accounts

This class receives a minimum sustained downstream data rate of 2 Mbit/s and a maximum sustained downstream data rate of 6 Mbit/s and a burst rate of up to 16 Mbit/s if sufficient capacity exists in the channel or bonding group. A minimum sustained upstream data rate of 512 Kbit/s, a sustained maximum upstream rate of 2 Mbit/s and if channel or bonding group capacity is available, a burst of up to 16 Mbit/s.

  - PacketCable MGCP and SIP are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit per call session)
    - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line phone replacement
  - P2P traffic will be prioritized over unclassified data traffic within the customer's capacity allocation with further proxy and redirect functions controlling which nodes are visible to the P2P client software.
- "On Demand"

This class of "on demand" service allows a subscriber to request additional bandwidth available for a specific period of time. For example, a subscriber can go to an operator's web site and request increased bandwidth service levels from his registered subscribed class of service from their currently subscribed rate to a maximum upstream/downstream data rate of 25 Mbit/s upstream by 35 Mbit/s downstream between the hours of 2 PM to 4 AM of the following day, after which the customer's subscribed service level will return to its original service level. The provisioning server will check the scheduled bandwidth commitments and utilization history to decide whether such "on demand" services can be granted, or assign a lower bandwidth commitment, informs the customer via the website scheduling engine and set the adjusted commitment for the requested time.

- PacketCable VoIP protocols are prioritized, with each allocated up to 384 Kbit symmetric bit rate with prioritization through the queue. 384 Kbit bi-directional assumes an uncompressed G.711 codec and a three-way call (192Kbit per call session)
  - E-911 calls are prioritized above all traffic except management traffic to ensure that the service is suitable for primary line phone replacement
- P2P traffic will be prioritized over unclassified data traffic within the customer's capacity allocation with further proxy and redirect functions controlling which nodes are visible to the P2P client software.

Many service classes can co-exist on a single account service profile. Service classes can be dynamically applied (added, changed or removed) and the control applied layer 3 through layer 7 (the IP network through application layer) and not in the DOCSIS configuration file (service profile) as is commonplace today. The underlying service profile is often best configured as an "uncapped" service with the only limit being the available capacity of the channel or bonding group and a simple best effort service level.

The classes themselves provide additional refinement as to the upper, lower and burst quotas to police the bit rates, with application-specific QoS applied to such services as operator provided/partnership provided VoIP, video conferencing or customer controlled applications such as P2P.

Session based QoS for specific applications (must be known in advance, it is not possible to dynamically configure QoS for applications of unknown characteristics and requirements) can provide incremental revenue as an add-on to the basic High Speed Internet service, or be "bundled" with the service as a value-add. While the customer satisfaction with these approaches has the potential to be very high, it is important to weigh the benefits and manage the complexity of these services through both phased introduction and care in the crafting of the marketing message in support of such services.

### I.3.3 Usage-Based Billing

A complete billing solution involves the following processes:

- A matrix of billing options appropriate to the services being offered
  - Usage based H.S.I. services
    - Session based services, such as special application delivery/quality guarantees
    - Scheduled (On-Demand) data rate adjustments
    - 95th percentile burstable rate billing
  - Capture and manage subscriber account and service subscription information
  - Estimate future usage based on past history
  - Collect billable event data
  - Generate and rate billing records
  - Calculate, prepare and deliver bill
  - Flat rate billing for simple services and service profiles
- Process and manage bill payment information and records
- Handle customer account inquiries
- Manage debt and fraud

### I.3.4 Designing Simple Usage-Based Billing Models

In support of the offering of different classes of service is a new set of billing processes, which are based on the accounting of actual usage of subscribed service by each subscriber calculated by the associated fee structures.

There are several alternatives to implementing usage-based billing. The following offers a few examples:

- **Billing Based on an Average Bandwidth Usage**

The average bandwidth usage is defined as the total octets transmitted divided by the billing period. This type of accounting does not fully take into account burst rates above the average rate and can cause the bill to fluctuate more than the 95th percentile approach.

- **Billing Based on Peak Bandwidth Usage**

The peak bandwidth usage is the highest bandwidth usage sample during the entire billing period. Each usage sample is defined as the average bandwidth usage over a data collection period (typically 10 minutes). Since it is usually the peak usage pattern that creates the highest possibility of access problems for the cable operator, therefore, it is reasonable to charge for such usage. One scheme of peak usage billing referred to as "95 percentile billing". The process is as follows: At the end of each billing period, the billing software examines the usage records of each subscriber and it "throws away" the top five percent of usage records of that period, then charges the subscriber on the next highest bandwidth usage.

- "Flat Monthly Fee", Plus Usage Billing Based on the Class of Service Subscribed

Any usage beyond the minimum guaranteed bandwidth for that particular subscriber service class is subject to an extra charge based on the number of bytes transmitted.

- **Billing for "On Demand" Service**

This special billing process is to support the "On Demand" Service offering described in the above sections.

#### I.4 Conclusions

There is no single billing model that is appropriate for all services or all customer classes. The type of service being delivered (the service class); the pricing of that service and the target customer will dictate the most effective model for approaching the ideal compromise.

## **Appendix II      Summary of CM Authentication and Code File Authentication (Informative)**

The purpose of this appendix is to provide the overview of the two authentication mechanisms defined by the DOCSIS 3.0 Security specification [SEC] as well as to provide an example of the responsibility assignment for actual operation but not to add any new requirements for the CMTS or the CM. Please refer to [SEC] regarding the requirement for the CMTS and the CM.

### **II.1      Authentication of the CM**

When the CM is required to run EAE or BPI+, the CMTS authenticates the CM by verifying the CM Device certificate and the manufacturer CA certificate. These certificates are contained in the Auth Request and Auth Info packets respectively, and are sent to the CMTS by the CM. Only CMs with valid certificates will be authorized by the CMTS.

#### **II.1.1      Responsibility of the DOCSIS Root CA**

The DOCSIS Root CA is responsible for the following:

- Storing the DOCSIS Root private key in secret
- Maintaining the DOCSIS Root CA certificate
- Issuing manufacturer CA certificates (centralized or distributed) which are signed by the DOCSIS Root CA
- Maintaining the CRL of the manufacturer CA
- Providing the operators with the CRL

The DOCSIS Root CA or CableLabs is likely to put the DOCSIS Root CA on their Web or Config File server to let the operators (or the CMTS, on behalf of the operator) download it.

#### **II.1.2      Responsibility of the CM manufacturers**

The CM manufacturers are responsible for the following:

- Storing the manufacturer CA private key in secret
- If using the "Distributed Model" manufacturers maintain their manufacturer CA certificate. The manufacturer CA certificate is usually signed by the DOCSIS Root CA, but can be self-signed until the DOCSIS Root CA issues it based on the CableLabs policy.
- If using the "Distributed Model" manufacturers issue their CM certificates
- Putting the manufacturer CA certificate in the CM's software
- Putting each CM certificate in the CM's secure non-volatile memory
- Providing the operators with revocation status of CM certificates. This may be in CRL format. However, the detail of the format and the method of delivery are TBD.

#### **II.1.3      Responsibility of the operators**

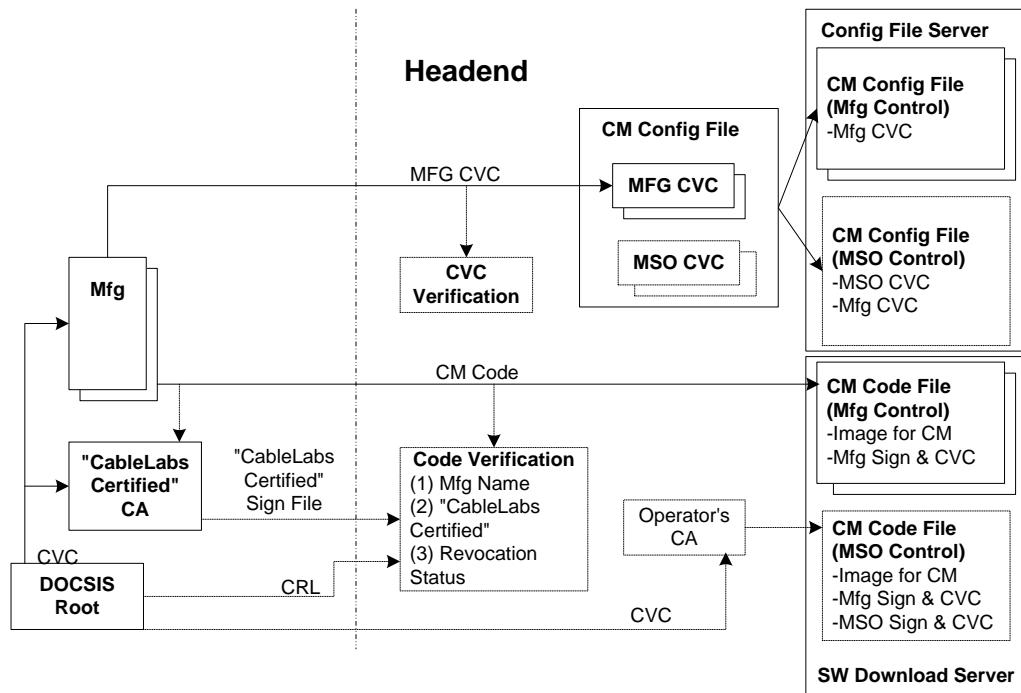
The operators are responsible for the following:

- Maintaining that the CMTSs have an accurate date and time. If a CMTS has a wrong date or time, the invalid certificate may be authenticated or the valid certificate may not be authenticated.
- Putting the DOCSIS Root CA certificate in the CMTS during the CMTS provisioning using the BPI+ MIB or the CMTS's proprietary function. The operator may have a server to manage this certificate for one or more CMTS(s).

- Putting the manufacturer CA certificate(s) in the CMTS during the CMTS provisioning using the BPI+ MIB or the CMTS's proprietary function (optional). The operator may have a server to manage this certificate for one or more CMTSs.
- Maintaining the status of the certificates in the CMTSs if desired using the BPI+ MIB or the CMTS's proprietary function (optional). The operator may have a server to manage all the status of the certificates recorded in one or more CMTSs.
- The operator may have a server to manage the DOCSIS Root CA certificate, manufacturer CA certificate(s) and also the status of the certificates recorded in one or more CMTSs.
- Maintaining a certificate revocation server (CRL or OCSP) for the CMTS based on the CRLs provided by the DOCSIS Root CA and the manufacturer CAs (optional).

## II.2 Authentication of the code file for the CM<sup>410</sup>

When a CM downloads a code file from a Software Download server, the CM must authenticate the code file as defined in [SEC]. The CM installs the new image and restarts using it only if verification of the code image was successful (as defined in [SEC]). If authentication fails, the CM rejects the code file downloaded from the Software Download server and continues to operate using the current code. The CM performs a software download, whether initiated by the configuration file or SNMP, only if it was initialized with a valid CVC received in the CM configuration file. In addition to the code file authentication by the CM, the operators may authenticate the code file before they put it on the Software Download server. The following figure shows the summary of these mechanisms.



**Figure II-1 - Authentication of the code file for the CM**

### II.2.1 Responsibility of the DOCSIS Root CA

The DOCSIS Root CA is responsible for the following:

- Storing the DOCSIS Root private key in secret

<sup>410</sup> Section modified per OSSIV3.0-N-07.0581-2 on 1/29/08 by KN.

- Maintaining the DOCSIS Root CA certificate
- Issuing the code verification certificates (CVCs) for the CM manufacturers, for the operators, and for "CableLabs Certified™"
- The Root CA may maintain the CRL of the CVCs and provide it to the operators.

### **II.2.2 Responsibility of the CM manufacturer**

The CM manufacturers are responsible for the following:

- Storing the manufacturer CVC private key in secret
- Storing the DOCSIS Root CA certificate in the CM.
- Maintaining the manufacturer CVC ([SEC] only allows CVCs signed by the DOCSIS Root CA and does not accept self-signed CVCs)
- Generating the code file with the manufacturer's SW image, CVC and signature
- Providing the operators with the code file and the manufacturer CVC

### **II.2.3 Responsibility of CableLabs**

CableLabs is responsible for the following:

- Storing the "CableLabs Certified" CVC private key in secret
- Maintaining the "CableLabs Certified" CVC signed by the DOCSIS Root CA
- Issuing the "CableLabs Certified" signature file for the DOCSIS CM code file certified by CableLabs

### **II.2.4 Responsibility of the operators**

Operators have the following responsibilities and options:

- Verifying the manufacturer CVC and signature in the code file provided by the manufacturer prior to using it (optional). The code file may be rejected (not used to upgrade CMs) if the manufacturer signature or CVC is invalid.
- Checking if the code file provided by the CM manufacturer is "CableLabs Certified" by verifying the "CableLabs Certified" CVC and signature in the "CableLabs Certified" signature file against the code file before the operator loads the code file on the Software Download server (optional).<sup>411</sup>
- Maintaining the operator code signing agent (CSA) by storing the operator CVC private key in secret and maintaining the operator's (co-signer) CVC issued by the DOCSIS Root CA (optional)
- Generating the MSO-controlled code file by adding the operator's CVC and signature to the original code file provided by the CM manufacturer (optional)
- Checking if the CVC provided by the CM manufacturer is valid (optional)
- Putting the appropriate CVC(s) in the CM configuration file. In the case that the original code file is to be downloaded to the CMs, the CM configuration file must contain the valid CVC from the CM's manufacturer. In case that the operator-controlled code file is to be downloaded, the CM configuration file must contain the valid CVC of the operator and may contain the valid CVC from the CM manufacturer. If a CVC is not present the CM configuration file, or the CVCs that are present are invalid, the CM will not initiate a software download if instructed to via SNMP or the CM configuration file. Note that the CM may be registered and authorized by the CMTS and become operational regardless of whether the CM configuration file contains valid CVCs.

---

<sup>411</sup> Text modified per OSSIV3.0-N-07.0581-2 on 1/29/08 by KN.

## Appendix III DOCSIS IPDR Sample Instance Documents (Informative)

This appendix provides a sampling of the XML Instance Documents which conform to the corresponding DOCSIS IPDR Service Definition schemas defined in Annex R.

### III.1 Collector Aggregation

IPDRDoc is expected to be aggregated by the Collector with the IPDR/SP data streamed within the session start stop boundary.

### III.2 Schema Location

The schemaLocation attribute [W3 XSD1.0] is used to associate a XML Instance Document to a published schema XSD document.

The DOCSIS XML Schema location is defined and maintained by CableLabs as:

[http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/<Service-Definition-Schema>\\_3.5.1-A.1.xsd](http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/<Service-Definition-Schema>_3.5.1-A.1.xsd)

**Note:** The schema location is a Uniform Resource Location (URL) which points to the actual schema file.

### III.3 DIAG-LOG-TYPE

This section provides a sample XML Instance Document for the Diagnostic Log Service Definition, DIAG-LOG-TYPE and corresponding XML Schema DOCSIS-DIAG-LOG-TYPE\_3.5.1-A.2.xsd.

#### III.3.1 Use Case

The CMTS "cmts01.mso.com" logs an entry in its diagnostic log for the CM with MAC Address 00-09-36-A7-70-89 when the CM fails to register. The CM last registered at 9:15 on 06/04/2006. The registration trigger count has reached 3. The CM was originally added to the diagnostic log at 9:30 on 06/04/2006. The latest trigger occurred at 6:30 on 06/05/2006. The CMTS streams this information to a Collector as shown in the following instance document.

#### III.3.2 Instance Document <sup>412</sup>

```
<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
    LOG-TYPE"
    xmlns:DOCSIS-DIAG-
    LOG="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
    OCSIS-DIAG-LOG-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
        TYPE/DOCSIS-DIAG-LOG-TYPE_3.5.1-A.2.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.1">
    <ipdr:IPDR xsi:type="DIAG-LOG-TYPE">
        <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
        <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
        <DOCSIS-DIAG-LOG:LastUpdateTime>2006-06-05T06:30:00Z</DOCSIS-DIAG-
```

<sup>412</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

```

LOG:LastUpdateTime>
    <DOCSIS-DIAG-LOG:CreateTime>2006-06-04T09:30:00Z</DOCSIS-DIAG-LOG:CreateTime>
    <DOCSIS-DIAG-LOG:LastRegTime>2006-06-04T09:15:00Z</DOCSIS-DIAG-
LOG:LastRegTime>
    <DOCSIS-DIAG-LOG:RegCount>3</DOCSIS-DIAG-LOG:RegCount>
    <DOCSIS-DIAG-LOG:RangingRetryCount>0</DOCSIS-DIAG-LOG:RangingRetryCount>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z"/>
</ipdr:IPDRDoc>

```

### III.4 DIAG-LOG-DETAIL-TYPE

This section provides a sample XML Instance Document for the Diagnostic Log Service Definition, DIAG-LOG-DETAIL-TYPE and corresponding XML Schema DOCSIS-DIAG-LOG-DETAIL-TYPE\_3.5.1-A.2.xsd.

#### III.4.1 Use Case

The CMTS "cmts01.mso.com" logs an entry in its diagnostic log for the CM with MAC Address 00-09-36-A7-70-89 when the CM fails to register. The CM last triggered a registration diagnostic log entry at 6:30 on 06/05/2006. The detail Count of 1 represents the total number of times the CM had reached the startRegistration (TypeValue=11) state before failing the registration process. The corresponding event is:

<73000401> Service Unavailable – Unrecognized configuration setting

The CMTS streams this information to a Collector as shown in the following instance document.

#### III.4.2 Instance Document <sup>413</sup>

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
LOG-DETAIL-TYPE"
    xmlns:DOCSIS-DIAG-LOG-
DETAIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
DETAIL"
    xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:DOCSIS-
CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
OCSIS-DIAG-LOG-DETAIL-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
DETAIL-TYPE/DOCSIS-DIAG-LOG-DETAIL-TYPE_3.5.1-A.2.xsd"
    docId="3d07ba27-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.1">
<ipdr:IPDR xsi:type="DIAG-LOG-DETAIL-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-DIAG-LOG-DETAIL:TypeValue>11</DOCSIS-DIAG-LOG-DETAIL:TypeValue>
    <DOCSIS-DIAG-LOG-DETAIL:Count>1</DOCSIS-DIAG-LOG-DETAIL:Count>
    <DOCSIS-DIAG-LOG-DETAIL:LastUpdate>2006-06-05T06:30:00Z</DOCSIS-DIAG-LOG-
DETAIL:LastUpdate>
    <DOCSIS-DIAG-LOG-DETAIL:LastErrorText>
        &lt;73000401&gt; Service Unavailable – Unrecognized configuration setting
    </DOCSIS-DIAG-LOG-DETAIL:LastErrorText>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
</ipdr:IPDR>

```

<sup>413</sup> Revised per OSSlv3.0-N-10.0968-2 on 1/21/11 by JB.

```
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z" />
</ipdr:IPDRDoc>
```

### III.5 DIAG-LOG-EVENT-TYPE

This section provides a sample XML Instance Document for the Diagnostic Log Service Definition, DIAG-LOG-EVENT-TYPE and corresponding XML Schema DOCSIS-DIAG-LOG-EVENT-TYPE\_3.5.1-A.2.xsd.

#### III.5.1 Use Case

At the CMTS sysUpTime "2226878", the CMTS "cmts01.mso.com" detects a diagnostic log trigger for the CM with MAC Address 00-09-36-A7-70-89 when the CM fails to register (TriggerFlagValue of 1 indicates a registration trigger). The CM had reached the startRegistration (TypeValue=11) state before failing the registration process. The corresponding event is:

<73000401> Service Unavailable – Unrecognized configuration setting

Since the RecType value of 4 indicates an event based record, the CMTS autonomously streams this information to a Collector as shown in the following instance document.

#### III.5.2 Instance Document<sup>414</sup>

```
<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-
    LOG-EVENT-TYPE"
    xmlns:DOCSIS-DIAG-
    LOG="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG"
    xmlns:DOCSIS-DIAG-LOG-
    DETAIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
    DETAIL"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D-
    OCSIS-DIAG-LOG-EVENT-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-
        EVENT-TYPE/DOCSIS-DIAG-LOG-EVENT-TYPE_3.5.1-A.2.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.1">
<ipdr:IPDR xsi:type="DIAG-LOG-EVENT-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-CMTS:CmtssysUpTime>2226878</DOCSIS-CMTS:CmtssysUpTime>
    <DOCSIS-DIAG-LOG:TriggerFlagValue>1</DOCSIS-DIAG-LOG:TriggerFlagValue>
    <DOCSIS-DIAG-LOG-DETAIL:TypeValue>11</DOCSIS-DIAG-LOG-DETAIL:TypeValue>
    <DOCSIS-DIAG-LOG-DETAIL:LastErrorText>
        &lt;73000401&gt; Service Unavailable - Unrecognized configuration setting
    </DOCSIS-DIAG-LOG-DETAIL:LastErrorText>
    <DOCSIS-REC:RecType>4</DOCSIS-REC:RecType>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z" />
</ipdr:IPDRDoc>
```

<sup>414</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

### III.6 SPECTRUM-MEASUREMENT-TYPE

This section provides a sample XML Instance Document for the Spectrum Measurement Service Definition, SPECTRUM-MEASUREMENT-TYPE and corresponding XML Schema DOCSIS-SPECTRUM-MEASUREMENT-TYPE\_3.5.1-A.2.xsd.

#### III.6.1 Use Case

Refer to "Use Case 3 Data Analysis" in Appendix V for the Use Case defining the following XML Instance Document.

This instance document includes the "current" data plot from the Use Case mentioned above. For clarity, each eight data points in the element SpectrumAnalysisMeasAmplitude of the XML Instance Document are shown per line inside the comment above the element instance. The Center Frequency data is indicated in one line alone (i.e., "FFF5"). Each data point in the comment is delimited with a single space for readability and is not part of the actual XML Instance Document.

#### III.6.2 Instance Document <sup>415</sup>

```
<ipdr:IPDRDoc xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM-MEASUREMENT-TYPE" xmlns:DOCSIS-CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS" xmlns:DOCSIS-SPECTRUM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM" xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" IPDRRecorderInfo="cmts01.mso.com" creationTime="2006-06-05T07:11:00Z" docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f" version="3.5.1-A.1" xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM-MEASUREMENT-TYPE/DOCSIS-SPECTRUM-MEASUREMENT-TYPE_3.5.1-A.2.xsd">
    <ipdr:IPDR xsi:type="SPECTRUM-MEASUREMENT-TYPE">
        <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
        <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
        <DOCSIS-CMTS:CmtsMdIfIndex>1</DOCSIS-CMTS:CmtsMdIfIndex>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasIfIndex>5</DOCSIS-SPECTRUM:SpectrumAnalysisMeasIfIndex>
        <DOCSIS-SPECTRUM:ChId>2</DOCSIS-SPECTRUM:ChId>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasChCenterFreq>25000000</DOCSIS-SPECTRUM:SpectrumAnalysisMeasChCenterFreq>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasFreqSpan>6400000</DOCSIS-SPECTRUM:SpectrumAnalysisMeasFreqSpan>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasNumOfBins>257</DOCSIS-SPECTRUM:SpectrumAnalysisMeasNumOfBins>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasResolutionBW>25000</DOCSIS-SPECTRUM:SpectrumAnalysisMeasResolutionBW>
        <DOCSIS-SPECTRUM:SpectrumAnalysisMeasBinSpacing>12500</DOCSIS-SPECTRUM:SpectrumAnalysisMeasBinSpacing>
    <!-- The following data instance is formatted for readability
        F07A F7F4 FC64 FE23 FEDE FFF7 FFDF FFF9
        FFFA FFFC FFF8 FFF0 FFF7 000F 000C FFF7
        0009 001B FFE8 FFFE FFDA FFE9 FFFE FFE8
        0007 0001 0002 0004 000A 0014 FFFD 000C
        FFFB 0029 000A FFFB FFFA FFDC 000B FFFA
        FFF8 0003 FFF3 000E FFEF FFE6 FFFE FFF3
        FFF7 FF00 FFF7 0013 FFFD 0009 000D 001A
        0016 FFE4 0013 FFF7 0010 000A 0019 0005
        0019 0000 0003 FFF8 FFDE FFFF 0009 0007
```

<sup>415</sup> Revised per OSSIV3.0-N-10.0968-2 on 1/21/11 by JB.

```

FFEA FFF5 0006 FFFC 0339 074A 06A4 0010
0011 0030 FFF1 0022 0028 FFFE FFFF3 0001
0001 FFFF FFFF7 001D FFFB FFFF FFED FFFF
000D FFFF7 FFFF9 0002 000B FFEB 000B 0018
0004 001F FFFF5 0003 000F 0005 FFE6 001B
FFFFB 000A 0000 000E 000A 0019 0022 0017
FFED FFFFEE 000F FFFF4 0008 FFE3 FFEC 0020
FFFF5
0025 0018 FFD5 FFE8 FFFF7 0017 FFFF1 0013
FFFFD FFEB 0003 FFFE FFFF3 FFFF8 0017 0015
FFEE FFE6 001A 0029 FFFF FFFF7 FFFF8
FFEO FFFF3 000C 0001 0002 000A FFFF9 FFE2
0022 0016 0008 0013 0006 FFFF FFFF0 000F
0000 0006 FFED 001F FFFF2 0006 FFFF D FFFF5
0000 0019 0009 FFC1 FFE8 0008 0026 001D
0018 FFFF D 0003 FFFE 001D 0009 0004 FFE7
FFF5 001C 0027 FFE7 000B FFFF FFFF0 FFD
FFE1 001B 001C 0034 FFFF D 0008 0000 0027
0009 FFFF0 FFFF2 FFFE FFFF A FFFF B 0014 0016
FFFE FFFF E 0018 0000 0006 FFD C FFFF6 FFFE
FFFF FFFF0 000A 000E 0015 0023 FFFF5 0001 000C
000B 0001 FFFF9 000E 0024 FFFF7 0000 FFFE
0022 FFFF E FFFF C 0002 0004 0011 FFFF2
000D FFFF B 000F FEFA FE39 FBED F87E F098 -->
<DOCSIS-
SPECTRUM:SpectrumAnalysisMeasAmplitude>F07AF7F4FC64FE23FEDEFFF7FFDFFFF9FFFACFFCF8FFF
0FFF7000F000CFFF70009001BF8E8FFFEDAFFE9FFFEB0007000100020004000A0014FFF000CFFF80
029000AFFFBFFFACFFDC000BFFFACFF80003FFF3000EFFEFFF6FFFEBFFF3FFF7FFD0FFF70013FFF0009000
D001A0016FFE40013FFF70010000A0019000500190000003FFF8FFDEFFF800090007FFEAFFF50006FFF80
339074A06A4001000110030FFF100220028FFFEBFFF300010001FFFFF7001DFFF8FFF8FFF000DFFF
7FFF90002000BFFFEB000B00180004001FFF50003000F0005FF6001BFFF8000A0000000E000A001900220
017FFFEDFFFEE000FFF40008FFE3FFEC0020FFF500250018FFF5FF8FFF70017FFF10013FFFDFE80003FFF
EFF3FFF800170015FFEEFFECFFE6001A0029FFF7FFF8FFF0FFF3000C00010002000AFF9FFE200220
016000800130006FFF8FFF0000F00000006FFFED001FFF20006FFFDF8FFF50000000190009FFC1FFE80008002
6001D0018FFF80003FFF8001D00090004FFE7FFF5001C0027FFF7000BFFFFFFF0FFFDCFFE1001B001C0034F
FFF80000000270009FFF0FFF2FFF8FFF8FFF00180000006FFFDCFFF6FFF8FFF000
A000E00150023FFF50001000C000B0001FFF9000E0024FFF70000FFF80022FFF8000FFF8000200040011F
FF2000DFFF8000FFEF8E39FBEDF87EF098</DOCSIS-SPECTRUM:SpectrumAnalysisMeasAmplitude>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z"></ipdr:IPDRDoc.End>
</ipdr:IPDRDoc>
```

### III.7 CMTS-CM-US-STATS-TYPE<sup>416</sup>

This section provides a sample XML Instance Document for the CMTS CM Upstream Statistics Service Definition, CMTS-CM-US-STATS-TYPE and corresponding XML Schema DOCSIS-CMTS-CM-US-STATS-TYPE\_3.5.1-A.2.xsd.

#### III.7.1 Use Case

At a CMTS sysUpTime of "2226878", the CMTS "cmts01.mso.com" with MAC Domain ifName of "Int0/1" and MAC Domain ifIndex of "456", streams the upstream status information of a CM with MAC Address "00-09-36-A7-70-89" connected to upstream channel ifName of "Int0/1/4" and upstream channel ifIndex of "17". In addition, the CmRegStatusId of "1" and the following upstream status information of CM are included in the record:

ModulationType = 1

RxPower = -5

SignalNoise = 361

<sup>416</sup> Section revised per OSSIV3.0-N-07.0410-4, #15 on 5/8/07 by KN, per OSSIV3.0-N-10.0914-3 on 5/20/10 and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

Microreflections = 0

EqData = 0x0401080000700028ff60ffa0018000783db000000080fe98ff70ffe8ff58003800480138

Unerroreds = 219678

Correcteds = 10

Uncorrectables = 5

HighResolutionTimingOffset = 5

IsMuted = 0

RangingStatus = 4

### III.7.2 Instance Document <sup>417</sup>

```
<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
    CM-US-STATS-TYPE"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-CM-
    US="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
    OCSIS-CMTS-CM-US-STATS-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-
    US-STATS-TYPE/DOCSIS-CMTS-CM-US-STATS-TYPE_3.5.1-A.2.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.2">
<ipdr:IPDR xsi:type="CMTS-CM-US-STATS-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsMdifName>Int0/1</DOCSIS-CMTS:CmtsMdifName>
    <DOCSIS-CMTS:CmtsMdifIndex>456</DOCSIS-CMTS:CmtsMdifIndex>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-CM:CmRegStatusId>1</DOCSIS-CM:CmRegStatusId>
    <DOCSIS-CMTS-CM-US:CmtsCmUsChIfName>Int/0/1/4</DOCSIS-CMTS-CM-
    US:CmtsCmUsChIfName>
    <DOCSIS-CMTS-CM-US:CmtsCmUsChIfIndex>17</DOCSIS-CMTS-CM-US:CmtsCmUsChIfIndex>
    <DOCSIS-CMTS-CM-US:CmtsCmUsChId>5</DOCSIS-CMTS-CM-US:CmtsCmUsChId>
    <DOCSIS-CMTS-CM-US:CmtsCmUsModulationType>1</DOCSIS-CMTS-CM-
    US:CmtsCmUsModulationType>
    <DOCSIS-CMTS-CM-US:CmtsCmUsRxPower>-5</DOCSIS-CMTS-CM-US:CmtsCmUsRxPower>
    <DOCSIS-CMTS-CM-US:CmtsCmUsSignalNoise>361</DOCSIS-CMTS-CM-
    US:CmtsCmUsSignalNoise>
    <DOCSIS-CMTS-CM-US:CmtsCmUsMicroreflections>0</DOCSIS-CMTS-CM-
    US:CmtsCmUsMicroreflections>
    <DOCSIS-CMTS-CM-US:CmtsCmUsEqData>
        0401080000700028ff60ffa0018000783db000000080fe98ff70ffe8ff58003800480138
    </DOCSIS-CMTS-CM-US:CmtsCmUsEqData>
    <DOCSIS-CMTS-CM-US:CmtsCmUsUnerroreds>219678</DOCSIS-CMTS-CM-
    US:CmtsCmUsUnerroreds>
    <DOCSIS-CMTS-CM-US:CmtsCmUsCorrecteds>10</DOCSIS-CMTS-CM-
```

<sup>417</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

US:CmtsCmUsCorrecteds>
    <DOCSIS-CMTS-CM-US:CmtsCmUsUncorrectables>5</DOCSIS-CMTS-CM-
US:CmtsCmUsUncorrectables>
    <DOCSIS-CMTS-CM-US:CmtsCmUsHighResolutionTimingOffset>5</DOCSIS-CMTS-CM-
US:CmtsCmUsHighResolutionTimingOffset>
    <DOCSIS-CMTS-CM-US:CmtsCmUsIsMuted>0</DOCSIS-CMTS-CM-US:CmtsCmUsIsMuted>
    <DOCSIS-CMTS-CM-US:CmtsCmUsRangingStatus>4</DOCSIS-CMTS-CM-
US:CmtsCmUsRangingStatus>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z"/>
</ipdr:IPDRDoc>

```

## III.8 CMTS-CM-REG-STATUS-TYPE<sup>418</sup>

This section provides a sample XML Instance Document for the CMTS CM Registration Status Service Definition, CMTS-CM-REG-STATUS-TYPE and corresponding XML Schema DOCSIS-CMTS-CM-REG-STATUS-TYPE\_3.5.1-A.1.xsd.

### III.8.1 Use Case<sup>419</sup>

At a CMTS sysUpTime of "2226878", the CMTS "cmts01.mso.com" with MAC Domain ifName of "Int0/1" and MAC Domain ifIndex of "456", streams the registration status information of a CM with MAC Address "00-09-36-A7-70-89", having an ip4Address of "55.12.48.113", ipv6Address of "2001:0400:0000:0209:36FF:FEA7:7089", ipv6 link local address of "FE80:0000:0000:0209:36FF:FEA7:7089", registration status value of "8" and QosVersion as "2"(DOCSIS 1.1 QoS mode). The CM last registered with the CMTS at 9:15GMT on 06/04/2006. In addition, the CMTS CM Channel information consisting of MAC Domain Cable Modem Service Group Id of "17", Receive Channel Profile Id of "MYCID", Receive Channel Configuration status Id of "5", Receive Channel Set Id of "5" and Transmit Channel Set If of "5" is also included in the record.

### III.8.2 Instance Document<sup>420</sup>

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
    CM-REG-STATUS-TYPE"
    xmlns:DOCSIS=
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-CMTS-CM-NODE=
    CH="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH"
    xmlns:DOCSIS=
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS=
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
    OCSIS-CMTS-CM-REG-STATUS-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-
        REG-STATUS-TYPE/DOCSIS-CMTS-CM-REG-STATUS-TYPE_3.5.1-A.1.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.1">
<ipdr:IPDR xsi:type="CMTS-CM-REG-STATUS-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>

```

<sup>418</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 by KN.

<sup>419</sup> Section revised per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

<sup>420</sup> Section revised per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```

<DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
<DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
<DOCSIS-CMTS-CM-NODE-CH:CmtsMdCmSgId>17</DOCSIS-CMTS-CM-NODE-CH:CmtsMdCmSgId>
<DOCSIS-CMTS-CM-NODE-CH:CmtsRcpId>MYCID</DOCSIS-CMTS-CM-NODE-CH:CmtsRcpId>
<DOCSIS-CMTS-CM-NODE-CH:CmtsRccStatusId>5</DOCSIS-CMTS-CM-NODE-
CH:CmtsRccStatusId>
    <DOCSIS-CMTS-CM-NODE-CH:CmtsRcsId>5</DOCSIS-CMTS-CM-NODE-CH:CmtsRcsId>
    <DOCSIS-CMTS-CM-NODE-CH:CmtsTcsId>5</DOCSIS-CMTS-CM-NODE-CH:CmtsTcsId>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-CM:CmIpv4Addr>55.12.48.113</DOCSIS-CM:CmIpv4Addr>
    <DOCSIS-CM:CmIpv6Addr>2001:0400:0000:0000:0209:36FF:FEA7:7089</DOCSIS-
CM:CmIpv6Addr>
    <DOCSIS-
CM:CmIpv6LinkLocalAddr>FE80:0000:0000:0000:0209:36FF:FEA7:7089</DOCSIS-
CM:CmIpv6LinkLocalAddr>
        <DOCSIS-CM:CmQosVersion>2</DOCSIS-CM:CmQosVersion>
        <DOCSIS-CM:CmRegStatusValue>8</DOCSIS-CM:CmRegStatusValue>
        <DOCSIS-CM:CmLastRegTime>2006-06-04T09:15:00Z</DOCSIS-CM:CmLastRegTime>
        <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
        <DOCSIS-REC:RecCreationTime>2006-06-05T07:11:00Z</DOCSIS-REC:RecCreationTime>
    </ipdr:IPDR>
    <ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z"/>
</ipdr:IPDRDoc>

```

## III.9 CMTS-TOPOLOGY-TYPE<sup>421</sup>

This section provides a sample XML Instance Document for the CMTS Topology Service Definition, CMTS-TOPOLOGY-TYPE and corresponding XML Schema DOCSIS-CMTS-TOPOLOGY-TYPE\_3.5.1-A.2.xsd.

### III.9.1 Use Case

At a CMTS sysUpTime of "2226878", the CMTS "cmts01.mso.com" with ipv4Address of "10.40.57.11", ipv6Address of "2001:0400:0000:0000:FF00:FE00:0000", MAC Domain ifName of "Int0/1" and MAC Domain ifIndex of "456", streams the topology information consisting of Node Name as "DENVER288", MAC Domain Cable Modem Service Group Id of "1010", MAC Domain Downstream Service Group Id of "2", MAC Domain Upstream Service Group Id "5", MAC Domain Downstream Service Group Channel List of "01020304" and MAC Domain Upstream Service Group Channel List of "0A0B0C3D".

### III.9.2 Instance Document<sup>422</sup>

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
TOPOLOGY-TYPE"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-MD-
    NODE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
OCSIS-CMTS-TOPOLOGY-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
TOPOLOGY-TYPE/DOCSIS-CMTS-TOPOLOGY-TYPE_3.5.1-A.2.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    creationTime="2006-06-05T07:11:00Z"
    IPDRRecorderInfo="cmts01.mso.com"
    version="3.5.1-A.2">

```

<sup>421</sup>Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

<sup>422</sup>Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

<ipdr:IPDR xsi:type="CMTS-TOPOLOGY-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsIpv4Addr>10.40.57.11</DOCSIS-CMTS:CmtsIpv4Addr>
    <DOCSIS-CMTS:CmtsIpv6Addr>2001:0400:0000:0000:0000:FF00:FE00:0000</DOCSIS-
CMTS:CmtsIpv6Addr>
    <DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
    <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-MD-NODE:CmtsNodeName>DENVER2881</DOCSIS-MD-NODE:CmtsNodeName>
    <DOCSIS-MD-NODE:CmtsMdCmSgId>1010</DOCSIS-MD-NODE:CmtsMdCmSgId>
    <DOCSIS-MD-NODE:CmtsMdDsSgId>2</DOCSIS-MD-NODE:CmtsMdDsSgId>
    <DOCSIS-MD-NODE:CmtsMdUsSgId>5</DOCSIS-MD-NODE:CmtsMdUsSgId>
    <DOCSIS-MD-NODE:CmtsMdDsSgChList>01020304</DOCSIS-MD-NODE:CmtsMdDsSgChList>
    <DOCSIS-MD-NODE:CmtsMdUsSgChList>0A0B0C3D</DOCSIS-MD-NODE:CmtsMdUsSgChList>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z" />
</ipdr:IPDRDoc>

```

### III.10 CPE-TYPE<sup>423</sup>

This section provides a sample XML Instance Document for the CPE Service Definition, CPE-TYPE and corresponding XML Schema DOCSIS-CPE-TYPE\_3.5.1-A.2.xsd.

#### III.10.1 Use Case

At a CMTS sysUpTime of "2226878", the CMTS "cmts01.mso.com" streams the CPE record for a CPE with MAC Address 00-08-22-B4-66-90 corresponding to a CM with MAC Address 00-09-36-A7-70-89 and a CMTS MAC Domain ifName of "Int0/1" and ifIndex of 456. In addition, the CPE IPv4 address of 192.168.0.11, IPv6 address of 2001:0400:0000:0000:1000:FFFF:0000 and FQDN of "somehost.example.com." are included in the record.

#### III.10.2 Instance Document<sup>424</sup>

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CPE-TYPE"
    xmlns:DOCSIS-
    CPE="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/i
    pdr/DOCSIS-CPE-TYPE
        http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE-
        TYPE/DOCSIS-CPE-TYPE_3.5.1-A.2.xsd"
        docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f" version="3.5.1-A.2"
creationTime="2006-06-05T07:11:00Z" IPDRRecorderInfo="cmts01.mso.com">
    <ipdr:IPDR xsi:type="CPE-TYPE">
        <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
        <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
        <DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
        <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
        <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
        <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>

```

<sup>423</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

<sup>424</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 and per OSSIV3.0-N-10.0937-4 on 9/24/10 by JB.

```

<DOCSIS-CPE : CpeMacAddr>00-08-22-B4-66-90</DOCSIS-CPE : CpeMacAddr>
<DOCSIS-CPE : CpeIpv4AddrList>192.168.0.11</DOCSIS-CPE : CpeIpv4AddrList>
<DOCSIS-CPE : CpeIpv6AddrList>2001:0400:0000:0000:0000:1000:FFFF:0000</DOCSIS-
CPE : CpeIpv6AddrList>
    <DOCSIS-CPE : CpeFqdn>somehost.example.com.</DOCSIS-CPE : CpeFqdn>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z" />
</ipdr:IPDRDoc>

```

### III.11 SAMIS-TYPE-1 and SAMIS-TYPE-2

#### III.11.1 Use Case

The Type 1 and Type 2 XML Instance Documents defined in the following sections represent the same use case, but differ in the amount of data which is streamed. Type 1 streams the full record containing all CMTS, CM and service statistics counters. The optimized record, Type 2, only streams those elements that are needed in each record instance such that correlation can be performed at the collector.

**Note:** The instance documents presented below represent one streaming record for illustrative purposes only. The full set of streaming records for the defined use case are not included.

The use case represented in this section is defined in the following section.

##### III.11.1.1 Example Usage Record Streaming model Containing diverse services<sup>425</sup>

Table III-1 includes a set of records from a bigger set that contains active Service Flows/ CoS for the collection interval from 10:30 AM to 11:00 AM of a day Nov 10 2004 (30 minutes intervals) PCxx correspond to PacketCable 1.5 voice calls; FLPxx correspond to CMs flapping in the registration process after some time being online; CMxx correspond to CMs with steady registration, and passing data. Not all the statistics are presented and for simplicity only Upstream data is shown in this example.

**Table III-1 - Sample of records for the period 10:30 to 11:00 AM**

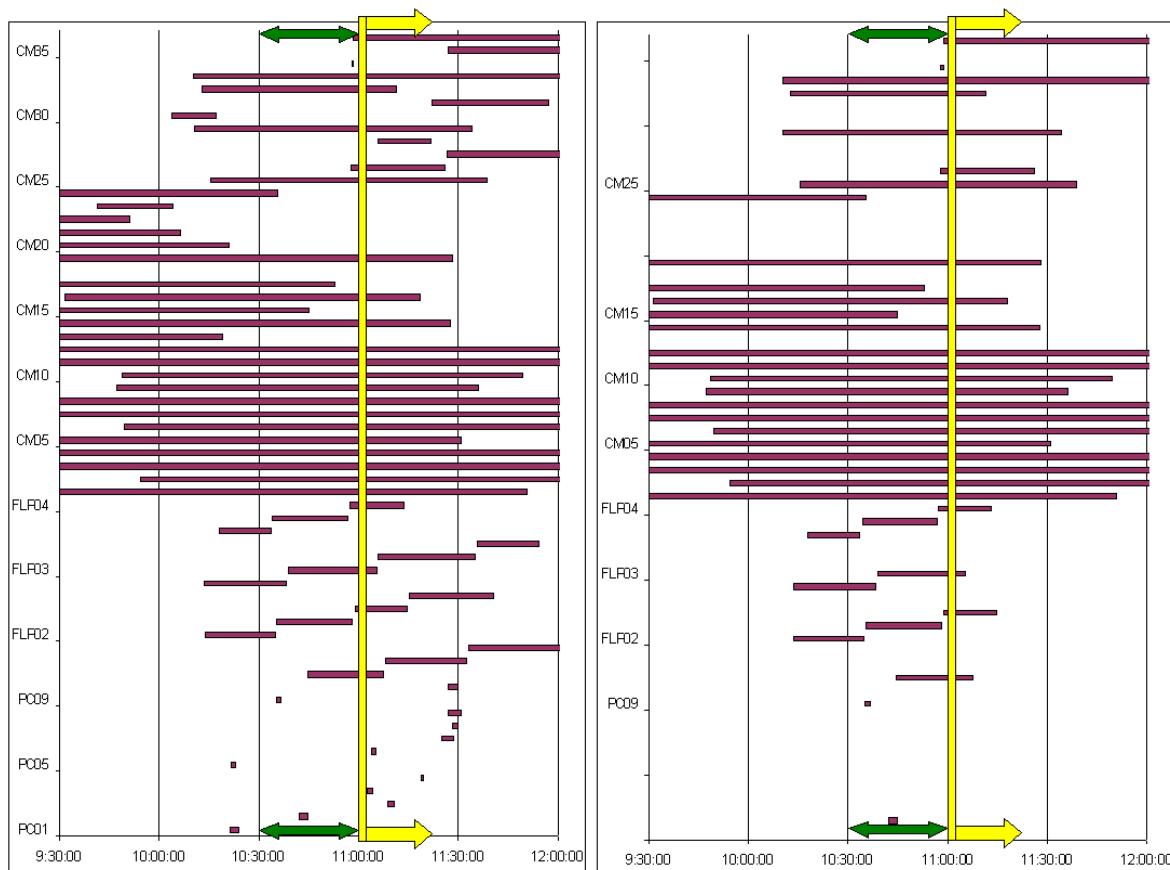
Device	TimeStart	TimeEnd	TimeLast (sec)	RecType	Device	TimeStart	TimeEnd	TimeLast (sec)	RecType
PC02	10:42:01	10:44:42	161	Stop	CM08	8:16:46	12:05:34	13728	Interim
PC09	10:35:11	10:36:46	95	Stop	CM09	9:47:07	11:36:04	6537	Interim
FLP01	10:44:33	11:07:30	1377	Interim	CM10	9:48:39	11:49:21	7242	Interim
FLP02	10:13:53	10:34:49	1256	Stop	CM11	9:05:29	12:30:36	12307	Interim
FLP02	10:35:25	10:58:08	1363	Stop	CM12	8:40:34	12:17:30	13016	Interim
FLP02	10:58:47	11:14:39	952	Interim	CM14	8:08:13	11:27:41	11968	Interim
FLP03	10:13:39	10:38:26	1487	Stop	CM15	8:04:46	10:44:59	9613	Stop
FLP03	10:39:00	11:05:32	1592	Interim	CM16	9:31:22	11:18:15	6413	Interim
FLP04	10:17:50	10:33:35	945	Stop	CM17	8:44:49	10:53:03	7694	Stop
FLP04	10:34:11	10:56:43	1352	Stop	CM19	9:07:13	11:28:10	8457	Interim
FLP04	10:57:18	11:13:22	964	Interim	CM24	8:02:37	10:35:35	9178	Stop
CM01	9:06:43	11:50:29	9826	Interim	CM25	10:15:27	11:38:47	5000	Interim
CM02	9:54:13	12:31:34	9441	Interim	CM26	10:57:44	11:26:00	1696	Interim
CM03	9:27:57	12:58:43	12646	Interim	CM29	10:10:35	11:34:02	5007	Interim
CM04	8:56:05	12:07:37	11492	Interim	CM32	10:12:35	11:11:12	3517	Interim

<sup>425</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07.

Device	TimeStart	TimeEnd	TimeLast (sec)	RecType	Device	TimeStart	TimeEnd	TimeLast (sec)	RecType
CM05	9:03:01	11:30:46	8865	Interim	CM33	10:10:13	12:20:49	7836	Interim
CM06	9:49:23	12:58:20	11337	Interim	CM34	10:57:58	10:58:41	43	Stop
CM07	8:19:37	12:59:17	16780	Interim	CM36	10:58:36	12:38:25	5989	Interim

Table III-1 shows in the left side, an arbitrary set of active CM services from start to end: Basic, Premium and Business services (SCN being associated by the CMTS) are here static services and PacketCable Services (SCN = G711) represent VoIP calls over PacketCable infrastructure. Note that CMTS have signaled in a proprietary manner a SCN = Basic for CMs in 1.0 mode of operation; this could be considered a CMTS specific feature for filling the SCN with the purpose of aggregating that service segment and does not constitute a CMTS requirement

The right side of Figure III-1 corresponds to the records that are reported for the collector interval 10:30 to 11:00 AM as RecType 'Stop' or 'Interim'.



**Figure III-1 - Set of CM Services in an arbitrary period of time (Left Graphic)  
Set of Records associated to the Collection Interval 10:30 to 11:00 AM (Right Graphic)**

One example instance of the corresponding records sent by exporter for the time interval 10:30 to 11:00 AM as indicated in the figures above is represented in the below IPDRDoc XML format. IPDRDoc is expected to be aggregated by the Collector with the IPDR/SP data streamed within the session start stop boundary.

### III.11.2 SAMIS Type 1 Instance Document<sup>426</sup>

```

<?xml version='1.0' ?>
<ipdr:IPDRDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SAMIS-TYPE-1"
    xmlns:DOCSIS-
    QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr
/DOCSIS-SAMIS-TYPE-1
    http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-
TYPE-1/DOCSIS-SAMIS-TYPE-1_3.5.1-A.1.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    version="3.5.1-A.2"
    creationTime="2004-11-10T07:11:05Z"
    IPDRRecorderInfo="cmts01.mso.com">
<ipdr:IPDR xsi:type="SAMIS-TYPE-1">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsIpv4Addr>10.40.57.11</DOCSIS-CMTS:CmtsIpv4Addr>
    <DOCSIS-CMTS:CmtsIpv6Addr>2001:0400:0000:0000:0000:FF00:FE00:0000</DOCSIS-
CMTS:CmtsIpv6Addr>
    <DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
    <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-CM:CmIpv4Addr>55.12.48.113</DOCSIS-CM:CmIpv4Addr>
    <DOCSIS-CM:CmIpv6Addr>2001:0400:0000:0000:0000:1000:FF00:0000</DOCSIS-
CM:CmIpv6Addr>
    <DOCSIS-
    CM:CmIpv6LinkLocalAddr>FE80:0000:0000:0000:0209:36FF:FEA7:7089</DOCSIS-
CM:CmIpv6LinkLocalAddr>
    <DOCSIS-CM:CmQosVersion>2</DOCSIS-CM:CmQosVersion>
    <DOCSIS-CM:CmRegStatusValue>8</DOCSIS-CM:CmRegStatusValue>
    <DOCSIS-CM:CmLastRegTime>2006-06-04T09:15:00Z</DOCSIS-CM:CmLastRegTime>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
    <DOCSIS-REC:RecCreationTime>2004-11-10T07:11:05Z</DOCSIS-REC:RecCreationTime>
    <DOCSIS-QOS:ServiceFlowChSet>01020304</DOCSIS-QOS:ServiceFlowChSet>
    <DOCSIS-QOS:ServiceAppId>10000</DOCSIS-QOS:ServiceAppId>
    <DOCSIS-QOS:ServiceDsMulticast>false</DOCSIS-QOS:ServiceDsMulticast>
    <DOCSIS-QOS:ServiceIdentifier>361</DOCSIS-QOS:ServiceIdentifier>
    <DOCSIS-QOS:ServiceGateId>500</DOCSIS-QOS:ServiceGateId>
    <DOCSIS-QOS:ServiceClassName>Premium</DOCSIS-QOS:ServiceClassName>
    <DOCSIS-QOS:ServiceDirection>2</DOCSIS-QOS:ServiceDirection>
    <DOCSIS-QOS:ServiceOctetsPassed>16486400</DOCSIS-QOS:ServiceOctetsPassed>
    <DOCSIS-QOS:ServicePktsPassed>82431</DOCSIS-QOS:ServicePktsPassed>
    <DOCSIS-QOS:ServiceSlaDropPkts>412</DOCSIS-QOS:ServiceSlaDropPkts>
    <DOCSIS-QOS:ServiceSlaDelayPkts>8</DOCSIS-QOS:ServiceSlaDelayPkts>
    <DOCSIS-QOS:ServiceTimeCreated>2210822</DOCSIS-QOS:ServiceTimeCreated>
    <DOCSIS-QOS:ServiceTimeActive>161</DOCSIS-QOS:ServiceTimeActive>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2004-11-10T07:11:08Z"/>
</ipdr:IPDRDoc>
```

<sup>426</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 by KN, per OSSIV3.0-N-0478-2 by ab on 7/12/07, and per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

### III.11.3 SAMIS Type 2 Instance Document<sup>427</sup>

```

<?xml version='1.0' ?>
<ipdr:IPDRDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
SAMIS-TYPE-2"
    xmlns:DOCSIS-
    QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
    xmlns:DOCSIS-
    CM="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM"
    xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
    xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr
/DOCSIS-SAMIS-TYPE-2
    http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-
TYPE-2/DOCSIS-SAMIS-TYPE-2_3.5.1-A.1.xsd"
    docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
    version="3.5.1-A.2"
    creationTime="2004-11-10T07:11:05Z"
    IPDRRecorderInfo="cmts01.mso.com">
<ipdr:IPDR xsi:type="SAMIS-TYPE-2">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
    <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-CM:CmMacAddr>00-09-36-A7-70-89</DOCSIS-CM:CmMacAddr>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
    <DOCSIS-REC:RecCreationTime>2004-11-10T07:11:05Z</DOCSIS-REC:RecCreationTime>
    <DOCSIS-QOS:ServiceFlowChSet>01020304</DOCSIS-QOS:ServiceFlowChSet>
    <DOCSIS-QOS:ServiceAppId>10000</DOCSIS-QOS:ServiceAppId>
    <DOCSIS-QOS:ServiceDsMulticast>false</DOCSIS-QOS:ServiceDsMulticast>
    <DOCSIS-QOS:ServiceIdentifier>361</DOCSIS-QOS:ServiceIdentifier>
    <DOCSIS-QOS:ServiceGateId>500</DOCSIS-QOS:ServiceGateId>
    <DOCSIS-QOS:ServiceClassName>Premium</DOCSIS-QOS:ServiceClassName>
    <DOCSIS-QOS:ServiceDirection>2</DOCSIS-QOS:ServiceDirection>
    <DOCSIS-QOS:ServiceOctetsPassed>16486400</DOCSIS-QOS:ServiceOctetsPassed>
    <DOCSIS-QOS:ServicePktsPassed>82431</DOCSIS-QOS:ServicePktsPassed>
    <DOCSIS-QOS:ServiceSlaDropPkts>412</DOCSIS-QOS:ServiceSlaDropPkts>
    <DOCSIS-QOS:ServiceSlaDelayPkts>8</DOCSIS-QOS:ServiceSlaDelayPkts>
    <DOCSIS-QOS:ServiceTimeCreated>2210822</DOCSIS-QOS:ServiceTimeCreated>
    <DOCSIS-QOS:ServiceTimeActive>161</DOCSIS-QOS:ServiceTimeActive>
</ipdr:IPDR>
<ipdr:IPDRDoc.End count="1" endTime="2004-11-10T07:11:08Z"/>
</ipdr:IPDRDoc>
```

### III.12 CMTS-US-UTIL-STATS-TYPE<sup>428</sup>

This section provides a sample XML Instance Document for the CMTS Upstream Utilization Statistics Service Definition, CMTS-US-UTIL-STATS-TYPE and corresponding XML Schema DOCSIS-CMTS-US-UTIL-STATS-TYPE\_3.5.1-A.3.xsd.

#### III.12.1 Use Case

At a CMTS sysUpTime of "2226878", the CMTS "cmts01.mso.com" with MAC Domain ifIndex of "456", streams (using an event based session) the upstream utilization statistics information for the upstream logical channel with

<sup>427</sup> Revised per OSSIV3.0-N-07.0478-2 by ab on 7/12/07 and per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

<sup>428</sup> Section added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

ifIndex of "17". In addition, the UsUtilInterval of "900" (15 minutes) and the following utilization information is included in the record:

```

IndexPercentage = 80
TotalMslots = 1403854841
UcastGrantedMslots = 33281121
TotalCntnMslots = 1370280369
UsedCntnMslots = 815830
CollCntnMslots = 1332
TotalCntnReqMslots = 311083615
UsedCntnReqMslots = 574833
CollCntnReqMslots = 1332
TotalCntnReqDataMslots = 0
UsedCntnReqDataMslots = 0
CollCntnReqDataMslots = 0
TotalCntnInitMaintMslots = 1059212846
UsedCntnInitMaintMslots = 240997
CollCntnInitMaintMslots = 0

```

### **III.12.2 Instance Document <sup>429</sup>**

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
US-UTIL-STATS-TYPE"
  xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
  xmlns: DOCSIS-CMTS-US-
UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL"
  xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
  xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/D
OCSIS-CMTS-US-UTIL-STATS-TYPE
  http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-
UTIL-STATS-TYPE/DOCSIS-CMTS-US-UTIL-STATS-TYPE_3.5.1-A.3.xsd"
  docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
  creationTime="2006-06-05T07:11:00Z"
  IPDRRecorderInfo="cmts01.mso.com"
  version="3.5.1-A.2">
<ipdr:IPDR xsi:type="CMTS-US-UTIL-STATS-TYPE" >
  <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com</DOCSIS-CMTS:CmtsHostName>
  <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
  <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
  <DOCSIS-CMTS-US-UTIL:UsIfIndex>17</DOCSIS-CMTS-US-UTIL:UsIfIndex>
  <DOCSIS-CMTS-US-UTIL:UsIfName> Int/0/1/4</DOCSIS-CMTS-US-UTIL:UsIfName>
  <DOCSIS-CMTS-US-UTIL:UsChId>2</DOCSIS-CMTS-US-UTIL:UsChId>
  <DOCSIS-CMTS-US-UTIL:UsUtilInterval>900</DOCSIS-CMTS-US-UTIL:UsUtilInterval>
  <DOCSIS-CMTS-US-UTIL:UsUtilIndexPercentage>80</DOCSIS-CMTS-US-
  UTIL:UsUtilIndexPercentage>

```

<sup>429</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

        <DOCSIS-CMTS-US-UTIL:UsUtilTotalMslots>1403854841</DOCSIS-CMTS-US-
UTIL:UsUtilTotalMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilUcastGrantedMslots>33281121</DOCSIS-CMTS-US-
UTIL:UsUtilUcastGrantedMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnMslots>1370280369</DOCSIS-CMTS-US-
UTIL:UsUtilTotalCtnMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnMslots>815830</DOCSIS-CMTS-US-
UTIL:UsUtilUsedCtnMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilCollCtnMslots>1332</DOCSIS-CMTS-US-
UTIL:UsUtilCollCtnMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnReqMslots>311083615</DOCSIS-CMTS-US-
UTIL:UsUtilTotalCtnReqMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnReqMslots>574833</DOCSIS-CMTS-US-
UTIL:UsUtilUsedCtnReqMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilCollCtnReqMslots>1332</DOCSIS-CMTS-US-
UTIL:UsUtilCollCtnReqMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnReqDataMslots>0</DOCSIS-CMTS-US-
UTIL:UsUtilTotalCtnReqDataMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnReqDataMslots>0</DOCSIS-CMTS-US-
UTIL:UsUtilUsedCtnReqDataMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilCollCtnReqDataMslots>0</DOCSIS-CMTS-US-
UTIL:UsUtilCollCtnReqDataMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilTotalCtnInitMaintMslots>1059212846</DOCSIS-CMTS-
US-UTIL:UsUtilTotalCtnInitMaintMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilUsedCtnInitMaintMslots>240997</DOCSIS-CMTS-US-
UTIL:UsUtilUsedCtnInitMaintMslots>
        <DOCSIS-CMTS-US-UTIL:UsUtilCollCtnInitMaintMslots>0</DOCSIS-CMTS-US-
UTIL:UsUtilCollCtnInitMaintMslots>
        <DOCSIS-REC:RecType>4</DOCSIS-REC:RecType>
    </ipdr:IPDR>
    <ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z" />
</ipdr:IPDRDoc>
```

### III.13 CMTS-DS-UTIL-STATS-TYPE<sup>430</sup>

This section provides a sample XML Instance Document for the CMTS Downstream Utilization Statistics Service Definition, CMTS-DS-UTIL-STATS-TYPE and corresponding XML Schema DOCSIS-CMTS-DS-UTIL-STATS-TYPE\_3.5.1-A.3.xsd.

#### III.13.1 Use Case

At a CMTS sysUpTime of "2226888", the CMTS "cmts01.mso.com" with MAC Domain ifIndex of "456", streams (using an event based session) the downstream utilization statistics information for the downstream channel with ifIndex of "18". In addition, the DsUtilInterval of "900" (15 minutes) and the following utilization information is included in the record:

```

IndexPercentage = 70
TotalBytes = 2668756233
UsedBytes = 3323829507
```

#### III.13.2 Instance Document<sup>431</sup>

```

<?xml version="1.0"?>
<ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
    DS-UTIL-STATS-TYPE">
```

<sup>430</sup> Section added per OSSIV3.0-N-08.0642-3 on 4/25/08 by KN and per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

<sup>430</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

<sup>431</sup> Revised per OSSIV3.0-N-10.0928-1 on 6/3/10 by JB.

```

    xmlns:DOCSIS-
    CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
        xmlns: DOCSIS-CMTS-DS-
    UTIL="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL"
            xmlns:DOCSIS-
    REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"
                xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL-STATS-TYPE
                    http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL-STATS-TYPE/DOCSIS-CMTS-DS-UTIL-STATS-TYPE_3.5.1-A.3.xsd"
                        docId="3d07ba27-0000-0000-1a2b3c4d5e6f"
                        creationTime="2006-06-05T07:11:00Z"
                        IPDRRecorderInfo="cmts01.mso.com"
                        version="3.5.1-A.2">
<ipdr:IPDR xsi:type="CMTS-DS-UTIL-STATS-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226888</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-CMTS-DS-UTIL:DsIfIndex>18</DOCSIS-CMTS-DS-UTIL:DsIfIndex>
    <DOCSIS-CMTS-DS-UTIL:DsIfName> Int/0/1/1</DOCSIS-CMTS-DS-UTIL:DsIfName>
    <DOCSIS-CMTS-DS-UTIL:DsChId>1</DOCSIS-CMTS-DS-UTIL:DsChId>
    <DOCSIS-CMTS-DS-UTIL:DsUtilInterval>900</DOCSIS-CMTS-DS-UTIL:DsUtilInterval>
    <DOCSIS-CMTS-DS-UTIL:DsUtilIndexPercentage>70</DOCSIS-CMTS-DS-UTIL:DsUtilIndexPercentage>
        <DOCSIS-CMTS-DS-UTIL:DsUtilTotalBytes>2668756233</DOCSIS-CMTS-DS-UTIL:DsUtilTotalBytes>
        <DOCSIS-CMTS-DS-UTIL:DsUtilUsedBytes>3323829507</DOCSIS-CMTS-DS-UTIL:DsUtilUsedBytes>
            <DOCSIS-REC:RecType>4</DOCSIS-REC:RecType>
        </ipdr:IPDR>
        <ipdr:IPDRDoc.End count="1" endTime="2006-06-05T07:15:00Z"/>
</ipdr:IPDRDoc>

```

## III.14 CMTS-CM-SERVICE-FLOW-TYPE<sup>432</sup>

This section provides a sample XML Instance Document for the CMTS CM Service Flow Service Definition, CMTS-CM-SERVICE-FLOW-TYPE and corresponding XML Schema DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE\_3.5.1-A.1.xsd.

### III.14.1 Use Case

At a CMTS sysUpTime of "2226888", the CMTS "cmts01.mso.com" with MAC Domain ifIndex of "456" and Service Identifier 361, streams (using an event based session) the Service Flow information. The Service Flow is a statically provisioned Best Effort Service Flow. The Service Flow has the following characteristics:

Service Flow Channel Set = 01020304

MaxRate = 1000000

MaxBurst = 2000000

Peak Rate = 3000000

Service Priority = 2

Service Class Name = premium\_up

### III.14.2 Instance Document

```

<?xml version='1.0' ?>
<ipdr:IPDRDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

```

<sup>432</sup> Revised per OSSlv3.0-N-10.0923-5 on 9/24/10 by JB.

```

        xmlns:ipdr="http://www.ipdr.org/namespaces/ipdr"
        xmlns="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-
CM-SERVICE-FLOW-TYPE"
        xmlns:DOCSIS-
QOS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS"
        xmlns:DOCSIS-
CMTS="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS"
        xmlns:DOCSIS-
REC="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC"

xsi:schemaLocation="http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-
CMTS-CM-SERVICE-FLOW-TYPE
    http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-
SERVICE-FLOW-TYPE_3.5.1-A.1.xsd"
        docId="3d07ba27-0000-0000-0000-1a2b3c4d5e6f"
        version="3.5.1-A.1"
        creationTime="2004-11-10T07:11:05Z"
        IPDRRecorderInfo="cmts01.mso.com">
<ipdr:IPDR xsi:type="CMTS-CM-SERVICE-FLOW-TYPE">
    <DOCSIS-CMTS:CmtsHostName>cmts01.mso.com.</DOCSIS-CMTS:CmtsHostName>
    <DOCSIS-CMTS:CmtsSysUpTime>2226878</DOCSIS-CMTS:CmtsSysUpTime>
    <DOCSIS-CMTS:CmtsMdIfName>Int0/1</DOCSIS-CMTS:CmtsMdIfName>
    <DOCSIS-CMTS:CmtsMdIfIndex>456</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
    <DOCSIS-REC:RecCreationTime>2004-11-10T07:11:05Z</DOCSIS-REC:RecCreationTime>
    <DOCSIS-QOS:ServiceFlowChSet>01020304</DOCSIS-QOS:ServiceFlowChSet>
    <DOCSIS-QOS:ServiceAppId>10000</DOCSIS-QOS:ServiceAppId>
    <DOCSIS-QOS:ServiceDsMulticast>false</DOCSIS-QOS:ServiceDsMulticast>
    <DOCSIS-QOS:ServiceIdentifier>361</DOCSIS-QOS:ServiceIdentifier>
    <DOCSIS-QOS:ServiceGateId></DOCSIS-QOS:ServiceGateId>
    <DOCSIS-QOS:ServiceClassName>premium_up</DOCSIS-QOS:ServiceClassName>
    <DOCSIS-QOS:ServiceDirection>2</DOCSIS-QOS:ServiceDirection>
    <DOCSIS-QOS:ServiceTimeCreated>2210822</DOCSIS-QOS:ServiceTimeCreated>
    <DOCSIS-SERVICE-FLOW:ServiceTrafficPriority>2</DOCSIS-SERVICE-
FLOW:ServiceTrafficPriority>
        <DOCSIS-SERVICE-FLOW:ServiceMaxSustained>1000000</DOCSIS-SERVICE-
FLOW:ServiceMaxSustained>
        <DOCSIS-SERVICE-FLOW:ServiceMaxBurst>2000000</DOCSIS-SERVICE-
FLOW:ServiceMaxBurst>
        <DOCSIS-SERVICE-FLOW:ServiceMinReservedRate>0</DOCSIS-SERVICE-
FLOW:ServiceMinReservedRate>
        <DOCSIS-SERVICE-FLOW:ServiceIpTos></DOCSIS-SERVICE-FLOW:ServiceIpTos>
        <DOCSIS-SERVICE-FLOW:ServicePeakRate>3000000</DOCSIS-SERVICE-
FLOW:ServicePeakRate>
        <DOCSIS-SERVICE-FLOW:ServiceSchedule>2</DOCSIS-SERVICE-FLOW:ServiceSchedule>
        <DOCSIS-SERVICE-FLOW:ServiceNomPollInterval></DOCSIS-SERVICE-
FLOW:ServiceNomPollInterval>
        <DOCSIS-SERVICE-FLOW:ServiceTolPollJitter></DOCSIS-SERVICE-
FLOW:ServiceTolPollJitter>
        <DOCSIS-SERVICE-FLOW:ServiceUGSize></DOCSIS-SERVICE-FLOW:ServiceUGSize>
        <DOCSIS-SERVICE-FLOW:ServiceNomGrantInterval></DOCSIS-SERVICE-
FLOW:ServiceNomGrantInterval>
        <DOCSIS-SERVICE-FLOW:ServiceTolGrantJitter></DOCSIS-SERVICE-
FLOW:ServiceTolGrantJitter>
        <DOCSIS-SERVICE-FLOW:ServiceGrantsPerInterval></DOCSIS-SERVICE-
FLOW:ServiceGrantsPerInterval>
        <DOCSIS-SERVICE-FLOW:ServicePacketClassifier></DOCSIS-SERVICE-
FLOW:ServicePacketClassifier>

    </ipdr:IPDR>
    <ipdr:IPDRDoc.End count="1" endTime="2004-11-10T07:11:08Z" />
</ipdr:IPDRDoc>

```

## Appendix IV IPDR/SP Message Encoding Details

The CMTS encodes the IPDR/SP messages as indicated in the following subsections. Refer to Table 1 of [IPDR/SP] for the complete message set for IPDR/SP including the direction for each message. This section provides an example of the schematic representation of the XDR encoding of the CMTS Subscriber Usage Billing (SAMIS-TYPE-1) messages originating from the CMTS (i.e., Exporter-to-Collector).

### IV.1 IPDR/SP Message Header

For details on connection related messages, see the section on Common Header in [IPDR/SP]. The messageLen field value of 'n' denotes the total length of the IPDR/SP Message in octets including the header.

```
<IPDRStreamingHeader>
  <version> 2 </version>
  <!-- Encoded as a CONNECT message -->
  <messageId> 0x05 </messageId>
  <!-- Encoded as zero since this is a
connection related message -->
  <sessionId> 0 </sessionId>
  <!-- No flags are defined in [IPDR/SP] -->
  <messageFlags> 0 </messageFlags>
  <!-- A value of n denotes the total length of the IPDR/SP
Message in octets including the header -->
  <messageLen> n </messageLen>
</IPDRStreamingHeader>
```

### IV.2 IPDR/SP Version Discovery Messages

#### IV.2.1 VERSION REQUEST

```
<VersionRequest>
  <!-- The CMTS is using 10.10.3.1 as the IP address -->
  <requesterAddress> 10.10.3.1 </requesterAddress>
  <!-- The CMTS boot time in seconds from epoch time -->
  <requesterBootTime> 1157564677261 </requesterBootTime>
  <!-- version 2 -->
  <msg> IPDR </msg>
</VersionRequest>
```

#### IV.2.2 VERSION RESPONSE

```
<VersionResponse>
  <ProtocolInfo>
    <!-- using TCP as transportType -->
    <transportType> 1 </transportType>
    <!-- IPDR Streaming Protocol version supported -->
    <protocolVersion> 2 </protocolVersion>
    <!-- The standard TCP port 4737 -->
    <portNumber> 4737 </portNumber>
    <!-- unused -->
    <reserved> 0 </reserved>
  </ProtocolInfo>
</VersionResponse>
```

## IV.3 IPDR/SP Connection Messages

### IV.3.1 CONNECT

```

<Connect>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <b><!– denotes a CONNECT message –></b>
        <messageId> 0x05 </messageId>
<b><!– Encoded as zero since this is a
connection related message –></b>
    <sessionId> 0 </sessionId>
    <messageFlags> 0 </messageFlags>
    <messageLength> n </messageLength>
</IPDRStreamingHeader>
<b><!– The CMTS Is using 10.10.3.1 as the IP address –></b>
    <initiatorAddress> 10.10.3.1 </initiatorAddress>
<b><!– The standard TCP port 4737 –></b>
    <initiatorPort> 4737 </initiatorPort>
<b><!– The capabilities encoding assumes the Structures bit (S) and
Template Negotiation bit (T) are both enabled. –></b>
    <capabilities> 5 </capabilities>
<b><!– 60 second keep alive interval –></b>
    <keepAliveInterval> 60 </keepAliveInterval>
<b><!– Vendor Identifier of the connection
Initiator (exporter) –></b>
    <vendorId> CMTS Vendor XYZ </vendorId>
</Connect>

```

### IV.3.2 CONNECT RESPONSE

```

<ConnectResponse>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <b><!– messageId denotes a CONNECT RESPONSE message –></b>
        <messageId> 0x06 </messageId>
        <sessionId> 0 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
</IPDRStreamingHeader>
<b><!– The capabilities encoding assumes the Structures bit (S) and
Template Negotiation bit (T) are both enabled. –></b>
    <capabilities> 5 </capabilities>
    <keepAliveInterval> 60 </keepAliveInterval>
<b><!– Vendor Identifier of the responder (exporter) –></b>
    <vendorId> CMTS Vendor XYZ </vendorId>
</ConnectResponse>

```

### IV.3.3 DISCONNECT

```

<Disconnect>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <b><!– messageId denotes a DISCONNECT message –></b>
        <messageId> 0x07 </messageId>
        <sessionId> 0 </sessionId>

```

```

<messageFlags> 0 </messageFlags>
<messageLength> n </messageLength>
</IPDRStreamingHeader>
</Disconnect>

```

## IV.4 IPDR/SP Error Messages

```

<Error>
  <IPDRStreamingHeader>
    <version> 2 </version>
    <b><!- messageId denotes an ERROR message -></b>
    <messageId> 0x23 </messageId>
    <b><!- the sessionId in which this error has occurred -></b>
    <sessionId> session1 </sessionId>
    <messageFlags> 0 </messageFlags>
    <messageLength> n </messageLength>
  </IPDRStreamingHeader>
  <b><!- time of error in seconds from epoch time -></b>
  <timeStamp> 1157564677261 </timeStamp>
  <b><!- this errorCode corresponds to keepalive expired</b>
  <b>error (standard error code 0). It has the MSB (for dataType short)</b>
  <b>set to indicate a session specific error -></b>
  <errorCode> 32768 </errorCode>
  <b><!- the standard error description for errorCode 0 -></b>
  <description> keepalive expired </description>
</Error>

```

## IV.5 IPDR/SP Flow Control Messages

### IV.5.1 FLOW START/STOP

CMTS expects IPDR collector to issue FLOW START before it can start session transmission. The sessionId in the common header will be 0 if only a single session is supported. If multiple sessions are supported, the sessionId in FLOW START message will be one of the sessionIds configured on the CMTS and the IPDR collector.

If IPDR collector issues FLOW STOP, the current session corresponding to the sessionId in the header will be stopped for transmission. If only a single session is supported, sessionId will be 0. If multiple sessions are supported, the sessionId in the common header of the FLOW STOP message will be one of the sessionIds configured on the CMTS and the IPDR collector.

### IV.5.2 SESSION START

```

<SessionStart>
  <IPDRStreamingHeader>
    <version> 2 </version>
    <b><!- messageId denotes a SESSION START message -></b>
    <messageId> 0x08 </messageId>
    <b><!- uses session1 as the sessionId -></b>
    <sessionId> session1 </sessionId>
    <messageFlags> 0 </messageFlags>
    <messageLength> n </messageLength>
  </IPDRStreamingHeader>
  <b><!- boot time of cmts in seconds from epoch time -></b>
  <exporterBootTime> 1157564677261 </exporterBootTime>
  <b><!- no records dropped in gap situations -></b>
  <b><!- uses 1 as the first sequence number of data record -></b>
  <firstRecordSequenceNumber> 1 </firstRecordSequenceNumber>

```

```

<droppedRecordCount> 0 </droppedRecordCount>
<!-- the primary collector -->
<primary> 1 </primary>
<!-- uses 30 seconds as the maximum time between acknowledge from collector -->
<ackTimeInterval> 30 </ackTimeInterval>
<!-- number of unacknowledged records is 0 -->
<ackSequenceInterval> 0 </ackSequenceInterval>
<!-- uses the following UUID in the data being sent in this session -->
<documentId> C8A93279-0000-0000-0000-0002FC84F870 </documentId>
</SessionStart>

```

#### IV.5.3 SESSION STOP

```

<SessionStop>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes a SESSION STOP message -->
        <messageId> 0x09 </messageId>
        <sessionId> session1 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- this reasonCode denotes end of data for session -->
    <reasonCode> 0 </reasonCode>
    <!-- the standard description associated with reasonCode 0 -->
    <reasonInfo> end of data for session </reasonInfo>
</SessionStop>

```

### IV.6 IPDR/SP Template Messages

#### IV.6.1 TEMPLATE DATA<sup>433</sup>

```

<TemplateData>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes a TEMPLATE DATA message -->
        <messageId> 0x10 </messageId>
        <sessionId> 0 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- configId 0 denotes Template Set Configuration change is not supported -->
    <configId> 0 </configId>
    <!-- flags denote non negotiable Template Data message -->
    <flags> 0 </flags>
    <TemplateBlock>
        <!-- The templateId 1 is used by exporter -->
        <templateId> 1 </templateId>
        <!-- reference to IPDR service specification -->

```

<sup>433</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 by KN, per OSSIV3.0-N-07.0478-2 by ab on 7/12/07, and per OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```

<schemaName> http://www.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-
TYPE-1/DOCSIS-SAMIS-TYPE-1_3.5.1-A.1.xsd
    </schemaName>
    <!-- reference to typeName -->
    <typeName> DOCSIS-SAMIS-TYPE-1:SAMIS-TYPE-1 </typeName>
    <fieldDescriptor>
        <!-- dataType of the filed -->
        <typeId> string </typeId>
        <!-- field code for this filed -->
        <fieldId> 1 </fieldId>
        <!-- namespace qualified filed name for CmtsHostName -->
        <fieldName> DOCSIS-CMTS:CmtsHostName </fieldName>
        <!-- This filed is enabled -->
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 2 </fieldId>
        <fieldName> DOCSIS-CMTS:CmtsSysUpTime</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> ipv4addr </typeId>
        <fieldId> 3 </fieldId>
        <fieldName>
            DOCSIS-CMTS:CmtsIpv4Addr
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> ipV6addr </typeId>
        <fieldId> 4 </fieldId>
        <fieldName>
            DOCSIS-CMTS:CmtsIpv6Addr
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> string </typeId>
        <fieldId> 5 </fieldId>
        <fieldName>
            DOCSIS-CMTS:CmtsMdIfName
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 6 </fieldId>
        <fieldName>
            DOCSIS-CMTS:CmtsMdIfIndex
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> macAddr </typeId>
        <fieldId> 7 </fieldId>
        <fieldName> DOCSIS-CM:CmMacAddr </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> ipV4Addr </typeId>
        <fieldId> 8 </fieldId>
    
```

```
        <fieldName> DOCSIS-CM:CmIpv4Addr </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> ipV6Addr </typeId>
        <fieldId> 9 </fieldId>
        <fieldName> DOCSIS-CM:CmIpv6Addr </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> ipV6Addr </typeId>
        <fieldId> 10 </fieldId>
        <fieldName>
            DOCSIS-CM:CmIpv6LinkLocalAddr
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> string </typeId>
        <fieldId> 11 </fieldId>
        <fieldName>
            DOCSIS-CM:CmQosVersion
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> integer </typeId>
        <fieldId> 12 </fieldId>
        <fieldName> DOCSIS-CM:CmRegStatusValue </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> dateTime </typeId>
        <fieldId> 13 </fieldId>
        <fieldName>
            DOCSIS-CM:CmLastRegTime
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> integer </typeId>
        <fieldId> 14 </fieldId>
        <fieldName> DOCSIS-REC:RecType </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> dateTimeMsec </typeId>
        <fieldId> 15 </fieldId>
        <fieldName>
            DOCSIS-REC:RecCreationTime
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> hexBinary </typeId>
        <fieldId> 16 </fieldId>
        <fieldName>
            DOCSIS-QOS:ServiceFlowChSet
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
```

```

        <fieldId> 17 </fieldId>
        <fieldName>
            DOCSIS-QOS:ServiceAppId
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> boolean </typeId>
        <fieldId> 18 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceDsMulticast
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 19 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceIdentifier
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 20 </fieldId>
        <fieldName>
DOCSIS-QOS:GateId
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> string </typeId>
        <fieldId> 21 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceClassName
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> integer </typeId>
        <fieldId> 22 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceDirection
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedLong </typeId>
        <fieldId> 23 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceOctetsPassed
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedLong </typeId>
        <fieldId> 24 </fieldId>
        <fieldName>
DOCSIS-QOS:ServicePktsPassed
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>

```

```

        <typeId> unsignedInt </typeId>
        <fieldId> 25 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceSlaDropPkts
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 26 </fieldId>

<fieldName>
DOCSIS-QOS:ServiceSlaDelayPkts
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 27 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceTimeCreated
        </fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
    <fieldDescriptor>
        <typeId> unsignedInt </typeId>
        <fieldId> 28 </fieldId>
        <fieldName>
DOCSIS-QOS:ServiceTimeActive
</fieldName>
        <isEnabled> 1 </isEnabled>
    </fieldDescriptor>
</TemplateBlock>
</TemplateData>

```

#### IV.6.2 MODIFY TEMPLATE RESPONSE

The MODIFY TEMPLATE RESPONSE message is optional as specified in [IPDR/SP].

```

<ModifyTemplateResponse>
    <IPDRStreamingHeader>
        <version> 2 </version>
    <!-- messageId denotes a MODIFY TEMPLATE
        RESPONSE message -->
        <messageId> 0x1b </messageId>
        <sessionId> session1 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- configId 0 denotes Template Set Configuration change
        is not supported -->
    <configId> 0 </configId>
    <!-- unused flags -->
    <flags> 0 </flags>
    <TemplateBlock>
        [The template Block as described in Template Data
            (Section IV.6.1)]
        </TemplateBlock>
    </ModifyTemplateResponse>

```

#### IV.6.3 START NEGOTIATION REJECT

The START NEGOTIATION REJECT message is optional as specified in [IPDR/SP].

```
<StartNegotiationReject>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes a START NEGOTIATION
             REJECT message -->
        <messageId> 0x1e </messageId>
        <!-- the sessionId associated -->
        <sessionId> session1 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
</StartNegotiationReject>
```

### IV.7 IPDR/SP Data Messages

#### IV.7.1 DATA<sup>434</sup>

```
<Data>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes a DATA message -->
        <messageId> 0x20 </messageId>
        <sessionId> session1 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- used templateId 1 corresponding to this session -->
    <templateId> 1 </templateId>
    <!-- configId 0 denotes Template Set Configuration change
         is not supported -->
    <configId> 0 </configId>
    <!-- indicates that this data is not a duplicate -->
    <flags> 0 </flags>
    <!-- sequence number relative to this session. This is the first
         Record being sent -->
    <sequenceNum> 1 </sequenceNum>
    <!-- the data record -->
    <dataRecord>
        <ipdr:IPDR xsi:type="SAMIS-TYPE-1">
            <DOCSIS-CMTS:CmtsHostName>
                cmts01.mso.com
            </DOCSIS-CMTS:CmtsHostName>
            <DOCSIS-CMTS:CmtsSysUpTime>
                2226878
            </DOCSIS-CMTS:CmtsSysUpTime>
            <DOCSIS-CMTS:CmtsIpv4Addr>
                10.40.57.11
            </DOCSIS-CMTS:CmtsIpv4Addr>
            <DOCSIS-CMTS:CmtsIpv6Addr>
                2001:0400:0000:0000:0000:FF00:FE00:0000
            </DOCSIS-CMTS:CmtsIpv6Addr>
            <DOCSIS-CMTS:CmtsMdIfName>
                Int0/1
            </DOCSIS-CMTS:CmtsMdIfName>
        </ipdr:IPDR>
    </dataRecord>
</Data>
```

<sup>434</sup> Section revised per OSSIV3.0-N-07.0447-2 on 5/10/07 and OSSIV3.0-N-08.0616-2 on 4/11/08 by KN.

```
</DOCSIS-CMTS:CmtsMdIfName>
    <DOCSIS-CMTS:CmtsMdIfIndex>
456
</DOCSIS-CMTS:CmtsMdIfIndex>
    <DOCSIS-CM:CmMacAddr>
00-09-36-A7-70-89
</DOCSIS-CM:CmMacAddr>
    <DOCSIS-CM:CmIpv4Addr>
55.12.48.113
</DOCSIS-CM:CmIpv4Addr>
    <DOCSIS-CM:CmIpv6Addr>
2001:0400:0000:0000:0000:1000:FF00:0000
</DOCSIS-CM:CmIpv6Addr>
    <DOCSIS-CM:CmIpv6LinkLocalAddr>
        FE80:0000:0000:0000:0209:36FF:FEA7:7089
    </DOCSIS-CM:CmIpv6LinkLocalAddr>
    <DOCSIS-CM:CmQosVersion>
        2
    </DOCSIS-CM:CmQosVersion>
    <DOCSIS-CM:CmRegStatusValue>
        8
    </DOCSIS-CM:CmRegStatusValue>
    <DOCSIS-CM:CmLastRegTime>
        2006-06-04T09:15:00Z
    </DOCSIS-CM:CmLastRegTime>
    <DOCSIS-REC:RecType>1</DOCSIS-REC:RecType>
    <DOCSIS-REC:RecCreationTime>
2004-11-10T07:11:05Z
</DOCSIS-REC:RecCreationTime>
    <DOCSIS-QOS:ServiceFlowChSet>
01020304
</DOCSIS-QOS:ServiceFlowChSet>
    <DOCSIS-QOS:ServiceAppId>10000</DOCSIS-QOS:ServiceAppId>
    <DOCSIS-QOS:ServiceDsMulticast>
False
</DOCSIS-QOS:ServiceDsMulticast>
    <DOCSIS-QOS:ServiceIdentifier>
361
</DOCSIS-QOS:ServiceIdentifier>
    <DOCSIS-QOS:ServiceClassName>
Premium
</DOCSIS-QOS:ServiceClassName>
    <DOCSIS-QOS:ServiceDirection>
        2
    </DOCSIS-QOS:ServiceDirection>
        <DOCSIS-QOS:ServiceOctetsPassed>
16486400
</DOCSIS-QOS:ServiceOctetsPassed>
        <DOCSIS-QOS:ServicePktsPassed>
82431
</DOCSIS-QOS:ServicePktsPassed>
        <DOCSIS-QOS:ServiceSlaDropPkts>
412
</DOCSIS-QOS:ServiceSlaDropPkts>
        <DOCSIS-QOS:ServiceSlaDelayPkts>
8
</DOCSIS-QOS:ServiceSlaDelayPkts>
        <DOCSIS-QOS:ServiceTimeCreated>
2210822
</DOCSIS-QOS:ServiceTimeCreated>
        <DOCSIS-QOS:ServiceTimeActive>
161
</DOCSIS-QOS:ServiceTimeActive>
```

```

        </ipdr:IPDR>
    </dataRecord>
</Data>

```

## IV.8 IPDR/SP State Independent Messages

### IV.8.1 GET SESSIONS RESPONSE <sup>435</sup>

```

<GetSessionsResponse>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes a GET SESSIONS RESPONSE message -->
        <messageId> 0x15 </messageId>
        <sessionId> 1 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- using requestId 5, assuming the initial GET SESSIONS Request
        had the same requestId -->
    <requestId> 5 </requestId>
    <!-- description of supported sessions
Note: Additional SessionBlocks to represent other
session configurations are left to vendor discretion -->
    <SessionBlock>
        <!-- sessionId associated with this session -->
        <sessionId> 1 </sessionId>
        <!-- sessionType field is used to provide session type information -->
        <sessionType> 1 </sessionType>
        <!-- the optional session name, same as sessionId -->
        <sessionName> session1 </sessionName>
        <!-- session description -->
    <sessionDescription>
        SAMIS TYPE-1 time interval session
    </sessionDescription>
    <!-- uses 30 seconds as the maximum time between acknowledge
        from collector -->
    <ackTimeInterval> 30 </ackTimeInterval>
    <!-- number of unacknowledged records is 0 -->
    <ackSequenceInterval> 0 </ackSequenceInterval>
    </SessionBlock>
</GetSessionsResponse>

```

### IV.8.2 GET TEMPLATES RESPONSE

```

<GetTemplatesResponse>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes GET TEMPLATES
            RESPONSE message -->
        <messageId> 0x17 </messageId>
        <sessionId> 0 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
    <!-- using requestId 5, assuming the initial GET TEMPLATES Request

```

<sup>435</sup> Revised per OSSIV3.0-N-09.0849-6 on 11/20/09 by JB.

```
had the same requestId ->
<requestId> 5 </requestId>
<!-- configId 0 denotes Template Set Configuration change
     is not supported -->
<configId> 0 </configId>
<TemplateBlock>
    [The template Block as described in Template
Data(Section IV.6.1)]
</TemplateBlock>
</GetTemplatesResponse>
```

#### IV.8.3 KEEP ALIVE

```
<KeepAlive>
    <IPDRStreamingHeader>
        <version> 2 </version>
        <!-- messageId denotes the KEEP ALIVE message -->
        <messageId> 0x40 </messageId>
        <sessionId> 0 </sessionId>
        <messageFlags> 0 </messageFlags>
        <messageLength> n </messageLength>
    </IPDRStreamingHeader>
</KeepAlive>
```

## Appendix V Signal Quality Use Cases (Informative)

This appendix describes several use cases where the Signal Quality Monitoring features introduced in DOCSIS 3.0 can be utilized to manage the HFC plant.

To maintain the HFC network in optimal conditions constant monitoring of the physical characteristics is desired. This practice helps in the early detection of plant problems. These problems, if not properly corrected could cause degradation of services that are offered over the DOCSIS network. The RF impairments may often be the root cause of the problem affecting the quality of services offered over DOCSIS. These impairments result in excessive logging, and poor statistics indicating a lower quality of experience for customer of the services.

Ideally, rather than inferring the presence of RF impairments in the HFC from DOCSIS MAC statistics (for example), the use of Signaling Quality measurement equipment dedicated to monitor the HFC spectrum is desired. However, the cost of such equipment and its associated management and operation may not be justifiable. Instead, active network elements such as CMTSs have evolved their capabilities to report RF measurements using an SNMP management interface. The main advantage of this approach is the constant availability of information across the network. Such information can be correlated to determine e.g., a group of CMs with a common tap in the HFC path reporting the same measurements problem. The signal monitoring approach is similar to how specialized equipment is used to further isolate the problems based on the coarse measurements from a CMTS.

This appendix describes use cases for two main categories of the Enhanced Signaling Quality Monitoring features of DOCSIS 3.0:

- Normalization of RF Impairments Measurements
- Spectrum Amplitude Measurements for Upstream Interfaces

### V.1 Normalization of RF Impairments Measurements

#### V.1.1 Problem Description

DOCSIS [RFC 4546] provides SNR (Signal-to-Noise) measurement. SNR among other measurements are available on a per CM basis and per interface.

SNR values reported may not be uniform amongst different CMTS vendors. Therefore it might not be possible to compare and analyze information from different devices to determine the HFC plant conditions.

#### V.1.2 Use Cases

Major contributors to impairments in the DOCSIS channels are linear distortion, non-linear distortion, impulse noise and ingress noise.

DOCSIS pre-equalization provides a mechanism to correct the linear distortion of each individual CM transmission. Ingress noise robustness has no specification requirements beyond the assumed RF plant conditions in [PHY]. However, vendors have provided mechanisms to mitigate noise and ingress interference in plants that have more severe noise conditions than the ones assumed in the [PHY] specification.

The available RF measurements in DOCSIS 3.0 are listed in Table V-1 where the DOCSIS 3.0 added features are indicated in **bold** text and are the basis for the use cases of this section. In general, downstream RF measurements are performed by individual CMs while the upstream measurements are performed by the CMTS either at an interface or at a CM level. Based on CMTS and CM interactions, the CM provides an indirect measure of the distortion in the upstream channel through its pre-equalization coefficients.

**Table V-1 - RF Management Statistics available in DOCSIS 3.0**

CM (Downstream Measurements)	CMTS (Upstream Measurements)	Measurements Categories
SNR	SNR	Noise conditions
<b>RxMER</b>	<b>RxMER</b>	
	<b>CNIR</b>	
	<b>Expected Received Power</b>	Power level

CM (Downstream Measurements)	CMTS (Upstream Measurements)	Measurements Categories
Correctable/uncorrectable errors	Correctable/uncorrectable errors per CM	FEC performance statistics
	Correctable/uncorrectable errors per US interface	
Downstream micro-reflections	Upstream micro-reflections per CM	Linear distortion
CM post-equalization data	CM pre-equalization <sup>1</sup>	

**Note:**  
<sup>1</sup>CM may provide more accurate pre-equalization coefficient than what the CMTS is able to calculate.

The following use cases refer to the noise measurement enhancements for DOCSIS 3.0.

#### V.1.2.1 Use Case 1: Figure of Merit Estimation for Logical Upstream Channel

This Use Case defines a Figure of Merit for Logical Upstream Channel measurement that an operator can use to periodically collect information to characterize the performance of the HFC part of the Cable distribution network.

To overcome non-uniform SNR measurements, DOCSIS 3.0 defines two measurements: RxMER (Receive Modulation Error Rate) and CNIR (Carrier to Noise plus Interference Ratio). These provide better indication of the HFC plant impairments and the corrections achieved by the CMTS through compensation techniques. Combining RxMER and CNIR, a Figure of Merit of impairment compensation efficiency can be defined when noise or interference is present.

RxMER measures the average quantization error just prior to FEC, and CNIR measures the carrier to noise plus interference ratio prior to demodulation. A Figure of Merit of how efficiently interference and distortion is compensated in a logical channel can be defined as:

$$\text{Figure of Merit (logical channel)} = \text{RxMER} - \text{CNIR}$$

The variables from Annex J to retrieve are:

- RxMER: docsIf3SignalQualityExtRxMER
- CNIR: docsIf3CmtsSignalQualityExtCNIR

The Figure of Merit is relevant when the device is capable of suppressing ingressors, thus increasing the RxMER value with respect to the channel CNIR.

To minimize the uncertainties in measuring the Figure of Merit due to distortion that is unique to individual upstream paths between a CM and CMTS, it is advisable to operate with pre-equalization on (see docsIfUpChannelPreEqEnable of [RFC 4546]).

#### V.1.2.2 Use Case 2 Figure of Merit Estimation per CM<sup>436</sup>

This Use Case defines a Figure of Merit per CM transmission. Similar to Use Case 1, the operator can periodically collect information to characterize the performance of CMs in terms of figure of Merit for the given CMTS the CM is attached to.

Unlike RxMER, the SNR parameter is unique for each CM. This allows you to define a Figure of Merit on a per CM basis. A Figure of Merit of how efficiently interference and distortion affecting a CM is compensated can be defined as:

$$\text{Figure of Merit (CM)} = \text{SNR (CM)} - \text{CNIR (of the logical upstream channel)}$$

The variables from Annex Q and Annex J to retrieve are:

- SNR: docsIf3CmtsCmUsStatusSignalNoise
- CNIR: docsIf3CmtsSignalQualityExtCNIR

<sup>436</sup> Section revised per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

This Figure of Merit indicates if a CM, through its pre-equalization mechanism, is efficiently compensating the linear distortion in its upstream path.

#### **V.I.2.3      Use Case 3 Absolute Noise and Interference Estimation<sup>437</sup>**

Traditionally CMTSs are expected to command the CMs' power transmission so that the CMTS received power is close to 0 dBmV across all CMs.

This Use Case defines how an operator may derive the absolute value of the noise plus interference (in dBmV) from the reported value (CNIR in dB) which is a relative measure.

For example, CNIR and ExpectedRxSignalPower can be used to estimate noise and interference levels (N+I) across the operator's network in dBmV as:

$$N + I = CNIR - \text{ExpectedRxSignalPower} \text{ (CMs of the logical upstream channel)}$$

Operators may determine the difference between the target and the actual received power at the CMTS using the following equation:

$$\text{CM Offset Power} = \text{CM Rx Power} - \text{ExpectedRxSignalPower}$$

The variables from Annex Q and Annex J to retrieve are:

- CM Rx Power: docsIf3CmtsCmUsStatusRxPower
- ExpectedRxSignalPower: docsIf3CmtsSignalQualityExtExpectedRxSignalPower

#### **V.I.2.3.1      CM Estimated CNIR**

Operators may estimate individual CM CNIR by combining the CNIR obtained for the logical channel and the CM offset power as follows:

$$\text{CM Estimated CNIR} = \text{CM Offset Power} + \text{CNIR}$$

CM Offset Power: The difference between the actual received CM power level and the expected commanded received signal power at the CMTS.

The variables from Annex Q and Annex J to retrieve are:

- CNIR: docsIf3CmtsSignalQualityExtCNIR
- CM Rx Power: docsIf3CmtsCmUsStatusRxPower
- Expected Commanded Received Signal Power: docsIf3CmtsSignalQualityExtExpectedRxSignalPower

## **V.2      Upstream Spectrum Measurement Monitoring**

### **V.2.1      Problem Description**

Placing spectrum analyzers to obtain granular spectrum monitoring to achieve extensive coverage of the number of nodes, the number of channels, increased frequency of samples, and with increased frequency resolution is cost prohibitive and cumbersome. Such limited coverage complicates agile troubleshooting of plant spectrum.

### **V.2.2      Use Cases**

DOCSIS 3.0 adds the spectrum monitoring feature where the management system requests CMTSs to perform spectrum measurement over an upstream channel.

#### **V.2.2.1      Use Case 1 Spectrum Analysis Measurement Setup**

This Use Case describes the operator configuration procedure to start the measurements of spectrum amplitude values for a specific channel.

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<sup>437</sup> Section revised per OSSIV3.0-N-07.0550-2 by ab on 11/9/07.

The operator only needs to select the logical upstream channel for which the upstream receiver will capture the spectrum amplitude. SNMP is used to trigger the test using a read-create RowStatus object set to 'CreateAndGo'.

The CMTS reports the following pre-configured parameters (refer to Annex J for object details):

- The *NumberOfBins* is the number of data points that compose the spectral data.
- The *FrequencySpan* is the width of the band across which the spectral amplitudes characterizing the channel are measured.
- The *ResolutionBW* is the equivalent noise bandwidth for each bin.
- The *TimeInterval* is the estimated average repetition period of measurements defining the average rate at which new spectra can be retrieved. An SNMP manager should not attempt to collect the data at a higher rate than the value specified.
- The *BinSpacing* is the frequency separation between adjacent bin centers.

#### **V.2.2.2      Use Case 2 Data Retrieval**

This Use Case describes a typical procedure for the retrieval of spectrum amplitude data from the CMTS. The data can be retrieved via SNMP or streamed by the CMTS using the Spectrum Amplitude IPDR Service Definition defined in Annex J.

Section 8 illustrates the detailed steps for the IPDR connection establishment and data retrieval. The following process briefly defines the data retrieval process. Refer to Section 6.2 for details on the IPDR Streaming Protocol.

The collector opens a connection with the CMTS. If a reliable collection mechanism is not required, there is no need to have a backup collector.

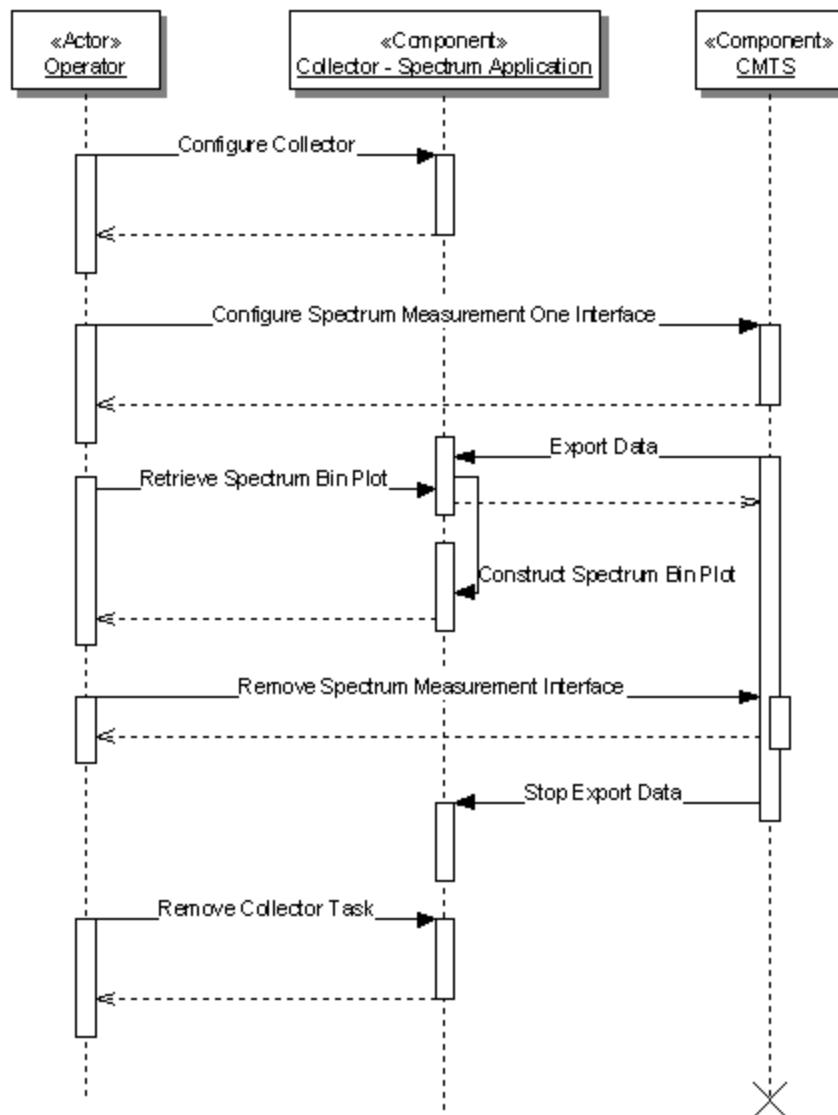
The CMTS is configured to generate data for a given interface.

When the CMTS setup is complete, it starts the transfer of information to the collector.

The operator can then use an application to plot the information collected as shown in Figure V-1 and Figure V-2.

When the operator no longer wishes to continue retrieving information, the operator can remove the measurement point in the CMTS which suspends the data generation and export. The operator can then tear down the previously established IPDR/SP connection.

The Figure V-1 shows the sequence diagram for streaming of spectrum analysis measurement data. The operator selects the logical upstream channel of interest. The CMTS starts the data streaming to the collector. After the data is captured, the streaming may be terminated.



**Figure V-1 - Sequence Diagram for Streaming of Spectrum Analysis Measurement Data**

### V.2.2.3 Use Case 3 Data Analysis

Table V-2 shows a data point for a given time and plotted in Figure V-2 and Figure V-3 as the "current" data series. For this analysis, the following parameters are known from the configuration:

Center Frequency of the channel is 25000000 Hz and is reported in the 129th bin (assuming 257 bins).

Frequency Span is 3200000 Hz (Channel Width)

Bin Spacing is 12500 Hz

From the collected data, the following parameters can be derived:

Frequency of the lower bin is 23400000 Hz

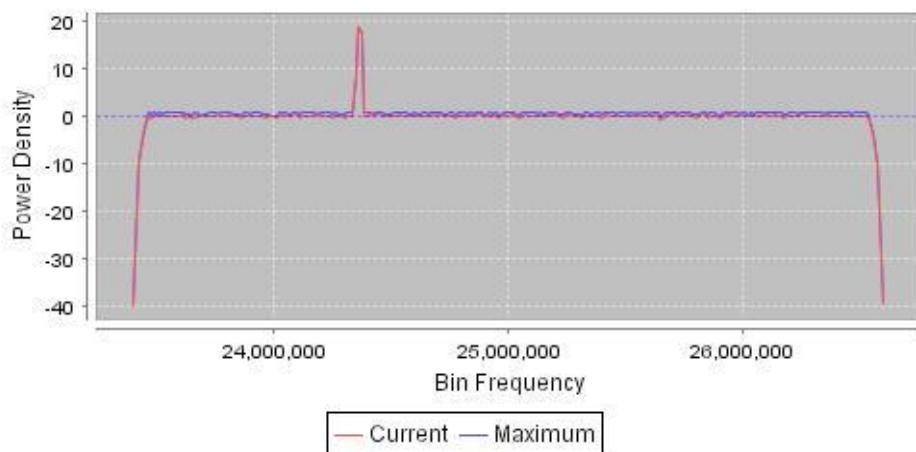
Frequency of the upper bin is 26600000 Hz

Figure V-2 shows the plotted graph of two data series. The first series "Current" consist of the current spectral content characterized by the frequency bin amplitude values. The second data series is the "Maximum" amplitude values per frequency bin recorded over time (max hold). Each time a new measurement point is collected the figure is updated. Figure V-3 zooms around 24 MHz to show the presence of an interferer.

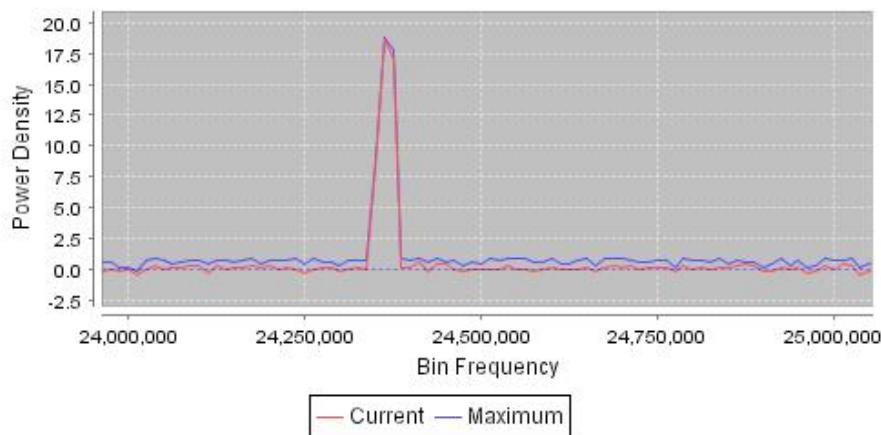
**Table V-2 - Spectrum Analysis Measurement Constructed Graph from collected data**

First Bin Frequency (For Reference)	Bin Amplitude Values for 8 bins (Decimal)	Bin Amplitude Values for 8 bins (Hexadecimal)
23400000	-39.73 -20.60 -9.23 -4.77 -2.90 -0.08 -0.32 -0.07	F07A F7F4 FC64 FE23 FEDE FFF7 FFDF FFF9
23500000	-0.06 -0.03 -0.08 -0.16 -0.08 0.16 0.13 -0.09	FFFA FFAC FFF8 FFF0 FFF7 000F 000C FFF7
23600000	0.10 0.28 -0.24 -0.02 -0.38 -0.23 -0.01 -0.20	0009 001B FFE8 FFFE FFDA FFE9 FFFE FFEB
23700000	0.08 0.02 0.03 0.04 0.11 0.20 -0.03 0.13	0007 0001 0002 0004 000A 0014 FFFD 000C
23800000	-0.05 0.42 0.11 -0.05 -0.05 -0.36 0.12 -0.06	FFFB 0029 000A FFFB FFFA FFDC 000B FFFA
23900000	-0.07 0.03 -0.13 0.15 -0.17 -0.25 -0.01 -0.13	FFF8 0003 FFF3 000E FFEF FFE6 FFFE FFF3
24000000	-0.09 -0.47 -0.08 0.19 -0.03 0.09 0.13 0.27	FFF7 FFD0 FFF7 0013 FFFD 0009 000D 001A
24100000	0.23 -0.27 0.19 -0.08 0.17 0.11 0.25 0.06	0016 FFE4 0013 FFF7 0010 000A 0019 0005
24200000	0.26 0.00 0.03 -0.08 -0.33 -0.05 0.10 0.08	0019 0000 0003 FFF8 FFDE FFFB 0009 0007
24300000	-0.21 -0.11 0.07 -0.03 8.25 18.67 17.01 0.16	FFEA FFF5 0006 FFFC 0339 074A 06A4 0010
24400000	0.17 0.48 -0.15 0.34 0.40 -0.01 -0.12 0.02	0011 0030 FFF1 0022 0028 FFFE FFF3 0001
24500000	0.01 0.00 -0.08 0.30 -0.04 -0.04 -0.19 -0.01	0001 FFFF FFF7 001D FFFB FFFB FFED FFFF
24600000	0.13 -0.08 -0.07 0.02 0.12 -0.20 0.11 0.25	000D FFF7 FFF9 0002 000B FFEB 000B 0018
24700000	0.04 0.32 -0.11 0.03 0.16 0.06 -0.26 0.28	0004 001F FFF5 0003 000F 0005 FFE6 001B
24800000	-0.05 0.11 0.01 0.14 0.10 0.26 0.34 0.23	FFFB 000A 0000 000E 000A 0019 0022 0017
24900000	-0.18 -0.17 0.15 -0.11 0.08 -0.29 -0.20 0.32	FFED FFEE 000F FFF4 0008 FFE3 FFEC 0020
25000000	-0.10	FFF5
25012500	0.37 0.24 -0.43 -0.24 -0.09 0.23 -0.14 0.19	0025 0018 FFD5 FFE8 FFF7 0017 FFF1 0013
25112500	-0.02 -0.20 0.03 -0.01 -0.12 -0.07 0.24 0.22	FFFD FFEB 0003 FFFE FFF3 FFF8 0017 0015
25212500	-0.17 -0.20 -0.26 0.27 0.42 0.00 -0.08 -0.06	FFEE FFEC FFE6 001A 0029 FFFF FFF7 FFFA
25312500	-0.31 -0.12 0.13 0.02 0.03 0.10 -0.06 -0.30	FFE0 FFF3 000C 0001 0002 000A FFF9 FFE2
25412500	0.35 0.23 0.08 0.19 0.06 0.00 -0.15 0.16	0022 0016 0008 0013 0006 FFFF FFF0 000F
25512500	0.00 0.06 -0.19 0.32 -0.13 0.06 -0.03 -0.10	0000 0006 FFED 001F FFF2 0006 FFFD FFF5
25612500	0.00 0.26 0.09 -0.63 -0.23 0.09 0.38 0.30	0000 0019 0009 FFC1 FFE8 0008 0026 001D
25712500	0.24 -0.03 0.03 -0.01 0.30 0.09 0.05 -0.25	0018 FFFD 0003 FFFE 001D 0009 0004 FFE7
25812500	-0.11 0.29 0.39 -0.24 0.11 -0.01 -0.16 -0.36	FFF5 001C 0027 FFE7 000B FFFF FFF0 FFDC
25912500	-0.31 0.27 0.28 0.53 -0.03 0.08 0.00 0.40	FFE1 001B 001C 0034 FFFD 0008 0000 0027
26012500	0.10 -0.16 -0.13 -0.02 -0.05 -0.05 0.20 0.23	0009 FFF0 FFF2 FFFE FFFA FFBD 0014 0016
26112500	-0.01 -0.01 0.24 0.00 0.06 -0.36 -0.09 -0.02	FFFE FFFE 0018 0000 0006 FFDC FFF6 FFFE
26212500	0.00 0.10 0.15 0.21 0.36 -0.11 0.01 0.13	FFFF 000A 000E 0015 0023 FFF5 0001 000C
26312500	0.11 0.01 -0.07 0.15 0.36 -0.08 0.01 -0.02	000B 0001 FFF9 000E 0024 FFF7 0000 FFFE
26412500	0.35 -0.17 0.16 -0.03 0.03 0.05 0.18 -0.14	0022 FFEB 000F FFFC 0002 0004 0011 FFF2
26512500	0.13 -0.04 0.15 -2.62 -4.54 -10.43 -19.22 -39.43	000D FFFB 000F FEFA FE39 FBED F87E F098

**Table Note:** This first column corresponds to the frequency of the first spectrum amplitude bin value of each row and is for reference only (i.e., not part of the reported data array). The decimal representation of the reported data array is shown in the second column. The hexadecimal representation of the reported data array is shown in the third column. Each data point is delimited with a single space for readability.

**Spectrum Amplitude CMTS X Interface Y**

*Figure V-2 - Spectrum Amplitude Constructed Graph from collected data*

**Spectrum Amplitude CMTS X Interface Y**

*Figure V-3 - Spectrum Amplitude Detail Graph from collected data*

## Appendix VI Object Model Notation

This appendix illustrates the UML notation used throughout this specification to define object models.

### VI.1 Overview

The Unified Modeling Language (UML) is a unified model for object oriented analysis and design (OOA&D). UML is an OMG standard and is an accepted ISO specification [ISO 19501].

UML defines a general-purpose, graphical modeling language that can be applied to any application domain (e.g., communications) and implementation platforms (e.g., J2EE).

### VI.2 Object Model Diagram

The OSSi object model diagram is represented by the UML Class Diagram. The class diagram describes the types of objects existing in a system and their static relationship.

#### VI.2.1 Classes

Classes are generally represented by a square box with three compartments. The top compartment contains the class name (used here as the object name) with the first letter capitalized. The middle compartment contains the list of attributes with the first letter of each attribute in lower case. The bottom compartment contains the list of operations. For the purposes of this specification, the methods section of the class box is not used (suppressed) and the implementation level details of the attributes are omitted.

Attributes also include a visibility notation which precedes the attribute name and is one of the following:

- '+' public (default)
- '-' private
- '#' protected

If the above notation is omitted from the attribute, the default of public is implied. For the purposes of this specification, the protected visibility generally refers to indexes of MIB tables, schema instances, etc.

An interface is represented in the class diagram as an object with the keyword <<interface>> preceding the object name. In general, an interface is a declaration of a set of public features and obligations (such as get methods).

#### VI.2.2 Associations

A class diagram also contains associations which represent relationships between instances of classes. An association has two ends with each end attached to one of the classes. The association end also has a multiplicity indicator which defines how many objects may participate in the relationship. Multiplicity notation is as follows:

- '1' exactly one
- '\*' zero or more (default)
- '0..1' zero or one (optional)
- 'm..n' numerically specified

If the above notation is omitted from the association end, the default of '\*' is implied.

If one end of the association contains an open arrowhead, this implies navigability in the direction indicated by the arrow.

#### VI.2.3 Generalization

Generalization is the concept of creating subclasses from superclasses and is also known as inheritance within programming languages. Subclasses include (or inherit) all the elements of the superclass and may override inherited methods. Subclasses are more specific classes while superclasses are generalized classes.

The UML notation for Generalization is shown as a line with a hollow triangle as an arrowhead pointing to the generalized class.

#### VI.2.4 Dependencies

Dependencies between two classes are represented by a dashed arrow between two objects. The object at the tail of the arrow depends on the object at the other end.

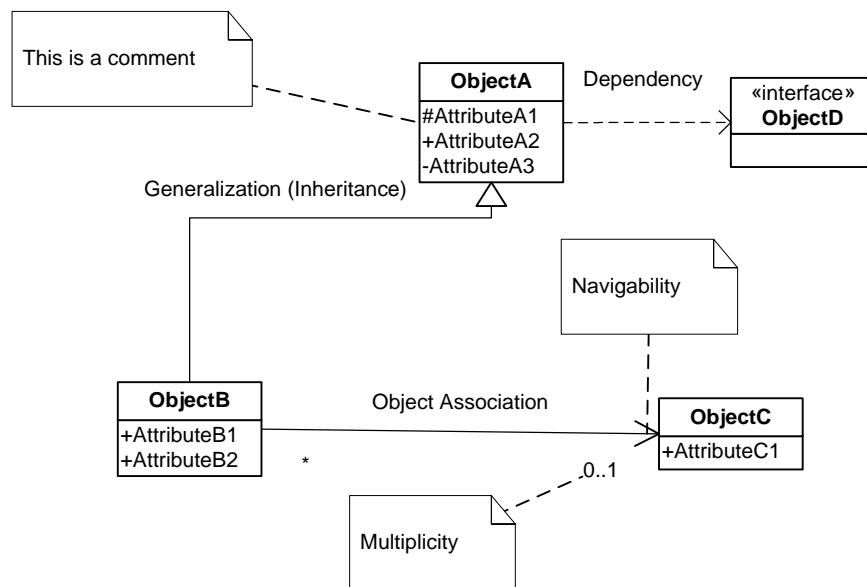
#### VI.2.5 Comment

A Comment in a class diagram is a textual annotation attached to any element. This is represented as a note symbol with a dashed line connecting the note with the element.

#### VI.2.6 Diagram Notation

Figure VI-1 highlights the UML Class Diagram notation discussed in this section.

Figure VI-1 is not a complete representation of the UML Class Diagram notation, but captures those concepts used throughout this specification.



**Figure VI-1 - Object Model UML Class Diagram Notation**

### VI.3 Object Instance Diagram

An Object Instance Diagram represents the objects in a system during one snapshot in time. In this diagram, the class objects are instantiated.

Figure V-2 shows an Object Instance Diagram for an instantiation (`myObjectA`) of **ObjectA** from Figure VI-1.

<code>myObjectA : ObjectA</code>
<code>AttributeA1 = 20</code>
<code>AttributeA2 = Test</code>
<code>AttributeA3 = 254</code>

**Figure VI-2 - Object Instance Diagram for ObjectA**

## VI.4 ObjectA Definition Example<sup>438</sup>

This section defines the details of the object and its associated attributes as defined in the object model diagram. The description of the object includes behavior, persistence requirements (if any), object creation and deletion behavior (if any), etc.

Table VI-1 lists the attributes the object defined in the object model. The object table is derived from the object model diagram where each row in the table represents an attribute of the object.

The "Attribute Name" column contains each defined attribute of the object. The naming convention for attributes is to capitalize the first letter and each letter of successive words within the name. Also, attribute names typically do not include any of the object name elements since this would cause duplication when the object and attributes are realized in SNMP.

The "Type" column contains the data type for the attribute. The data type can be a simple type such as unsignedInt or a defined data type such as EnumBits. DOCSIS 3.0 data types are defined in Annex K.

The "Access" column indicates the attributes accessibility (as mapped to an SNMP object for example). Example values include "key", "read-only", "read-write", and "read-create".

The "Type Constraints" column lists constraints on the normal data type specified in the "Type" column. If there are no defined constraints for the attribute, this column is empty. The example below for AttributeA1 lists a constraint on the unsignedInt Type where the range starts from 1 instead of normally starting from 0 for an unsignedInt.

The "Units" column lists units for the attribute or "N/A" if the attribute does not have units.

The "Default" column contains the default value for the attribute or "N/A" if the attribute does not have a default value or in cases where the attribute's description defines rules for the initialization value.

The sections following the table are attribute descriptions which might include behavioral requirements or references.

**Table VI-1 - ObjectA Example Table Layout**

Attribute Name	Type	Access	Type Constraints	Units	Default
AttributeA1	unsignedInt	key	1..4294967295	N/A	N/A
AttributeA2	AdminString	read-write	SIZE (1..15)	N/A	N/A
AttributeA3	unsignedByte	read-create		seconds	60

### VI.4.1.1 AttributeA1

AttributeA1 is a key defined for...

**Note:** Objects which represent a table (in an SNMP MIB realization) and have N number of instances need to include at least one "key" attribute which is used to denote the instance or id. Key attributes are typically denoted with a protected visibility whereas all other attributes are denoted with a public visibility.

### VI.4.1.2 AttributeA2

AttributeA2 is ...

**Note:** Persistence requirements are documented at the object level, not at the attribute level.

### VI.4.1.3 AttributeA3

AttributeA3 is ...

<sup>438</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/16/07.

## VI.5 Common Terms Shortened<sup>439</sup>

The following table lists common terms which have been shortened to allow shorter SNMP MIB names. These shortened names are desired to be used consistently throughout the object models, SNMP MIBs and IPDR schemas. However, in some cases it might not be possible to maintain parity with pre-3.0 DOCSIS requirements.

**Table VI-2 - Shortened Common Terms<sup>440</sup>**

Original Word	Shortened Word
Address	Addr
Aggregate	Agg
Algorithm	Alg
Application	App
Attribute	Attr
Authorization	Auth
Channel	Ch
Command	Cmd
Config*	Cfg
Control	Ctrl
Default	Def
Destination	Dest
Direction	Dir
Downstream	Ds
Encryption	Encrypt
Equalization	Eq
Group	Grp
Length	Len
Maximum	Max
Minimum	Min
Multicast	Mcast
Provision*	Prov
Receive	Rx
Registration	Reg
Replication	Repl
Request	Req
Resequence	Reseq
Resequencing	Reseq
Response	Rsp
Segment	Sgmt
Sequence	Seq
Service	Svc
ServiceFlow	Sf
Session(s)	Sess
Source	Src
Threshold	Thrshld
Total	Tot

<sup>439</sup> Revised per OSSIV3.0-N-07.0480-3 by ab on 7/12/07.

<sup>440</sup> Table modified per OSSIV3.0-N-07.0413-3, #4 on 5/11/07 by KN.

Original Word	Shortened Word
Transmit	Tx
Upstream	Us
* indicates a wildcard	

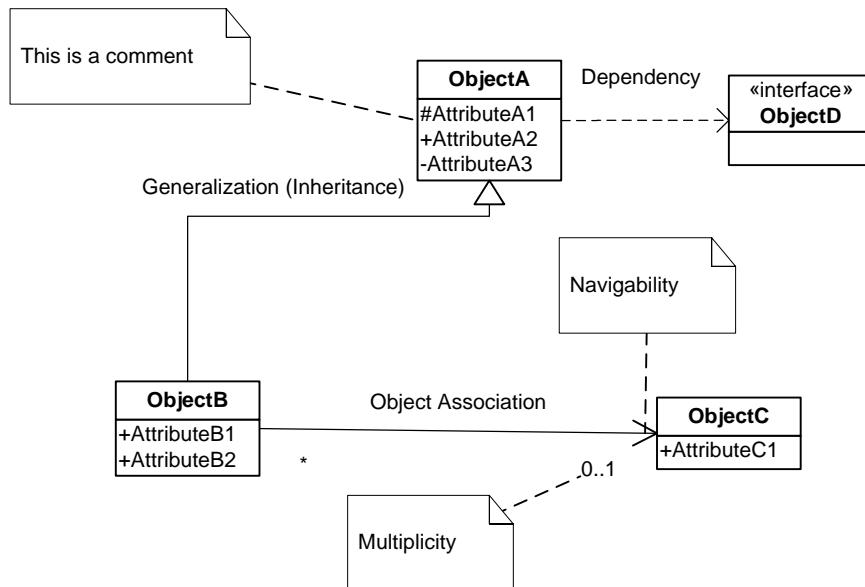
### VI.5.1 Exceptions

Data types and managed objects do not consistently use the shortened names. Also, the term ServiceFlowId remains unchanged. Service and ServiceFlow are often not shortened to retain backward compatibility with QoS managed objects.

## Appendix VII Receive Channel Object Model (Informative)

This appendix provides an object model of the Receive Channel Profiles and Receive Channel Configuration (RCP/RCC) from the Common Radio Frequency Interface Encodings Annex of [MULPI] that NMS integrators may use for the purpose of auditing and verification of configuration management with RCP/RCCs in consideration. The appendix also provides a XML schema for the object model and an XML instance document for the RCPs defined in the Standard Receive Channel Profile Encodings Annex of [MULPI].

### VII.1 RCP/RCC Object Model



**Figure VII-1 - RCP/RCC Object Model Diagram**

### VII.2 RCP/RCC XML Schema

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- 2006 (c)CableLabs. All rights reserved -->
<xss:schema xmlns:xss="http://www.w3.org/2001/XMLSchema" elementFormDefault="qualified">
  <!-- Class: <<XSDcomplexType>> RCPMessage -->
  <xss:element name="RCPMessage" type="RCPMessage" />
  <xss:complexType name="RCPMessage">
    <xss:sequence>
      <xss:element ref="ReceiveChannelProfile" minOccurs="1" maxOccurs="unbounded" />
    </xss:sequence>
  </xss:complexType>
  <!-- Class: <<XSDcomplexType>> RCCMessage -->
  <xss:element name="RCCMessage" type="RCCMessage" />
  <xss:complexType name="RCCMessage">
    <xss:sequence>
      <xss:element ref="ReceiveChannelConfiguration" />
    </xss:sequence>
  </xss:complexType>
  <!-- Class: <<XSDcomplexType>> ReceiveChannelProfile -->
  <xss:element name="ReceiveChannelProfile" type="ReceiveChannelProfile" />
  <xss:complexType name="ReceiveChannelProfile">
    <xss:sequence minOccurs="1" maxOccurs="unbounded" >
      <xss:element name="RpId" type="xs:hexBinary" />
      <xss:element name="Name" type="xs:string" />
    </xss:sequence>
  </xss:complexType>
</xss:schema>
  
```

```
<xs:element name="CenterFrequencySpacing" type="xs:unsignedByte" minOccurs="0"
maxOccurs="1"/>
<xs:element ref="ReceiveModuleCapability" minOccurs="0" maxOccurs="unbounded"/>
<xs:element ref="ReceiveChannelCapability" minOccurs="1" maxOccurs="unbounded"/>
</xs:sequence>
</xs:complexType>
<!-- Class: <<XSComplexType>> ReceiveChannelConfiguration -->
<xs:element name="ReceiveChannelConfiguration" type="ReceiveChannelConfiguration"/>
<xs:complexType name="ReceiveChannelConfiguration">
<xs:sequence minOccurs="0" maxOccurs="unbounded">
<xs:element name="RcpId" type="xs:hexBinary"/>
<xs:element ref="ReceiveChannelAssigned" minOccurs="1" maxOccurs="unbounded"/>
<xs:element ref="ReceiveModuleAssignment" minOccurs="0" maxOccurs="1"/>
</xs:sequence>
</xs:complexType>
<!-- Class: ReceiveChannelCapability -->
<xs:element name="ReceiveChannelCapability" type="ReceiveChannelCapability"/>
<xs:complexType name="ReceiveChannelCapability">
<xs:sequence>
<xs:element name="RcIndex" type="xs:unsignedByte"/>
<xs:element name="Offset" type="xs:unsignedByte" minOccurs="0" maxOccurs="1"/>
<xs:element name="PrimaryDsChannelIndicator" type="xs:boolean" minOccurs="0"
maxOccurs="1" default="false"/>
<xs:element name="VendorParameters" type="xs:string" minOccurs="0"
maxOccurs="unbounded"/>
<xs:element ref="Connectivity" minOccurs="0" maxOccurs="unbounded"/>
</xs:sequence>
</xs:complexType>
<!-- Class: ReceiveChannelAssigned -->
<xs:element name="ReceiveChannelAssigned" type="ReceiveChannelAssigned"/>
<xs:complexType name="ReceiveChannelAssigned">
<xs:sequence>
<xs:element name="RcIndex" type="xs:unsignedByte"/>
<xs:element name="CenterFrequencyAssignment" type="xs:unsignedInt"/>
<xs:element name="PrimaryDownstreamChannelIndicator" type="xs:boolean"
minOccurs="0" maxOccurs="1" default="false"/>
<xs:element name="VendorParameters" type="xs:string" minOccurs="0"
maxOccurs="unbounded"/>
<xs:element ref="Connectivity"/>
</xs:sequence>
</xs:complexType>
<!-- Class: <<XSAttributeGroup>> Connectivity -->
<xs:element name="Connectivity" type="Connectivity"/>
<xs:complexType name="Connectivity">
<xs:sequence>
<xs:element name="RmIndex" type="xs:unsignedByte"/>
</xs:sequence>
</xs:complexType>
<!-- Class: <<XSComplexType>> ReceiveModuleCapability -->
<xs:element name="ReceiveModuleCapability" type="ReceiveModuleCapability"/>
<xs:complexType name="ReceiveModuleCapability">
<xs:sequence>
<xs:element name="RmIndex" type="xs:unsignedByte"/>
<xs:element name="NumAdjacentChannels" type="xs:unsignedByte" minOccurs="0"
maxOccurs="1"/>
<xs:element name="VendorParameters" type="xs:string" minOccurs="0"
maxOccurs="1"/>
<xs:element ref="ResequencingChannelSubset" minOccurs="0"
maxOccurs="unbounded"/>
<xs:element ref="Connectivity" minOccurs="0" maxOccurs="unbounded"/>
<xs:element ref="CommonPhysicalLayerParameter" minOccurs="0" maxOccurs="1"/>
<xs:element ref="ChannelBlockRange" minOccurs="0" maxOccurs="1"/>
</xs:sequence>
```

```

</xs:complexType>
<!-- Class: <<XSComplexType>> ReceiveModuleAssignment -->
<xs:element name="ReceiveModuleAssignment" type="ReceiveModuleAssignment"/>
<xs:complexType name="ReceiveModuleAssignment">
  <xs:sequence>
    <xs:element name="RmIndex" type="xs:unsignedByte"/>
    <xs:element name="FirstChannelCenterFrequency" type="xs:unsignedInt"
minOccurs="0" maxOccurs="1"/>
    <xs:element name="VendorParameters" type="xs:string" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element ref="Connectivity"/>
  </xs:sequence>
</xs:complexType>
<!-- Class: <<XSGroup>> ChannelBlockRange -->
<xs:element name="ChannelBlockRange" type="ChannelBlockRange"/>
<xs:complexType name="ChannelBlockRange">
  <xs:sequence>
    <xs:element name="MinimumCenterFrequency" type="xs:unsignedInt"/>
    <xs:element name="MaximumCenterFrequency" type="xs:unsignedInt"/>
  </xs:sequence>
</xs:complexType>
<!-- Class: <<XSGroup>> ResequencingChannelSubset -->
<xs:element name="ResequencingChannelSubset" type="ResequencingChannelSubset"/>
<xs:complexType name="ResequencingChannelSubset">
  <xs:sequence>
    <xs:element name="Capability" type="xs:unsignedByte" minOccurs="0"
maxOccurs="1"/>
  </xs:sequence>
</xs:complexType>
<!-- Class: <<XSAttributeGroup>> CommonPhysicalLayerParameter -->
<xs:element name="CommonPhysicalLayerParameter"
type="CommonPhysicalLayerParameter"/>
<xs:complexType name="CommonPhysicalLayerParameter">
  <xs:sequence>
    <xs:element name="QamModulationOrder" type="xs:boolean"/>
    <xs:element name="Interleave" type="xs:boolean"/>
  </xs:sequence>
</xs:complexType>
</xs:schema>

```

### VII.3 XML Instance Document for DOCSIS Standard RCP profiles

```

<RCPMessage xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="file:///c:/Documents%20and%20Settings\bhedstrom\My%20D
ocuments\Specifications\DOCSIS\3.0\MULPI%20Spec\Receive%20Channel%20Class%20Diagram.xs
d">
  <!-- J.83 Annex B profiles-->
    <!-- 2 Channel Standard Receive Channel Profile for 6 MHz DOCSIS
        See Table E-1 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
        Specification CM-SP-MULPIv3.0-I01-060804 -->
    <ReceiveChannelProfile>
      <RcpId>0010000002</RcpId>
      <Name>CLAB-6M-002</Name>
      <CenterFrequencySpacing>6</CenterFrequencySpacing>
      <ReceiveModuleCapability>
        <RmIndex>1</RmIndex>
        <NumAdjacentChannels>10</NumAdjacentChannels>
      </ReceiveModuleCapability>
      <ReceiveChannelCapability>
        <RcIndex>1</RcIndex>
        <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
        <Connectivity>

```

```
<RmIndex>1</RmIndex> <!--0x40-->
</Connectivity>
</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>2</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
</ReceiveChannelProfile>

<!-- 3 Channel Standard Receive Channel Profile for 6 MHz DOCSIS
     See Table E-2 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
     Specification CM-SP-MULPIv3.0-I01-060804 -->
<ReceiveChannelProfile>
  <RcpId>0010000003</RcpId>
  <Name>CLAB-6M-003</Name>
  <CenterFrequencySpacing>6</CenterFrequencySpacing>
  <ReceiveModuleCapability>
    <RmIndex>1</RmIndex>
    <NumAdjacentChannels>10</NumAdjacentChannels>
  </ReceiveModuleCapability>
  <ReceiveChannelCapability>
    <RcIndex>1</RcIndex>
    <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>2</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>3</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
</ReceiveChannelProfile>

<!-- 4 Channel Standard Receive Channel Profile for 6 MHz DOCSIS
     See Table E-3 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
     Specification CM-SP-MULPIv3.0-I01-060804 -->
<ReceiveChannelProfile>
  <RcpId>0010000004</RcpId>
  <Name>CLAB-6M-004</Name>
  <CenterFrequencySpacing>6</CenterFrequencySpacing>
  <ReceiveModuleCapability>
    <RmIndex>1</RmIndex>
    <NumAdjacentChannels>10</NumAdjacentChannels>
  </ReceiveModuleCapability>
  <ReceiveChannelCapability>
    <RcIndex>1</RcIndex>
    <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
</ReceiveChannelProfile>
```

```

</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>2</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>3</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>4</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
</ReceiveChannelProfile>

<!-- J.83 Annex A profiles-->
<!-- 2 Channel Standard Receive Channel Profile for 8 MHz DOCSIS
      See Table E-4 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
      Specification CM-SP-MULPIv3.0-I01-060804 -->
<ReceiveChannelProfile>
  <RcpId>0010001002</RcpId>
  <Name>CLAB-8M-002</Name>
  <CenterFrequencySpacing>8</CenterFrequencySpacing>
  <ReceiveModuleCapability>
    <RmIndex>1</RmIndex>
    <NumAdjacentChannels>7</NumAdjacentChannels>
  </ReceiveModuleCapability>
  <ReceiveChannelCapability>
    <RcIndex>1</RcIndex>
    <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>2</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
</ReceiveChannelProfile>

<!-- 3 Channel Standard Receive Channel Profile for 8 MHz DOCSIS
      See Table E-5 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
      Specification CM-SP-MULPIv3.0-I01-060804 -->
<ReceiveChannelProfile>
  <RcpId>0010001003</RcpId>
  <Name>CLAB-8M-003</Name>
  <CenterFrequencySpacing>8</CenterFrequencySpacing>
  <ReceiveModuleCapability>
    <RmIndex>1</RmIndex>
    <NumAdjacentChannels>7</NumAdjacentChannels>
  </ReceiveModuleCapability>

```

```
<ReceiveChannelCapability>
  <RcIndex>1</RcIndex>
  <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>2</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
<ReceiveChannelCapability>
  <RcIndex>3</RcIndex>
  <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
  <Connectivity>
    <RmIndex>1</RmIndex> <!--0x40-->
  </Connectivity>
</ReceiveChannelCapability>
</ReceiveChannelProfile>

<!-- 4 Channel Standard Receive Channel Profile for 8 MHz DOCSIS
      See Table E-6 of DOCSIS 3.0 MAC And Upper Layer Protocol Interface
      Specification CM-SP-MULPIv3.0-I01-060804 -->
<ReceiveChannelProfile>
  <RcpId>0010001004</RcpId>
  <Name>CLAB-8M-004</Name>
  <CenterFrequencySpacing>8</CenterFrequencySpacing>
  <ReceiveModuleCapability>
    <RmIndex>1</RmIndex>
    <NumAdjacentChannels>7</NumAdjacentChannels>
  </ReceiveModuleCapability>
  <ReceiveChannelCapability>
    <RcIndex>1</RcIndex>
    <PrimaryDsChannelIndicator>true</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>2</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>3</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
  <ReceiveChannelCapability>
    <RcIndex>4</RcIndex>
    <PrimaryDsChannelIndicator>false</PrimaryDsChannelIndicator>
    <Connectivity>
      <RmIndex>1</RmIndex> <!--0x40-->
    </Connectivity>
  </ReceiveChannelCapability>
</ReceiveChannelProfile>
```

```
</ReceiveChannelProfile>
</RCPMessage>
```

## Appendix VIII RECOMMENDED CMTS EXPORTER CONFIGURATION<sup>441</sup>

To minimize chance for misconfiguration and to make sure data exported is usable by the various applications the following lowest common denominator configuration is recommended for usage:

1. Configure Exporter to delimit documents with session start/stop messages. This doesn't apply only to time interval sessions but also to topology event based sessions (CMTS-TOPOLOGY-TYPE, CMTS-CM-REG-STATUS-TYPE and CPE-TYPE). Event based sessions that use same time interval and corresponding document boundaries are easier to correlate with time interval sessions for samis services.
2. Configure one service per session.
3. For services such as TOPOLOGY that use adhoc session to get initial state and event session to get changes, configure separate adhoc and event sessions (use lower session number for adhoc session). Same applies to services that use combination of adhoc and time based sessions such as CM-US-STATS.
4. Make sure all services expected by the Collector are configured on CMTS. Below is the example of how full set of DOCSIS 3.0 services should be configured when these guidelines are applied:

**Table VIII-1 - Complete Set of DOCSIS 3.0 Services**

Service Definition	Session Id	Session Type (See Notation Below)	Description
SAMIS	0	T	Reserved for DOCSIS 2.0 compatible service if supported
SAMIS-TYPE-1	1	T	Similar to SAMIS DOCSIS 2.0
SAMIS-TYPE-2	2	T	SAMIS optimized (only SF stats)
CMTS-TOPOLOGY-TYPE	3	A	CMTS Topology Configuration
CMTS-TOPOLOGY-TYPE	4	ET	CMTS Topology Configuration
CMTS-CM-REG-STATUS-TYPE	5	A	CMTS CM Registration Info
CMTS-CM-REG-STATUS-TYPE	6	ET	CMTS CM Registration Info
CPE-TYPE	7	A	CPE Topo (CPE IP,MAC,FQDN)
CPE-TYPE	8	ET	CPE Topo (CPE IP,MAC,FQDN)
CMTS-CM-US-STATS-TYPE	9	A	CMTS CM Upstream Stats Info
CMTS-CM-US-STATS-TYPE	10	T	CMTS CM Upstream Stats Info
CMTS-US-UTIL-STATS-TYPE	11	ET	CMTS US If Utilization Statistics
CMTS-DS-UTIL-STATS-TYPE	12	ET	CMTS DS If Utilization Statistics
DIAG-LOG-TYPE	13	A	Diagnostic Log (All CMs)
DIAG-LOG-EVENT-TYPE	14	ET	Single Flap events in real time
DIAG-LOG-DETAIL-TYPE	15	A	Diag Log (All CM) detailed triggers
DIAG-LOG-DETAIL-TYPE	16	ET	Diag Log (All CM) detailed triggers
SPECTRUM-MEASUREMENT-TYPE	17	A	CMTS Spectrum amplitude Measurement
SPECTRUM-MEASUREMENT-TYPE	18	T	CMTS Spectrum amplitude Measurement

Notation

A - Ad-Hoc Based Session  
EO - Event Based Session (Open Ended)  
ET - Event Based Session (Time Based)  
T - Time Interval Based Session

If only a subset of service definitions/sessions are configured in the CMTS that subset could be extracted from full example above while making sure that multiple session types for the same services are included.

<sup>441</sup> Appendix added per OSSIV3.0-N-09.0849-6 on 11/20/09 by JB.

The example below contains SAMIS-TYPE-2 with basic topology information (CMTS, CM and CPE) and US/DS interface utilization. As far as session id allocation is concerned we are skipping session id 0 (reserved for DOCSIS 2.0) while making sure that services using multiple sessions always use lower session number for adhoc (initial state always comes first) and higher session number for event or time based session (changes or updates). Consistent ad-hoc session ordering helps when collector doesn't support session type detection as described in Section 6.2.7 and has to rely on specific order of sessions with services of the same type.

**Table VIII-2 - Subset of DOCSIS 3.0 Services**

Service Definition	Session Id	Session Type (See Notation Below)	Description
SAMIS-TYPE-2	1	T	SAMIS optimized (only SF stats)
CMTS-TOPOLGY-TYPE	2	A	CMTS Topology Configuration
CMTS-TOPOLGY-TYPE	3	ET	CMTS Topology Configuration
CMTS-CM-REG-STATUS-TYPE	4	A	CMTS CM Registration Info
CMTS-CM-REG-STATUS-TYPE	5	ET	CMTS CM Registration Info
CPE-TYPE	6	A	CPE Topo (CPE IP,MAC,FQDN)
CPE-TYPE	7	ET	CPE Topo (CPE IP,MAC,FQDN)
CMTS-US-UTIL-STATS-TYPE	8	ET	CMTS US If Utilization Statistics
CMTS-DS-UTIL-STATS-TYPE	9	ET	CMTS DS If Utilization Statistics

Notation

A - Ad-Hoc Based Session  
EO - Event Based Session (Open Ended)  
ET - Event Based Session (Time Based)  
T - Time Interval Based Session

## Appendix IX Acknowledgements (Informative)

On behalf of the cable industry and our member companies, CableLabs would like to thank the following individuals for their contributions to the development of this specification.

Contributor	Company Affiliation
Ben Bekele	Cox Cable
Eduardo Cardona	CableLabs
Kirk Erichsen	Time Warner
Deepak Gargeshwari	C-COR
Bill Hanks	Arris Group
Brian Hedstrom	CableLabs
Marco Laburada	Sunrise Telecom
Jaan Leemet	Sunrise Telecom
Kevin Luehrs	CableLabs
Fred Oko	C-COR
Sivakumar Patchayappan	Cisco
Michael Patrick	Motorola
Lucy Pollak	Texas Instruments
Lakshmi Raman	CableLabs
Sebastien Roy	Sunrise Telecom
Jason Schnitzer	Rogers
Frances Shen	Cisco
Pak Siripunkaw	Comcast Cable
Dan Torbet	Arris Group
Charles Zheng	Cisco

We would particularly like to thank Eduardo Cardona (CableLabs) for his detailed knowledge of Network Management in the DOCSIS domain, his extensive contributions to this specification and for creating all those object model diagrams. We would also like to acknowledge the following CableLabs DOCSIS 3.0 Focus Team Leads for their contributions: Alberto Campos (PHY), Stuart Hoggan (Security), Matthew Schmitt (USCB), Deepak Kharbanda (IPv6), Amol Bhagwat (Multicast) and Greg White (MAC). We thank Brian Hedstrom (CableLabs), who was the Network Management Focus Team Lead and Kevin Luehrs (CableLabs), who was an early Network Management Focus Team Lead. We also thank Lakshmi Raman (CableLabs) for her technical contributions. And finally many thanks go out to all the active members of the Network Management focus team who contributed to this specification.

## Appendix X Revision History (Informative)

### X.1 Engineering Change for CM-SP-OSSIv3.0-I02-070223

The following Engineering Change is incorporated into CM-SP-OSSIv3.0-I02-070223:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-06.0357-1	1/17/2007	OSSIv3.0 MIB Corrections for docslf3CmtsSpectrumAnalysisMeasRowStatus and docssSecMib

### X.2 Engineering Changes for CM-SP-OSSIv3.0-I03-070518

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I03-070518:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-07.0376-1	1/31/2007	Replace reference [ID CD MIB] with new RFC 4639
OSSIv3.0-N-07.0384-1	2/28/2007	Annex O attributes clarifications
OSSIv3.0-N-07.0385-1	2/28/2007	CM filtering Requirements and Clarifications
OSSIv3.0-N-07.0386-1	2/28/2007	Removal of SNMP ColdStart notification after Diffie-Hellman kickstart process is completed
OSSIv3.0-N-07.0392-1	3/7/2007	Clarifications to CMTS MIB requirements
OSSIv3.0-N-07.0395-3	3/14/2007	Clarifications to Section 7.1.3.1 and corresponding rows in Annex A Table A-3
OSSIv3.0-N-07.0397-2	3/21/2007	ifLinkUpDownTrapEnable requirement clarifications
OSSIv3.0-N-07.0400-1	3/21/2007	SNMP Access from CPE and control
OSSIv3.0-N-07.0402-1	3/28/2007	USB Management requirements simplifications
OSSIv3.0-N-07.0403-1	3/28/2007	CMCI Interface Types requirements simplifications
OSSIv3.0-N-07.0404-1	3/28/2007	Alignment of Section 7.1.3.7 with Annex A requirements
OSSIv3.0-N-07.0410-4	4/18/2007	Updates for CM and CMTS registration states object, CmUsStatus object and CmtsCmUsStatus object.
OSSIv3.0-N-07.0411-3	4/11/2007	Multicast Annex Clarifications
OSSIv3.0-N-07.0412-2	4/11/2007	Annex O clarifications for RCP-ID and Hold-Off Timer for Sequence Out-of-Range Events Units
OSSIv3.0-N-07.0413-3	4/11/2007	Addition of CMTS debug object for triggering CM-CTRL-REQ
OSSIv3.0-N-07.0422-5	4/18/2007	Clarification to the index RccStatusId on the CM
OSSIv3.0-N-07.0424-3	4/18/2007	Updates to clarify references to docslfCmtsCmStatusTable and docslfCmStatusTable
OSSIv3.0-N-07.0435-2	4/18/2007	Updates for TLV 38 to support simultaneous IPv4 and IPv6 target Addresses
OSSIv3.0-N-07.0436-1	4/18/2007	Continuation of OSSIv2.0-N-05.0225-2 'OSSI changes in support of SID expansion' for docslfUpstreamStatsEntry
OSSIv3.0-N-07.0437-4	4/18/2007	Object model for SfSidCluster (Annex O) has correct indexes, however the corresponding MIB docslf3SfSidClusterTable is missing the ServiceFlowId index
OSSIv3.0-N-07.0441-4	4/18/2007	UDC updates for Subscriber Management Annex P
OSSIv3.0-N-07.0442-3	4/18/2007	Miscellaneous editorial corrections
OSSIv3.0-N-07.0443-2	4/18/2007	Compliance requirements for RFC 4546
OSSIv3.0-N-07.0444-3	4/18/2007	Max CPE IPv4 and Max IPv6 Prefix Support in OSSI
OSSIv3.0-N-07.0445-3	4/18/2007	Object Model Diagrams Updates for multiple ECNs
OSSIv3.0-N-07.0446-4	4/18/2007	Clarifications for the configuration of the Annex of Downstream Channels in a Mac Domain
OSSIv3.0-N-07.0447-2	4/18/2007	Clarification of modem capabilities reported by CMTS
OSSIv3.0-N-07.0448-1	4/18/2007	Editorial change for Table O-28

### X.3 Engineering Changes for CM-SP-OSSIv3.0-I04-070803

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I04-070803:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-07.0469-2	6/20/2007	Updates for MIB object access for CM access before registration
OSSIv3.0-N-07.0473-3	7/5/2007	Clarifications for the Application ID in OSSIv3.0
OSSIv3.0-N-07.0475-3	7/5/2007	New Format OSSI Annex A Table A.3 and updated requirements
OSSIv3.0-N-07.0477-2	6/27/2007	Correction of malformed requirements for ReqPro tagging
OSSIv3.0-N-07.0478-2	6/27/2007	Updates to SAMIS IPDR Service definitions
OSSIv3.0-N-07.0480-3	7/5/2007	Restructure of QOS Management requirements
OSSIv3.0-N-07.0481-2	7/5/2007	Changes for the McCfg Object and Load Balancing Changes
OSSIv3.0-N-07.0497-2	7/5/2007	Upstream Drop Classifier Corrections
OSSIv3.0-N-07.0498-1	7/5/2007	Clarifications for MGMD MIB support for CMTS
OSSIv3.0-N-07.0499-1	7/5/2007	Clarification to QosCfgld in the CMTS Group Config object
OSSIv3.0-N-07.0500-4	7/5/2007	Annex D Event Definitions for MULPI
OSSIv3.0-N-07.0501-1	7/5/2007	Remove Section 11 (introduced into I03 in error by CableLabs' editor)

### X.4 Engineering Changes for CM-SP-OSSIv3.0-I05-071206

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I05-071206:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-07.0473-3	6/20/2007	Corrected an editorial error in the implementation of change #3.
OSSIv3.0-N-07.0506-3	7/25/2007	Clarification on IPDR requirements.
OSSIv3.0-N-07.0510-1	8/1/2007	Requirement clarification for UDC provisioning and docsDevFilterIpTable access
OSSIv3.0-N-07.0511-2	8/1/2007	Expand CM requirement for standard SNMP Notification list for ReqPro tagging
OSSIv3.0-N-07.0512-1	8/1/2007	Annex A Clarification of ENTITY-SENSOR-MIB requirements for the CM
OSSIv3.0-N-07.0514-2	9/19/2007	Clarification of CM and CMTS support of ifPhysAddress from ifTable in RFC 2863
OSSIv3.0-N-07.0516-2	9/5/2007	Bridge MIB requirement clarifications for STP
OSSIv3.0-N-07.0522-7	10/31/2007	DOCSIS 3.0 Load Balancing Requirements
OSSIv3.0-N-07.0528-2	10/17/2007	Removal of docslf3CmStatusDocsisOperMode from Annex A table
OSSIv3.0-N-07.0531-1	10/17/2007	cmRegState Textual Convention
OSSIv3.0-N-07.0539-1	10/24/2007	DOCSIS 3.0 Enhanced Signal Quality Monitoring Clarification
OSSIv3.0-N-07.0540-4	10/31/2007	Clarifications for RFC 2863 interface counters
OSSIv3.0-N-07.0550-2	10/24/2007	Editorial Corrections for OSSIv3.0 I04
OSSIv3.0-N-07.0551-4	10/24/2007	Annex D Event Definition for Multicast & MaxNumSess MIB correction
OSSIv3.0-N-07.0552-4	10/31/2007	CMTS Management requirements for PHSI
OSSIv3.0-N-07.0553-4	10/24/2007	OSSI3.0 updates for DRFI and PHY3.0 Cm Power Requirements and Entity MIB requirements
OSSIv3.0-N-07.0554-4	10/31/2007	DOCSIS Path Verify Management requirements for CM
OSSIv3.0-N-07.0564-4	10/24/2007	Removal of Grant Mode and CCF mode from Annex A
OSSIv3.0-N-07.0565-2	10/24/2007	Reintroduce changes #2+3 in ECN-07.0424-3 which were never incorporated into published spec

## X.5 Engineering Changes for CM-SP-OSSIv3.0-I06-080215

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I06-080215:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-07.0480-3	7/5/2007	Incorporated changes # 6, 8, 20, and 21, which were not done in I04
OSSIv3.0-N-07.0532-4	1/16/2008	Removal of RFC 4547 Requirements and Definition of new Notifications
OSSIv3.0-N-07.0548-3	1/16/2008	Additional MULPI Event definitions
OSSIv3.0-N-07.0573-3	12/5/2007	Table A-3 Corrections
OSSIv3.0-N-07.0581-2	1/2/2008	Software Download (OSS)
OSSIv3.0-N-07.0583-1	1/2/2008	Correction of MIB name for docslfCmStatusCode
OSSIv3.0-N-07.0588-3	1/16/2008	IPDR clarifications for Sections 6 and 7
OSSIv3.0-N-07.0589-3	1/9/2008	Clarifications for DsidReseqTime and DsidReseqWarnThrshld default values
OSSIv3.0-N-07.0602-1	1/16/2008	Editorial Corrections for I05
OSSIv3.0-N-07.0603-2	1/16/2008	Removal of DHCP event 68000300
OSSIv3.0-N-07.0604-2	1/16/2008	Fix OSS1 CMCI IPv6 link-local address
OSSIv3.0-N-07.0605-1	1/16/2008	Clarification for RCC Numbering spaces in OSSIv3.0
OSSIv3.0-N-08.0614-1	2/6/2008	Editorial corrections to OSSIv3.0 ECNs 532-4 and 603-2

## X.6 Engineering Changes for CM-SP-OSSIv3.0-I07-080522

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I07-080522:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-08.0608-1	2/13/2008	Move reqs from Annex A to Sec 7.1 for NA MIB objects
OSSIv3.0-N-08.0609-2	2/20/2008	remove ocspStatusUnknown(9)
OSSIv3.0-N-08.0612-4	3/5/2008	Application of ifIndex 1Filters to Other Interfaces
OSSIv3.0-N-08.0613-1	2/27/2008	Fix Persistence Requirements in CMTS Debug DSID objects plus other REQ clarifications
OSSIv3.0-N-08.0616-2	3/19/2008	Eliminate overloaded use of the term Service Type in MIB and IPDR Schema objects
OSSIv3.0-N-08.0618-3	4/9/2008	ifTestTable Requirements changed to "D" since RFC 2863 has deprecated them
OSSIv3.0-N-08.0632-3	4/16/2008	Changes to make the dot3 counters optional and clarify ifTable counters for LAN-LAN traffic
OSSIv3.0-N-08.0633-2	4/16/2008	LED Clarifications
OSSIv3.0-N-08.0640-3	4/23/2008	DOCSIS Event management requirements
OSSIv3.0-N-08.0641-2	4/23/2008	TLV 38 snmpTargetAddrExtTable corrections
OSSIv3.0-N-08.0642-3	4/23/2008	Introduction of IPDR Schema for CMTS Utilization Statistics
OSSIv3.0-N-08.0643-1	4/23/2008	Editorial corrections for OSSIv3.0
OSSIv3.0-N-08.0644-1	4/23/2008	Packet Counters Definition Clarification
OSSIv3.0-N-08.0645-3	4/23/2008	OSSIv3.0 Load Balancing

## X.7 Engineering Changes for CM-SP-OSSIv3.0-I08-090121

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I08-090121:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-08.0651-3	10/8/2008	ENTITY-MIB and ENTITY-SENSOR-MIB requirements and docslfCmtsServiceTable clarifications
OSSIv3.0-N-08.0700-4	12/10/2008	Miscellaneous Editorial Corrections including changing term 'ipv4InterfaceTable' to 'ipv6InterfaceTable'.

## X.8 Engineering Changes for CM-SP-OSSIv3.0-I09-090529

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I09-090529:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-09.0773-1	4/29/2009	Remove persistence requirement for the LastUpdate attribute of the CmtsCertRevocationList object
OSSIv3.0-N-09.0775-3	4/29/2009	Miscellaneous editorial corrections
OSSIv3.0-N-09.0777-2	4/29/2009	Added a new Event for Local Syslog when TFTP retries are exceeded.

## X.9 Engineering Changes for CM-SP-OSSIv3.0-I10-091002

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I10-091002:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-09.0776-4	9/2/2009	Move and deprecate objects from docsQosParamSetTable and docsQosServiceClassTable to docsQosServiceFlowTable
OSSIv3.0-N-09.0834-3	9/2/2009	Changing DCID on the fly
OSSIv3.0-N-09.0835-2	9/2/2009	Update of IETF ID draft-ietf-magma-mgmd-mib-08 to RFC 5519.

## X.10 Engineering Changes for CM-SP-OSSIv3.0-I11-100115

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I11-100115:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-09.0849-6	11/18/2009	IPDR/SP service requirements clarification and configuration enhancements
OSSIv3.0-N-09.0854-3	12/2/2009	Requirement clarifications for docsDevNmAccessIp
OSSIv3.0-N-09.0865-2	11/11/2009	Event ID for TFTP retry was a duplicate in EC 777
OSSIv3.0-N-09.0871-4	12/16/2009	Editorial updates to the OSS Spec including Clarification on CmEventCtrl and CmtsEventCtrl object
OSSIv3.0-N-09.0872-4	12/16/2009	Object Model/MIB updates for new SEC feature
OSSIv3.0-N-09.0879-2	12/16/2009	Clarification of Event D103.0 in applicable Spec and ATPs
OSSIv3.0-N-09.0881-3	12/16/2009	CM Provisioning Mode Override

## X.11 Engineering Changes for CM-SP-OSSIv3.0-I12-100611

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I12-100611:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-10.0906-2	03/31/2010	Object Model/MIB update for BPI+ Enforce feature
OSSIv3.0-N-10.0908-3	04/14/2010	Provisioning Mode Override Update
OSSIv3.0-N-10.0914-3	05/05/2010	Missing and incorrect IPDR service data fields
OSSIv3.0-N-10.0921-4	05/05/2010	Subscriber Management updates and clarifications for IPV6
OSSIv3.0-N-10.0924-1	05/05/2010	OSSI Editorial Updates
OSSIv3.0-N-10.0928-1	06/03/2010	Corrections to ECNs OSSIv3.0-N-10.0921-4 and OSSIv3.0-N-10.0914-3

## X.12 Engineering Changes for CM-SP-OSSIv3.0-I13-101008

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0- I13-101008:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-10.0923-5	09/08/2010	IPDR SERVICEFLOW Type
OSSIv3.0-N-10.0934-1	09/1/2010	DocslfExt2CmMscStatusEntry description correction
OSSIv3.0-N-10.0937-4	09/08/2010	OSSI Omnibus ECR for Editorial Corrections
OSSIv3.0-N-10.0938-3	09/01/2010	Subscriber Management updates and clarifications for IPV6 Support for Template Negotiation changed from MAY to SHOULD for all Service Defs
OSSIv3.0-N-10.0945-2	09/08/2010	IP MIB Clarification

## X.13 Engineering Changes for CM-SP-OSSIv3.0-I14-110210

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0- I14-110210:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-10.0958-2	12/22/2010	Change CMTS SNMPv3 Protocol support from MUST to MAY
OSSIv3.0-N-10.0962-5	01/05/2011	MDD IP Prov Mode Override Clarifications and CmMdCfg Table Extension
OSSIv3.0-N-10.0966-2	12/22/2010	OSS changes to support new Buffer Control feature
OSSIv3.0-N-10.0967-3	01/05/2011	Omnibus Editorial Corrections
OSSIv3.0-N-10.0968-2	01/05/2011	Spectrum measurement, CM US, US/DS utilization and logging service changes
OSSIv3.0-N-10.0970-2	01/05/2011	Update minimum intervals for IPDR Time Interval Session types
OSSIv3.0-N-10.0972-2	01/05/2011	Correct references to SAMIS Session Behaviour
OSSIv3.0-N-11.0984-1	01/26/2011	Minor MIB Fixes

## X.14 Engineering Changes for CM-SP-OSSIv3.0-I15-110623

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I15-110623:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-10.0971-2	03/30/2011	Group Service Flow Reporting for Multicast
OSSIv3.0-N-11.0986-1	04/06/2011	IP Provisioning Mode Override Erratum
OSSIv3.0-N-11.0993-1	05/11/2011	Full DOCSIS Service Definition Object Model
OSSIv3.0-N-11.0996-1	05/19/2011	I14 Omnibus ECR
OSSIv3.0-N-11.0997-1	05/25/2011	Clear Learned MAC Addresses
OSSIv3.0-N-11.0985-1	02/09/2011	Minor Schema Fixes

## X.15 Engineering Changes for CM-SP-OSSIv3.0-I16-111117

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I16-111117:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-11.0989-2	07/27/2011	Correct references to SAMIS Session Behaviour
OSSIv3.0-N-11.1010-3	09/28/2011	Update IPDR References
OSSIv3.0-N-11.1019-1	10/19/2011	Minor Issues/Omnibus
OSSIv3.0-N-10.0968-2; OSSIv3.0-N-10.0985-1		These ECNs were incorporated into the I14 version, but were inadvertently left out of the I15 version. They are correctly included in this version.

## X.16 Engineering Changes for CM-SP-OSSIv3.0-I17-111213

CM-SP-OSSIv3.0-I17-111213 was issued to correct several editorial errors. It does not contain any technical changes, but instead just updates the specification to match all published ECNs accurately.

## X.17 Engineering Changes for CM-SP-OSSIv3.0-I18-120329

The following Engineering Change is incorporated into CM-SP-OSSIv3.0-I18-120329:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-11.1025-3	01/18/2012	ICMP Classifier Reporting

## X.18 Engineering Changes for CM-SP-OSSIv3.0-I19-120809

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I19-120809:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-12.1067-2	7/11/2012	Relaxation of CMTS SNMPv3 MIB table requirements
OSSIv3.0-N-12.1064-3	7/11/2012	Omnibus Changes for OSSIv3.0-118
OSSIv3.0-N-12.1062-3	7/11/2012	IPDR Updates
OSSIv3.0-N-12.1058-3	5/23/2012	Relaxation of support for Layer 3 Forwarding in CMTS - OSSI
OSSIv3.0-N-12.1040-3	5/2/2012	CMTS Support for 1.0 CM/CoS Relaxation - OSSI

## X.19 Engineering Changes for CM-SP-OSSIv3.0-I20-121113

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I20-121113:

EC Identifier	ECN Date	Summary
OSSIv3.0-N-12.1073-3	10/17/2012	1x1 Energy Management Support for OSSI
OSSIv3.0-N-12.1078-4	10/17/2012	CM requirements for Downstream Spectrum Capture
OSSIv3.0-N-12.1079-4	10/17/2012	DOCS-IF3-MIB updates for Energy Management and Spectrum Analysis ECs

## X.20 Engineering Changes for CM-SP-OSSIv3.0-I21-130404.

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I21-130404:

EC Identifier	ECN Date	Summary	Author
OSSIv3.0-N-12.1083-5	2/27/2013	Energy Management Metrics	Hedstrom
OSSIv3.0-N-13.1093-3	2/27/2013	Correction and Clarification of Spectrum Analysis MIB	Fish
OSSIv3.0-N-13.1096-1	2/27/2013	Omnibus correction to OSSI	Hedstrom

## X.21 Engineering Changes for CM-SP-OSSIv3.0-I22-131120.

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I22-131120:

EC Identifier	ECN Date	Summary	Author
OSSIv3.0-N-13.1119-3	10/16/2013	Correction to docslf3CmSpectrumAnalysisMeasFrequency in DOCS-IF3-MIB	Hedstrom

**X.22 Engineering Changes for CM-SP-OSSIv3.0-I23-14-4-3.**

The following Engineering Changes are incorporated into CM-SP-OSSIv3.0-I23-140403

EC Identifier	ECN Date	Summary	Author
OSSIv3.0-N-13.1125-2	11/13/2013	Subscriber Management MIB changes for new eSAFE devices	Howe

**X.23 Engineering Changes for CM-SP-OSSIv3.0-I24-140729.**

The following Engineering Change is incorporated into CM-SP-OSSIv3.0-I24-140729.

EC Identifier	ECN Date	Summary	Author
OSSIv3.0-N-14.1151-2	7/9/2014	Operationalization of IPTV Multicast service	Hedstrom

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