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Data-Over-Cable Service Interface Specification
DOCSIS 1.0 Operations Support System Interface (OSSI)

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1 INTRODUCTION

This document outlines the Management Information Bases (MIBs) for high-speed data-over-cable systems developed by the DOCSIS Data Over Cable Services working group.

Three Simple Network Management Protocol (SNMP) MIBs are defined. The first is the DOCSIS Radio Frequency Interface (RFI) MIB and defines objects that enable management of the CATV MAC and PHY layer interfaces. The second is the DOCSIS Cable Device (CD) MIB and defines objects that enable management of CMs and Cable Modem Termination Systems (CMTSs). The third is DOCSIS Base Line Interface (BPI) MIB and defines objects that enable management of security features in the CM and CMTS.

This specification is intended to enable prospective vendors of cable modems and other data-over-cable systems to address the operations support requirements in a uniform and consistent manner.

1.1 Requirements

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

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

2 CM AND CMTS MANAGEMENT REQUIREMENTS

This section describes the CM and CMTS management requirements. The MIBs compliant with these requirements are described in Section 4 and formally defined in Section 5.

2.1 Accounting Management

Although many different types of billing scenarios exist for operators, the only scenarios which require use of CM and CMTS managed objects are those based on metered usage or reserved bandwidth. Common practice by several Internet Service Providers (ISPs) allows usage-based billing based on peak rates. A DOCSIS provider can implement usage-based billing two ways: by polling the CMs, or by polling the CMTS.

In the first method, a service provider can poll the ifInOctets and ifOutOctets counters from the MIB-II [RFC-1213] Interfaces group on each CM. This has the advantage of enabling both upstream and downstream traffic metering with the potential disadvantage of affecting network performance.

The second metered billing method involves monitoring the docsIfCmtsServiceTotalDataSlots counter from the docsIfCmtsServiceTable on each CMTS. This has the advantage of avoiding congestion on the RF network; however, it enables upstream traffic metering only. In a typical ISP environment, a BSS polls the appropriate

counters on each customer device once every 15 minutes throughout a monthly billing cycle. This data is converted into an average utilization rate for the sample period. Doing so permits the ISP to bill based on peak bandwidth by choosing the sample ranked at the 90-95th percentile. Note that the billing system may also include time-of-day rate variations. The billing of reserved upstream MAC bandwidth is aided by information available from the docsIfQosProfileTable for each CM. These MIB variables report the upstream QoS characteristics, not just the nominal bandwidth, associated with each service ID and enable the service provider to bill for Grade of Service by verifying QoS.

2.2 Configuration Management

2.2.1 Version Control

The CM and CMTS SHOULD support software revision and operational parameter configuration interrogation. In particular, the fields of the sysObjectID Object Identifier (OID) of the CM should successively encode the vendor ID, the hardware platform, the hardware revision, the software/PROM major revision number, the software/PROM minor revision number, and (optionally) the software patch level. Each parameter MUST occupy exactly one field. The fields of the sysObjectID OID of the CMTS SHOULD use the same encoding.

Additionally, the CM MUST (and the CMTS SHOULD) include the same revision information in the vendor defined text of the sysDescr object in the MIB-II System Group [RFC-1213].

2.2.2 Software upgrades

The CM software upgrade process is documented in [DOCSIS7].

The mechanism to upgrade software from an SNMP manager MUST be supported by CMs, and SHOULD be supported by CMTSs. From a network management station, the operator:

- sets docsDevSwServer to the address of the TFTP server for software upgrades
- sets docsDevSwFilename to the file pathname of the software upgrade image
- sets docsDevSwAdminStatus to upgrade-from-mgt

docsDevSwAdminStatus MUST persist across resets/reboots until overwritten from an SNMP manager or via the CM configuration file.

The default state of docsDevSwAdminStatus MUST be allowProvisioningUpgrade(2) until it is overwritten by ignoreProvisioningUpgrade(3) following a successful SNMP-initiated software upgrade.

docsDevSwOperStatus MUST persist across resets to report the outcome of the last software upgrade attempt.

Both docsDevSwServer and docsDevSwFilename MUST behave according to their textual descriptions in the cable device MIB.

If a CM suffers loss of power or resets during an SNMP-initiated upgrade, the CM MUST resume the interrupted upgrade without requiring manual intervention.

One reason for the SNMP-initiated upgrade is to allow loading of a temporary software image (e.g., special diagnostic software) that differs from the software normally used on that modem without changing the provisioning database.

Note that software upgrades MUST NOT be accepted blindly by the cable modem. The processes defined in [DOCSIS7] for CM response following software upgrade failure MUST be supported.

2.2.3 System Initialization and Configuration

Most system configuration of CMs is performed through a combination of CATV MAC, DHCP, and TFTP exchanges. These exchanges are defined in detail in the Radio Frequency Interfaces Specification [DOCSIS7]. In particular, to enable event logging through SYSLOG, the DHCP server sets the log server option [RFC-2132] to the address of the SYSLOG server.

2.3 Fault Management

2.3.1 SNMP Usage

In the DOCSIS environment, the goals of fault management are the remote detection, diagnosis, and correction of network problems. Therefore, the CM MUST support SNMP management traffic across both the Ethernet and CATV MAC interfaces. Access may be restricted to support policy goals (see the docsDevNmAccessTable).

CM installation personnel can use SNMP queries from a station on the Ethernet to perform on-site CM and CATV MAC diagnostics and fault classification (note that this may require temporary provisioning of the CM from an Ethernet DHCP server). Further, future customer applications using SNMP queries can diagnose simple post-installation problems, avoiding visits from service personnel and minimizing help desk telephone queries.

Standard MIB-II support MUST be implemented to instrument interface status, packet corruption, protocol errors, etc. The transmission MIB for Ethernet-like objects [RFC-1643] MUST be implemented on each CM and CMTS Ethernet and Fast Ethernet port. The ifXTable [RFC-2233] SHOULD be implemented to provide discrimination between broadcast and multicast traffic.

The CM and CMTS MUST support managed objects for fault management of the PHY and MAC layers. The MIB 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 MIB also includes variables to track MAC state such as collisions and excessive retries for requests, immediate data transmits, and initial ranging requests.

For fault management at all layers, the CM/CMTS MUST generate replies to SNMP queries (subject to policy filters) for counters and status, MUST send SNMP traps to one or more trap NMSs (subject to policy), and MUST send event logging to a SYSLOG server (if a log server is defined). The ifTestTable [RFC-2233] SHOULD be implemented for any diagnostic test procedures that can be remotely initiated.

2.3.2 Event Logging

Event logging and history provide vendors an opportunity for product differentiation. The ability to report useful logs may depend on semi-graceful failure modes and on the ability to record such in nonvolatile storage.

Events SHOULD be reported via log entries in a MIB, the SYSLOG facility (as documented in Appendix B), and SNMP traps. Reporting of events SHOULD be fully configurable by priority class. At minimum, it MUST be possible to disable SNMP Trap and SYSLOG transmission.

A local event log that is available via SNMP queries SHOULD be implemented to track events that cannot be reported at the time that they occur. This log SHOULD support a minimum of ten event log entries, and SHOULD persist across device reboots.

The definition and coding of events is vendor-specific. However, the standard set of error codes and messages listed in Appendix I of [DOCSIS 7] SHOULD be used to textually describe events where applicable.

In deference to the network operator who must troubleshoot multi-vendor networks, the circumstances and meaning of each event are reported as human-readable text. Vendors SHOULD provide time-of-day clocks in CMs to provide useful timestamping of events. Similarly, event logs SHOULD be persistent across device reboots. The depth of the event log is vendor-dependent, with oldest entries discarded as needed.

For each vendor-specific event that is reportable via TRAP, the vendor must create an enterprise-specific trap definition. Trap definitions MUST include docsDevEvText and SHOULD be defined according to section 3.2.2. of draft-ietf-ipcdn-cable-device-mib.txt.

The event framework described in this section MUST be implemented in CMs and SHOULD be implemented in CMTSs.

2.3.3 Trap and Syslog Throttling

The CM and CMTS MUST provide support for trap and syslog message throttling as described below. The network operator can employ message rate throttling or trap limiting by manipulating the appropriate MIB variables.

2.3.3.1 Rate Throttling

Network operators may employ either of two rate control methods. In the first method, the device ceases to send traps and SYSLOG messages when the rate exceeds the specified maximum message rate. It resumes sending traps only if reactivated by a network management station request.

In the second method, the device resumes sending traps when the rate falls below the specified maximum message rate. The network operator configures the specified maximum message rate by setting the measurement interval (in seconds), and the maximum number of trap and SYSLOG messages (excluding duplicates) to be transmitted within the measurement interval. The operator can query the operational throttling state (to determine whether traps are enabled or blocked by throttling) of the device, as well as query and set the administrative throttling state (to manage the rate control method) of the device.

2.3.3.2 Trap Limiting

Network operators may wish to limit the number of traps sent by a device over a specified time period. The device ceases to send traps and SYSLOG messages when the number of traps exceeds the specified threshold. It resumes sending traps only when the measurement interval has passed.

The network operator defines the maximum number of traps he is willing to handle and sets the measurement interval to a large number (in hundredths of a second). For this case, the administrative throttling state is set to stop at threshold which is the maximum number of traps.

See “Techniques for Managing Asynchronously Generated Alerts” [RFC-1224] for further information.

2.3.4 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), traceroute (UDP and various ICMP Destination Unreachable flavors). Pings to a CM from its Ethernet side MUST be supported to enable local connectivity testing from a customer’s PC to the modem. The CM and CMTS MUST support IP end-station generation of ICMP error messages and processing of all ICMP messages.

2.4 Performance Management

At the CATV MAC layer, 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 interfaces statistics, as well as the docsifCmtsServiceTable and docsifCmServiceTable.

It is not anticipated that the CMTS upstream bandwidth allocation function will require active network management intervention and tuning. Nevertheless, management objects are provided in case tuning or direct control is necessary. The three key upstream contention intervals are the request interval, the immediate data interval, and the initial ranging maintenance interval. If the upstream collision rate of requests and immediate data is high relative to the upstream traffic bandwidth, then the network management system (NMS) might increase the size of the request and immediate data intervals, respectively. The NMS might increase the size of the initial ranging maintenance interval when the upstream collision rate of initial ranging messages is relatively high, such as at the conclusion of a wide-spread regional power outage. The NMS might also decrease the size of these contention intervals under low collision rate conditions, since these intervals occupy bandwidth that may be otherwise used for upstream transmission bandwidth. As a last resort, the NMS might change the guaranteed upstream bandwidth for one or more service IDs, to relieve upstream traffic congestion for key subscribers. The CM MUST implement MIB counters that report the number of contention interval collisions (measured as the number of contention interval retries) per service ID, and the CMTS MUST implement read-write MIB objects that control the size of the contention intervals for each upstream channel. The CMTS SHOULD implement a read-write MIB object that controls the guaranteed upstream bandwidth for each service ID.

At the LLC layer, the performance management focus is on bridge traffic management. The CM and CMTS (if the CMTS implements transparent bridging) MUST implement the Bridge MIB [RFC-1493], including the dot1dBase and dot1dTp groups. The CM and CMTS MUST implement a managed object that controls whether the 802.1d spanning tree protocol (STP) is run and topology update messages are generated; STP is unnecessary in hierarchical, loop-free topologies. If the STP is enabled for the CM/CMTS, then the CM/CMTS MUST implement

the dot1dStp group. These MIB groups' objects allow the NMS to detect when bridge forwarding tables are full, and enable the NMS to modify aging timers.

A final performance concern is the ability to diagnose unidirectional loss. Both the CM and CMTS MUST implement the MIB-II [RFC-1213] Interfaces group. When there exists more than one upstream or downstream channel, the CM/CMTS MUST implement an instance of IfEntry for each channel. The ifStack MIB [RFC-2233] MUST be used to define the relationships among the CATV MAC interfaces and their channels.

2.5 Protocol Filters

The CM MUST implement LLC and IP protocol filters. The LLC protocol filter entries can be used to limit CM forwarding to a restricted set of network-layer protocols (such as IP, IPX, NetBIOS, and Appletalk). The IP protocol filter entries can be used to restrict upstream or downstream traffic based on source and destination IP addresses, transport-layer protocols (such as TCP, UDP, and ICMP), and source and destination TCP/UDP port numbers. The CM MUST support a minimum of ten LLC protocol filter entries, and ten IP protocol filter entries.

2.6 Common Spectrum Management

The CMTS SHOULD implement the HFC RF Spectrum Management MIB [CSMI-MIB]. The definition of this MIB is likely to evolve, and vendors should anticipate changes in this area.

2.7 Protocol

The SNMPv1 protocol [RFC-1157] and the SNMPv2 protocol have been selected as the protocol for management of data-over-cable services and MUST be implemented. Many of the managed objects described in the MIB addendums are configurable parameters and allow read-write access. As operators of public data networks, most cable operators will wish to restrict access to those objects, both at the CM and CMTS. Two mechanisms are provided to accomplish this.

First, the docsDevNMAccessTable in the Cabel Device MIB described in [RFC-2670] provides a means of restricting access to particular network management stations over particular interfaces using specific community strings. For example, the CMTS may be configured to respond only to SNMP requests originating on its network-side interface.

Second, writable-access for individual managed objects is controlled through the provisioned configuration file as described in [DOCSIS7]. That is, each read-write object can be redefined at provisioning time to be read-only.

3 AREAS FOR FUTURE CONSIDERATION

This section outlines some areas for future consideration within this specification.

- Enterprise-specific traps will be defined in the future as dictated by field experience.
- Multicast service provisioning within the cable modem will be clearly defined.
- To support the billing of reserved downstream MAC bandwidth, the CMTS should implement the evolving RSVP/Integrated Services MIB(s). Because of the variety of output queuing mechanisms, comments are solicited for the management mechanisms to support this.

4 MANAGEMENT INFORMATION BASE (MIB)

This section defines the minimum set of managed objects required to support the CM and CMTS management requirements identified in the previous section. Vendors may augment this MIB with objects from other standard or vendor-specific MIBs where appropriate.

The DOCSIS OSSI specification has priority over IETF MIB specifications. Vendors MUST implement MIB requirements in accordance with the texts specified in the OSSI specification. See Appendix C for detailed MIB requirements. Certain objects are deprecated but may be required by the OSSI specification. Otherwise, implementation of deprecated objects MUST follow the following rules:

1. a deprecated “scalar” object MUST return ‘NoSuchName’
2. a deprecated “element that is part of table” MUST return ‘0’

Obsolete object(s) MUST be implemented if specified by the OSSI specification.

4.1 MIB Organization

There are four parts of the MIB needed for CMs and CMTSs. The first is a set of objects drawn from generic SNMP MIBs that bear on this set of devices. It is not the intention of this specification to duplicate existing specifications. These are available as RFCs from the IETF and are widely available.

The second part is a set of objects for the CATV interfaces of the CM and CMTS. This MIB provides the objects needed to configure, operate, and monitor the physical CATV interfaces. This specification is derived from the DOCSIS Radio Frequency Specification [DOCSIS7]. These objects are defined in the Radio Frequency (RF) Interface MIB for DOCSIS RF interfaces [RFC-2670] and MUST be implemented.

The docsIfDownChannelPower object-type MUST be implemented in a CMTS that provides an integrated RF upconverter. If the CMTS relies on an external upconverter, then the CMTS SHOULD implement the docsIfDownChannelPower object-type. The CMTS transmit power reported in the MIB object MUST be within 2 dB of the actual transmit power in dBmV when implemented. If transmit power management is not implemented, the MIB object will be read-only and report the value of 0 (zero).

The docsIfDownChannelPower object-type MUST be implemented in DOCSIS 1.0 conforming CMs. This object is read-only. When operated at nominal line voltage, at normal room temperature, the reported power MUST be within 3 dB of the actual received channel power. Across the input power range from -15 dBmV to +15 dBmV, for any 1 dB change in input power, the CM MUST report a power change in the same direction that is not less than 0.5 dB and not more than 1.5 dB.

The third part is a set of objects for management of CM and CMTS devices. These provide system-level functionality that is specific to the business and operational environments of cable data systems. These objects are defined in DOCSIS Cable Device MIB [RFC-2669] and MUST be implemented.

The fourth part is a set of objects needed to manage the security features in DOCSIS devices. The BPI MIB includes a set of objects needed to configure, operate, and monitor the baseline privacy interface. The BPI MIB is defined by [RFC-3083].

Due to the editorial error in [RFC-3083], the CMs MUST use the following definition for docBpiCmAuthState instead of the definition in [RFC-3083].

```
DocBpiCmAuthState OBJECT-TYPE
    SYNTAX INTEGER {
      Start(1),
      AuthWait(2),
      Authorized(3),
```

ReauthWait(4),

AuthRejectWait(5)

}

MAX-ACCESS read-only

STATUS current

DESCRPTION

"The value of this object is the state of the CM authorization

FMS. The start date indicates that FSM is in its initial state."

REFERENCE

"DOCSIS baseline Privacy Interface Specification,

Section 4.1.2.1."

::={docsBpiCmBaseEntry 3}

docsDevFilterLLCUnmatchedAction:

docsDevFilterLLCUnmatchedAction MUST follow the following requirement:

If set to discard(1), any L2 packet that does not match any filters will be discarded, otherwise accepted. If set to accept, any L2 packet that does not match any filters will be accepted, otherwise discarded. Another way to interpret this is the following:

```
action = UnMatchedAction
Iterate through the table
    if there is a match (packet.protocol = row.protocol)
    {   reverse the action (accept becomes discard, discard becomes accept)
        apply action to the packet
        terminate the iteration
    }
```

docsDevCpeIpMax:

DOCSIS-compliant CMs MUST implement the docsDevCpeIpMax object with a default value of -1.

docsDevNMAccessIP and docsDevNMAccessIpMask :

The devices that implement docsDevNMAccessTable MUST apply the following rule in order to determine whether to permit SNMP access from a SrcIpAddr:

```
if ( ( NmAccessIp AND NmAccessIpMask ) = = ( SrcIpAddr AND NmAccessIpMask ) )
    Permit the access from SrcIpAddr
else
    Do NOT permit the access from SrcIpAddr
```

4.2 Managed Objects from Existing Standards

4.2.1 Requirements for RFC-1907

4.2.1.1 The System Group

The System Group from RFC-1907 MUST be implemented. See Section 2.2.1 for sysObjectID requirements.

4.2.1.2 The SNMP Group

The SNMP Group from RFC-1907 MUST be implemented. Obsolete objects in RFC-1907 that are current in RFC-1213 MUST be implemented.

4.2.2 Requirements for RFC-2233

The interface group provides essential information about both MAC interfaces and individual channels and MUST be implemented. The ifXTable SHOULD be supported.

4.2.2.1 Interface Organization and Numbering

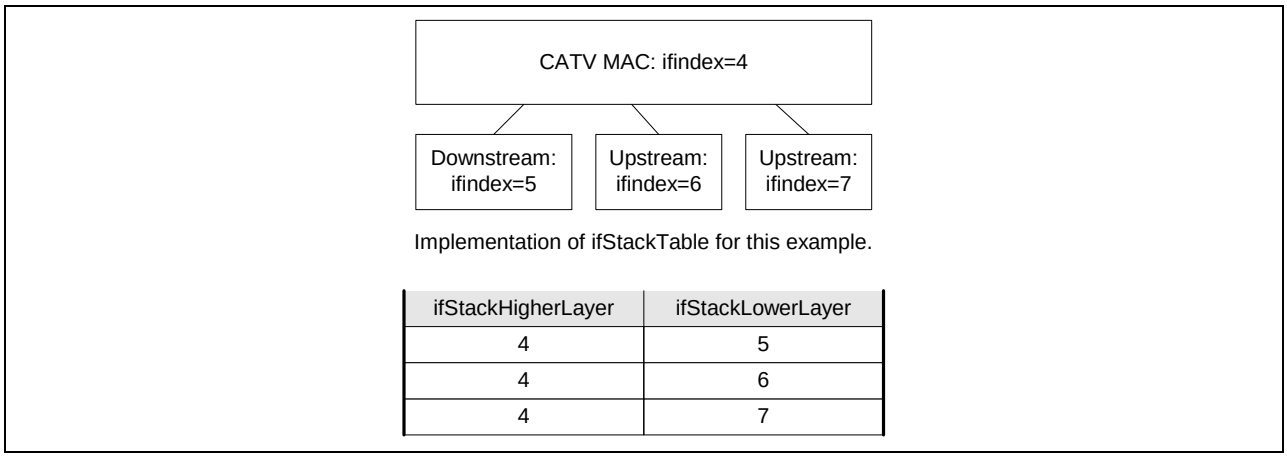
An instance of ifEntry MUST exist for each CATV-MAC interface, downstream channel, upstream channel, and each LAN interface enabled by the CM. The enablements of LAN interfaces MAY be fixed during the manufacturing process, or MAY be determined dynamically during operation by the CM according to whether an interface has a CPE device attached to it or not.

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

If a MAC interface consists of more than one upstream and downstream channel, then a separate instance of ifEntry MUST also exist for each channel.

The ifStack group ([RFC-2233]) MUST be implemented to identify relationships among sub-interfaces. Note that the CATV-MAC interface must exist, even though it is broken out into sub-interfaces.

The example below illustrates a MAC interface with one downstream and two upstream channels:



Implementation of ifStackTable for this example.

ifStackHigherLayer	ifStackLowerLayer
4	5
4	6
4	7

Figure 4-1. Interface Numbering Example

At the CMTS, interface numbering is at the discretion of the vendor, and should correspond to the physical arrangement of connections. If table entries exist separately for upstream and downstream channels, then the ifStack group ([RFC-2233]) must be implemented to identify relationships among sub-interfaces. Note that the CATV MAC interface(s) must exist, even if further broken out into sub-interfaces.

At the CM, Interfaces MUST be numbered as:

- CMCI: 1
- CATV-MAC: 2
- RF Downstream: 3
- RF Upstream: 4
- all others (additional channels, CPE ports, and telephony return interface if present): n+4

Creation of entries in both the docsDevNmAccessTable and docsDevFilter group relies on knowledge of CM interface numbering assignments. To support creation of these CM entries via configuration file SNMP encoding at registration time [RFI-SPEC], the numbering of these interfaces MUST be as described above.

The CMCI is a generic reference to any current or future form of CM CPE interface port technology [DOCSIS4]. Examples include ethernet, USB, IEEE-1394.

To determine the numbering and relationship of the remaining CM interfaces, the ifType and the ifStack table MUST be Supported.

4.2.2.2 Specific Interface Attributes

The ifAdminStatus object provides administrative control over both MAC interfaces and individual channels.

For CATV MAC interfaces, ifSpeed is defined as the bit rate of the highest-speed channel

which is attached to this interface.

The ifSpecific object must be set to { docsIfMib } for CATV MAC interfaces. For upstream channels, it is set to { docsIfUpstreamChannelTable }. For downstream channels, it is set to { docsIfDownstreamChannelTable }. Note that this object is deprecated in [RFC-2233].

The ifType object has been assigned the following enumerated values for each instance of a Data Over Cable Service (DOCS) interface:

- CATV MAC interface: docsCableMacLayer (127)
- CATV downstream channel: docsCableDownstream (128)
- CATV upstream channel: docsCableUpstream (129)

4.2.3 Requirements for RFC-2011

4.2.3.1 The IP Group

The IP group MUST be implemented. It does not apply to IP packets forwarded by the device as a link-layer bridge. For the CM, it apples only to the device as an IP host. At the CMTS, it applies to the device as an IP host, and as a router if IP routing is implemented.

4.2.3.2 The ICMP Group

The ICMP group MUST be implemented. See Section 2.3.4 for additional requirements.

4.2.4 Requirements for RFC-1493

In both the CM and the CMTS (if the CMTS implements transparent bridging), the Bridge MIB ([RFC-1493]) MUST be implemented to represent the bridging process.

In the CMTS that implements transparent bridging, the Bridge MIB SHOULD be used to represent information about the MAC Forwarder states.

4.2.5 Requirements for RFC-2665

The Ethernet-like MIB ([RFC-2665]) MUST be implemented if Ethernet or Fast Ethernet interfaces are present.

4.2.6 Requirements for RFC-2013

The UDP group in [RFC-2013] MUST be implemented.

4.2.7 Requirements for RFC-1512

The FDDI MIB ([RFC-1512]) MUST be implemented if a Fiber Distributed Data Interface is present.

4.3 MIB Transition

In order to help operators make a smooth MIB transition, CMs:

- MUST support the configuration file with CD-4 MIB OID and the configuration file with [RFC-2669] MIB OID
- MAY support querying of both MIBs (CD-4 and [RFC-2669]) from NMS

Appendix I Protocol Definition for SYSLOG (normative)

This appendix documents the usage of the SYSLOG protocol for the Operations Support System environment. The SYSLOG protocol is a UDP-based protocol that permits remote logging of device messages. Messages may be associated with different facilities and multiple priorities.

The basic format of the SYSLOG packet is simple to describe. The UDP source and destination port number is 514. The UDP payload consists of a facility/priority value enclosed in angle brackets, followed by a null-terminated string. The UDP payload string normally includes an optional time-of-day stamp, an identification string, an optional PID (in square brackets), and the actual logging message.

For consistency in a multi-vendor CM environment, this appendix adds further constraints to the SYSLOG packet. The CM uses the "local0" facility in its SYSLOG messages, so that the SYSLOG server can manage CM SYSLOG messages separately from kernel, mail, news, and other generic facilities. This limits the facility/priority values to the range of 128 to 135. The actual facility/priority value depends on the urgency of the message: emergency(128), alert(129), critical(130), error(131), warning(132), notice(133), information(134), and debug(135).

This appendix also constrains the UDP payload string. The time-of-day stamp SHOULD NOT be included, forcing the SYSLOG server to provide its own (consistent) timestamps for all CM SYSLOG messages. The identification string MUST be "Cablemodem", and the "optional PID" MUST be a constant vendor-specific identification label, to assist in SYSLOG server logging management.

An example of a valid SYSLOG UDP payload would be “<132>Cablemodem[VendorX]: Downloading new CM software”. This example payload might be recorded on the SYSLOG server as “Jan 12 12:56:03 24.1.1.1 Cablemodem[VendorX]: Downloading new CM software”.

Appendix II References (informative)

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Appendix III Glossary (informative)

American National Standards Institute (ANSI) – A U.S. standards body.

ANSI – See American National Standards Institute.

Availability – In cable television systems, availability is the long-term ratio of the actual RF channel operation time to scheduled RF channel operation time (expressed as a percent value) and is based on a bit error rate (BER) assumption.

Broadcast Addresses – A predefined destination address that denotes the set of all data network service access points.

BSS – See Business Support System.

Business Support System (BSS) – a collection of computing equipment maintaining accounting, billing, and access control for a cable modem network.

Cable Modem (CM) – A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.

Cable Modem Termination System (CMTS) – Cable modem termination system, located at the cable television system headend or distribution hub, which provides complementary functionality to the cable modems to enable data connectivity to a wide-area network.

Cable Modem Termination System - Network Side Interface (CMTS-NSI) – The interface, defined in [DOCSIS3], between a CMTS and the equipment on its network side.

Cable Modem to CPE Interface (CMCI) – The interface, defined in [DOCSIS4], between a CM and CPE.

CM – See Cable Modem.

CMCI – See Cable Modem to CPE Interface.

CMTS – See Cable Modem Termination System.

CMTS-NSI – See Cable Modem Termination System - Network Side Interface.

CPE – See Customer Premise Equipment.

Customer – See End User.

Customer Premises Equipment (CPE) – Equipment at the end user's premises; MAY be provided by the end user or the service provider.

Data Link Layer – Layer 2 in the Open System Interconnection (OSI) architecture; the layer that provides services to transfer data over the transmission link between open systems.

DHCP – See Dynamic Host Configuration Protocol.

Distribution Hub – A location in a cable television network which performs the functions of a Headend for customers in its immediate area, and which receives some or all of its television program material from a Master Headend in the same metropolitan or regional area; see, for example, [DOCSIS1].

DOCSIS – Data-Over-Cable Service Interface Specification.

Downstream – In cable television, the direction of transmission from the headend to the subscriber.

Dynamic Host Configuration Protocol (DHCP) – An Internet protocol used for assigning network-layer (IP) addresses.

End User – A human being, organization, or telecommunications system that accesses the network in order to communicate via the services provided by the network.

Fiber Node – A point of interface between a fiber trunk and the coaxial distribution.

Headend – The central location on the HFC network that is responsible for injecting broadcast video and other signals in the downstream direction. See also Master Headend, Distribution Hub.

Header – Protocol control information located at the beginning of a protocol data unit.

HFC – See Hybrid Fiber/Coax (HFC) System.

High Frequency (HF) – Used in this document to refer to the entire subsplit (5-30 MHz) and extended subsplit (5-42 MHz) band used in reverse channel communications over the cable television network.

Hybrid Fiber/Coax (HFC) System – A broadband bi-directional shared-media transmission system using fiber trunks between the headend and the fiber nodes, and coaxial distribution from the fiber nodes to the customer locations.

ICMP – See Internet Control Message Protocol.

IEEE – See Institute of Electrical and Electronic Engineers.

IETF – See Internet Engineering Task Force.

Internet Control Message Protocol (ICMP) – An Internet network-layer protocol.

Institute of Electrical and Electronic Engineers (IEEE) – A voluntary organization which, among other things, sponsors standards committees and is accredited by the American National Standards Institute.

Internet Engineering Task Force (IETF) – A body responsible, among other things, for developing standards used in the Internet.

Internet Protocol (IP) – An Internet network-layer protocol.

International Organization for Standardization (ISO) – An international standards body, commonly known as the International Standards Organization.

IP – See Internet Protocol.

Layer – A subdivision of the Open System Interconnection (OSI) architecture, constituted by subsystems of the same rank

LLC – See Logical Link Control (LLC) procedure.

Local Area Network (LAN) – A non-public data network in which serial transmission is used for direct data communication among data stations located on the user's premises.

Logical Link Control (LLC) procedure – In a local area network (LAN) or a Metropolitan Area Network (MAN), that part of the protocol that governs the assembling of data link layer frames and their exchange between data stations, independent of how the transmission medium is shared.

MAC – See Media Access Control (MAC) procedure.

Master Headend – A headend which collects television program material from various sources by satellite, microwave, fiber and other means, and distributes this material to Distribution Hubs in the same metropolitan or regional area. A Master Headend MAY also perform the functions of a Distribution Hub for customers in its own immediate area; see, for example, [DOCSIS1].

Media Access Control (MAC) address – The "built-in" hardware address of a device connected to a shared medium.

Media Access Control (MAC) procedure – In a subnetwork, that part of the protocol that governs access to the transmission medium independent of the physical characteristics of the medium, but taking into account the topological aspects of the subnetworks, in order to enable the exchange of data between nodes. MAC procedures include framing, error protection, and acquiring the right to use the underlying transmission medium.

Media Access Control (MAC) sublayer – The part of the data link layer that supports topology-dependent functions and uses the services of the Physical Layer to provide services to the logical link control (LLC) sublayer.

Network Layer – Layer 3 in the Open System Interconnection (OSI) architecture; the layer that provides services to establish a path between open systems.

Network Management – 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.

Open Systems Interconnection (OSI) – 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 ervice 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.

Operations Support System (OSS) – The backoffice software used for configuration, performance, fault, accounting and security management.

OSI – See Open Systems Interconnection.

OSS – See Operations Support System.

PHY – See Physical (PHY) Layer.

Physical (PHY) Layer – 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.

Protocol – A set of rules and formats that determines the communication behavior of layer entities in the performance of the layer functions.

QoS – See Quality of Service.

Quality of Service (QoS) –The accumulation of the cell loss, delay, and delay variation incurred by cells belonging to a particular connection.

Radio Frequency (RF) – In cable television systems, this refers to electromagnetic signals in the range 5 to 1000 MHz.

Reverse Channel – The direction of signal flow towards the headend, away from the subscriber; equivalent to Upstream.

Request For Comments (RFC) – A technical policy document of the IETF; these documents can be accessed on the World Wide Web at http://ds.internic.net/ds/rfcindex.html.

RFC – See Request for Comments.

Simple Network Management Protocol (SNMP) – A network management protocol of the ETF.

SNMP – See Simple Network Management Protocol.

Subscriber – See End User.

Sublayer – A subdivision of a layer in the Open System Interconnection (OSI) reference model.

Subnetwork – Subnetworks are physically formed by connecting adjacent nodes with transmission links.

Subsystem – An element in a hierarchical division of an Open System that interacts directly with elements in the next higher division or the next lower division of that open system. Systems Management – Functions in the application layer related to the management of various open systems Interconnection (OSI) resources and their status across all layers of the OSI architecture.

TFTP – See Trivial File-Transfer Protocol.

Transmission Control Protocol (TCP) – A transport-layer Internet protocol which ensures successful end-to-end delivery of data packets without error.

Trivial File-Transfer Protocol (TFTP) – An Internet protocol for transferring files without the requirement for user names and passwords that is typically used for automatic downloads of data and software.

Transmission Link – The physical unit of a subnetwork that provides the transmission connection between adjacent nodes.

Transmission Medium – The material on which information signals may be carried; e.g., optical fiber, coaxial cable, and twisted-wire pairs.

Transmission System – The interface and transmission medium through which peer physical layer entities transfer bits.

Upstream – The direction from the subscriber location toward the headend.

Appendix IV MIB Requirements (normative)

RFC/MIB Doc	Table/Group/Objects	CM	CMTS
RFC-2011	IP Group	M	M
	IpAddrTable	M	M
	ICMP Group	M	M
RFC-2013	UDP Group	M	M
RFC-1907	System Group	M	M
	SNMP Group	M	M
RFC-2358	dot3StatsTable	M	M
	dot3CollFrequencies	O	O
RFC-2233	ifTable	M	M
	ifXTable		
	ifName	M	M
	ifInMulticastPkts	M	M
	ifInBroadcastPkts	M	M
	ifOutMulticastPkts	M	M
	ifOutBroadcastPkts	M	M
	ifHCInOctets	O	O
	ifHCInUcastPkts	O	O
	ifHCInMulticastPkts	O	O
	ifHCInBroadcastPkts	O	O
	ifHCOutOctets	O	O
	iFHCOutUcastPkts	O	O
	ifHCOutMulticastPkts	O	O
	ifHCOutBroadcastPkts	O	O
	ifLinkUpDownTrapEnable	M	M
	ifHighSpeed	M	M
	ifPromiscuousMode	M	M
	ifConnectorPresent	M	M
	ifAlias	M	M
	ifCounterDiscontinuityTime	M	M
	ifStackTable	3	3
	ifStackStatus		
	ifTestTable	O	O
RFC-1493	dot1dBase Group	M	M
	dot1StpTable	1	1
	dot1StpPortTable	1	1
	dot1dtp Objects	M	M
	dot1dTpFdbTable	M	M
	dot1dTpPortTable	M	M
	dot1dStatic Table	O	O
RFC-2669	docsDevBaseGroup	M	O
	DocDevNmAccessTable	2	O
	docsDevSoftware Obj	M	O
	docsDevServer Objects	M	Not Implemented
	docsDevEvent Objects	M	O
	docsDevEvControl Table	M	O
	dosDevEventTable	M	O
	LLC UnmatchAction Object	M	O
	IP Default Object	M	O
	docsDevfilterIPTable	M	O
	docsDevfilterPolicyTable	M	O
	docsDevFilterTosTable	M	O
	docsDevCPE Objects	M	Not Implemented

	docsDevCpeTable	M	Not Implemented
RFC-2670	docsIfDownChannelTable	M	M
	docsIfUpstreamChannelTable	M	M
	docsIfQosProfileTable	M	M
	docsIfSignalQualityTable	M	M
	docsIfCmMacTable	M	Not Implemented
	docsIfCmStatusTable	M	Not Implemented
	docsIfCmServiceTable	M	Not Implemented
	docsIfCmtsMacTable	Not Imp	M
	docsIfCmtsStatusTable	Not Imp	M
	docsIfCmtsCmStatusTable	Not Imp	M
	docsIfCmtsServiceTable	Not Imp	M
	docsIfCmtsModulation Table	Not Imp	M
	docsIfCmtsQosProfilePermission	Not Imp	O
	docsIfCmtsMactoCmTable	Not Imp	M

Notes:

M = Mandatory.

If M applies to a table:

- “current” objects MUST be implemented if not explicitly stated in the OSSI to not implement.
- “deprecated” object(s) conform to OSSI rules specified above.
- “obsolete” object(s) conform to OSSI rules specified above

If M applies to an object:

- “current” objects MUST be implemented if not explicitly stated in the OSSI to not implement.
- “deprecated” objects conform to OSSI rules specified above.
- “obsolete” object(s) conform to OSSI rules specified above

O = Optional. If implemented, rules specified in the Mandatory section are in effect.

1 = required if STP is implemented

2 = devices running SNMPv3 agents MUST NOT implement this table

3 = Implementation of the ifStack table is only required if separate upstream and downstream interfaces are defined in the ifTable.

Appendix V USB MIB Definition (normative)

```
USB-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Counter32,
    Integer32,
    experimental
        FROM SNMPv2-SMI
    MODULE-COMPLIANCE,
    OBJECT-GROUP
        FROM SNMPv2-CONF
    TEXTUAL-CONVENTION,
    MacAddress,
    TruthValue
        FROM SNMPv2-TC
    InterfaceIndexOrZero
    FROM IF-MIB;

usbMib MODULE-IDENTITY
    LAST-UPDATED    "9912210000Z" -- December 21, 1999
    ORGANIZATION    "DOCSIS"
    CONTACT-INFO
        "          Benjamin Dolnik
        Postal: 3Com Corporation
            3800 Golf Road
            Rolling Meadows, IL 60008
            USA
        Phone:  +1 847 262 2098
        E-mail: benjamin_dolnik@3com.com"
    DESCRIPTION
        "The MIB module to describe the USB interface."
    REVISION "9911030000Z"
    DESCRIPTION
        "Initial Compilable Version."
    REVISION "9911100000Z"
    DESCRIPTION
        "Put different CDC subclasses into separate structures,
         Use experimental group instead of transmission.
         Clarify descriptions"
    REVISION "9912210000Z"
    DESCRIPTION
        "Clean the MIB syntax. Replace some INTEGER to Integer32.
         Compliance statements added"
    ::= { experimental 103 } -- This number is requested but not assigned yet

    -- Generic information

usbMibObjects OBJECT IDENTIFIER ::= { usbMib 1 }

usbNumber OBJECT-TYPE
    SYNTAX          Integer32 (0..65535)
    MAX-ACCESS      read-only
```

```
    STATUS          current
    DESCRIPTION
        "The number of ports regardless of their current state
        in the usb general port table"
    ::= { usbMibObjects 1 }

--
-- usb Generic Port Table
--

usbPortTable OBJECT-TYPE
    SYNTAX SEQUENCE OF UsbPortEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A list of port entries. The number of entries is
        given by the value usbNumber."
    ::= { usbMibObjects 2 }

usbPortEntry OBJECT-TYPE
    SYNTAX          UsbPortEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "Status and parameter values for the USB port."
    INDEX { usbPortIndex }
    ::= { usbPortTable 1 }
UsbPortEntry ::=
    SEQUENCE {
        usbPortIndex
                Integer32,
        usbPortType
                INTEGER,
        usbPortRate
                INTEGER
    }

usbPortIndex OBJECT-TYPE
    SYNTAX          Integer32 (1..65535)
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The unique identifier of the USB port hardware. By convention
          and if possible, hardware port numbers map directly to external
          connectors."
    ::= { usbPortEntry 1 }

usbPortType OBJECT-TYPE
    SYNTAX          INTEGER {host(1), device(2), hub(3)}
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The type of the USB port"
    ::= { usbPortEntry 2 }
```

```
usbPortRate OBJECT-TYPE
      SYNTAX     INTEGER {low-speed(1), full-speed(2), high-speed(3)}
      MAX-ACCESS         read-only
      STATUS     current
      DESCRIPTION
            "The USB port rate that could be low-speed(1) for 1.5 Mbps,
             full-speed(2) for 12Mbps or high-speed(3) for USB 2.0"
      ::= { usbPortEntry 3 }

--
-- usb Device MIB
--
usbDeviceTable OBJECT-TYPE
      SYNTAX             SEQUENCE OF UsbDeviceEntry
      MAX-ACCESS         not-accessible
      STATUS             current
      DESCRIPTION
            "A list of USB device ports. Usually the device has only one USB
             device port"
      ::= { usbMibObjects 3 }

usbDeviceEntry OBJECT-TYPE
      SYNTAX             UsbDeviceEntry
      MAX-ACCESS         not-accessible
      STATUS             current
      DESCRIPTION
            "Status and parameter values for the USB device port."
      INDEX { usbDeviceIndex }
      ::= { usbDeviceTable 1 }

UsbDeviceEntry ::=
      SEQUENCE {
            usbDeviceIndex
                  Integer32,
                  usbDevicePower INTEGER,
            usbDeviceVendorID
                  OCTET STRING,
            usbDeviceProductID
                  OCTET STRING,
            usbDeviceNumberConfigurations
                  Integer32,
            usbDeviceActiveClass
                  INTEGER,
            usbDeviceStatus
                  INTEGER,
            usbDeviceEnumCounter
                  Counter32,
            usbDeviceRemoteWakeup
                  TruthValue,
                  usbDeviceRemoteWakeupOn TruthValue
      }

usbDeviceIndex   OBJECT-TYPE
      SYNTAX             Integer32 (1..65535)
      MAX-ACCESS         read-only
```

```
        STATUS          current
        DESCRIPTION
            "The index is identical to usbPortIndex for the
            correspondent USB port"
        ::= { usbDeviceEntry 1 }

usbDevicePower OBJECT-TYPE
        SYNTAX INTEGER {unknown(1),self-powered(2),bus-powered(3)}
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
            "the way USB device port is powered"
        ::= { usbDeviceEntry 2 }

usbDeviceVendorID OBJECT-TYPE
        SYNTAX OCTET STRING
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
        "The USB device port vendor HEX-formatted string as
        it is provided
        to the USB host by the USB device"
        ::= { usbDeviceEntry 3 }

usbDeviceProductID OBJECT-TYPE
        SYNTAX OCTET STRING
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
        "The product ID HEX-formatted string as it is
        provided to the USB
        host by the USB device"
        ::= { usbDeviceEntry 4 }

usbDeviceNumberConfigurations OBJECT-TYPE
        SYNTAX Integer32 (1..65535)
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
        "The total number of configurations the USB port
        supports. Device port
        should support at least one configuration"
        ::= { usbDeviceEntry 5 }

usbDeviceActiveClass OBJECT-TYPE
        SYNTAX INTEGER {other(1), cdc(2)}
        MAX-ACCESS read-only
        STATUS current
        DESCRIPTION
        "This object returns USB Device Class type of the
        active configuration"
        ::= { usbDeviceEntry 6 }

usbDeviceStatus OBJECT-TYPE
        SYNTAX INTEGER {unattached(1), attached(2), powered(3), default(4),
```

```
                address(5), configured(6), suspended(7)}
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Current status of the USB device state machine"
    ::= { usbDeviceEntry 7 }

usbDeviceEnumCounter OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number reconnections (enumerations) since device is
         operational"
    ::= { usbDeviceEntry 8 }

usbDeviceRemoteWakeup OBJECT-TYPE
    SYNTAX          TruthValue
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "If set to true(1), the device supports Remote Wakeup function.
         If set to false(2), the device doesn't support it"
    ::= { usbDeviceEntry 9 }

usbDeviceRemoteWakeupOn OBJECT-TYPE
    SYNTAX          TruthValue
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "If set to true(1), the remote wakeup function is activated
         by the host.
         If set to false(2), remote wakeup function is not active."
    ::= { usbDeviceEntry 10 }

--
-- Table of the CDC interfaces
--

usbCDCTable OBJECT-TYPE
    SYNTAX SEQUENCE OF UsbCDCEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A list of Communication Device Class (CDC) interfaces supported
        by the USB device. It could be more than one CDC interface for the
        device that expose more than one interface to the network"
    ::= { usbMibObjects 4 }

usbCDCEntry OBJECT-TYPE
    SYNTAX          UsbCDCEntry
    MAX-ACCESS      not-accessible
    STATUS     current
    DESCRIPTION
        "Status and parameter values for CDC device"
```

```
    INDEX { usbCDCIndex, usbCDCIfIndex }
    ::= { usbCDCTable 1 }

UsbCDCEntry ::=
    SEQUENCE {
        usbCDCIndex
            Integer32,
        usbCDCIfIndex
            InterfaceIndexOrZero,
        usbCDCSubclass
            INTEGER,
        usbCDCVersion
            OCTET STRING,
        usbCDCDataTransferType
            INTEGER,
        usbCDCDataEndpoints
            Integer32,
        usbCDCStalls
            Counter32
    }

usbCDCIndex OBJECT-TYPE
    SYNTAX          Integer32 (1..65535)
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The index is identical to usbPortIndex for the
         correspondent USB port"
    ::= { usbCDCEntry 1 }

usbCDCIfIndex OBJECT-TYPE
    SYNTAX          InterfaceIndexOrZero
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The variable uniquely identifies the interface index which this
         CDC device is representing"
    ::= { usbCDCEntry 2 }
usbCDCSubclass OBJECT-TYPE
    SYNTAX INTEGER {other(0), directLine(1), acm(2), telephony(3),
            multichannel(4), capi(5), ethernet(6), atm(7)}
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Subclass used in data transfer in Communication Device Class"
    REFERENCE
        "USB Class definitions for Communication Devices ver 1.1, p.28"
    ::= { usbCDCEntry 3 }

usbCDCVersion OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE (2))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "String that describes the version of Communication Device
```

```
        Class in HEX format (Major, Minor) "
    ::= { usbCDCEntry 4 }

usbCDCDataTransferType OBJECT-TYPE
    SYNTAX INTEGER {synchronous(1), asynchronous(2)}
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Type of data transfer for Data Class Interface used by the
         Communication Device. Isochronous mode is used for
         synchronous(1) and bulk transfer mode is used for
         asynchronous(2)"
    ::= { usbCDCEntry 5 }

usbCDCDataEndpoints OBJECT-TYPE
    SYNTAX          Integer32 (0..16)
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Number of the data endpoints (IN and OUT) used by the
         Communication Device. If the networking device is in default
         interface setting, there are no.data endpoints and no
         traffic is exchanged. Under the normal operation there should be
         2 Data Endpoints (one IN and one OUT) for the networking device.
         For the multichannel model this number could be larger than 2."
    ::= { usbCDCEntry 6 }

usbCDCStalls OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of times USB Data interface recovered from stall
         since re-initialization and while the port state was 'up' or
         'test'."
    ::= { usbCDCEntry 7 }

--
-- Table of the CDC Ethernet-type interfaces
--

usbCDCEtherTable OBJECT-TYPE
    SYNTAX SEQUENCE OF UsbCDCEtherEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A list of Communication Device Class (CDC) USB devices that
         support Ethernet Networking Control Model."
    ::= { usbMibObjects 5 }

usbCDCEtherEntry OBJECT-TYPE
    SYNTAX          UsbCDCEtherEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
```

```
        "Status and parameter values for CDC devices that support Ethernet
        Networking Control Model"
    INDEX { usbCDCEtherIndex, usbCDCEtherIfIndex }
    ::= { usbCDCEtherTable 1 }

UsbCDCEtherEntry ::=
    SEQUENCE {
        usbCDCEtherIndex
            Integer32,
        usbCDCEtherIfIndex
            InterfaceIndexOrZero,
        usbCDCEtherMacAddress
            MacAddress,
        usbCDCEtherPacketFilter
            BITS,
        usbCDCEtherDataStatisticsCapabilities
            BITS,
        usbCDCEtherDataCheckErrs
            Counter32
    }

usbCDCEtherIndex OBJECT-TYPE
    SYNTAX          Integer32 (1..65535)
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The index is identical to usbPortIndex for the
         correspondent USB port"
    ::= { usbCDCEtherEntry 1 }

usbCDCEtherIfIndex OBJECT-TYPE
    SYNTAX          InterfaceIndexOrZero
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The variable uniquely identifies the interface index to which
         this CDC device is connected "
    ::= { usbCDCEtherEntry 2 }

usbCDCEtherMacAddress OBJECT-TYPE
    SYNTAX          MacAddress
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The 48bit MAC address that is provided by USB CDC device to the
         host. This address will be used as the source address of
         Ethernet frames sent by the host over the particular CDC
         interface."
    ::= { usbCDCEtherEntry 3}

usbCDCEtherPacketFilter OBJECT-TYPE
    SYNTAX BITS {
        packetPromiscuous(0),
        packetAllMulticast(1),
        packetDirected(2),
```

```
        packetBroadcast(3),
        packetMulticast(4)
    }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Bitmap indicates the host requirements to the USB device to
         perform Ethernet packet filtering of the particular type frames
         directed to the host."
    REFERENCE
        "USB Class definitions for Communication Devices ver 1.1, p.66
         Table 62"
    ::= { usbCDCEtherEntry 4 }

usbCDCEtherDataStatisticsCapabilities OBJECT-TYPE
    SYNTAX BITS {
        frameXmitOk(0),
        frameRcvOk(1),
        frameXmitErr(2),
        frameRcvErr(3),
        frameRcvNoBuff(4),
        bytesXmitDirectOk(5),
        framesXmitDirectOk(6),
        bytesXmitMulticastOk(7),
        framesXmitMulticastOk(8),
        bytesXmitBroadcastOk(9),
        framesXmitBroadcastOk(10),
        bytesRcvDirectOk(11),
        framesRcvDirectOk(12),
        bytesRcvMulticastOk(13),
        framesRcvMulticastOk(14),
        bytesRcvBroadcastOk(15),
        framesRcvBroadcastOk(16),
        framesRcvCrcErr(17),
        xmitQueueLen(18),
        rcvErrAlignment(19),
        xmitOneCollision(20),
        xmitMoreCollisions(21),
        xmitDeferred(22),
        xmitMaxCollision(23),
        rcvOverrun(24),
        xmitUnderrun(25),
        xmitHearbeatFailure(26),
        xmitTimesCrsLost(27),
        xmitLateCollisions(28)
    }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Bitmap indicates the ability to collect Ethernet statistics of
         different types as it provided in Ethernet Networking Functional
         Descriptor. If the particular bit is set, the device could
         provide the corresponding statistics counter to the host"
    REFERENCE
        "USB Class definitions for Communication Devices ver 1.1, p.46
```

```
            Table 42"
    ::= { usbCDCEtherEntry 5 }

usbCDCEtherDataCheckErrs OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of frames with an invalid frame check sequence,
         input from the USB Data interface since system re-initialization
         and while the port state was 'up' or 'test'."
    ::= { usbCDCEtherEntry 6 }

--
-- notification group is for future extension.
--

usbMibNotification          OBJECT IDENTIFIER    ::= { usbMib 2 }
usbMibConformance           OBJECT IDENTIFIER    ::= { usbMib 3 }
usbMibCompliances           OBJECT IDENTIFIER    ::= { usbMibConformance 1 }
usbMibGroups                OBJECT IDENTIFIER    ::= { usbMibConformance 2 }

-- compliance statements
usbMibBasicCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The compliance statement for devices that implement USB MIB"

MODULE -- usbMib

-- unconditionally mandatory groups
MANDATORY-GROUPS {
        usbMibBasicGroup
        }

-- conditionally mandatory group
GROUP usbMibCDCGroup
    DESCRIPTION
        "This group is implemented only in devices having at least
         one CDC interface"

-- conditionally mandatory group
GROUP usbMibCDCEtherGroup
    DESCRIPTION
        "This group is implemented only in devices supporting at least one
         CDC interface that uses Ethernet Networking Control Model"
    ::= {usbMibCompliances 1}

usbMibBasicGroup OBJECT-GROUP
    OBJECTS {
        usbNumber,
        usbPortIndex,
        usbPortType,
        usbPortRate,
        usbDeviceIndex,
```

```
            usbDevicePower,
            usbDeviceVendorID,
            usbDeviceProductID,
            usbDeviceNumberConfigurations,
            usbDeviceActiveClass,
            usbDeviceStatus,
            usbDeviceEnumCounter,
            usbDeviceRemoteWakeup,
                usbDeviceRemoteWakeupOn
        }
        STATUS              current
        DESCRIPTION
            "Group of objects that are mandatory to support by device
             implementing this MIB"
        ::= { docsIfGroups 1 }

usbMibCDCGroup OBJECT-GROUP
        OBJECTS {
            usbCDCIndex,
            usbCDCIfIndex,
            usbCDCSubclass,
            usbCDCVersion,
            usbCDCDataTransferType,
            usbCDCDataEndpoints,
            usbCDCStalls
        }
        STATUS              current
        DESCRIPTION
            "This group is implemented only in devices having at least
             one CDC interface"
        ::= { docsIfGroups 2 }

usbMibCDCEtherGroup OBJECT-GROUP
        OBJECTS {
            usbCDCEtherIndex,
            usbCDCEtherIfIndex,
            usbCDCEtherMacAddress,
            usbCDCEtherPacketFilter,
            usbCDCEtherDataStatisticsCapabilities,
            usbCDCEtherDataCheckErrs
        }
        STATUS              current
        DESCRIPTION
            "This group is implemented only in devices having at least one CDC
             interface that uses Ethernet Networking Control Model"
        ::= { docsIfGroups 3 }

END
```