

Network Working Group
Request for Comments: 4323
Category: Standards Track

M. Patrick
W. Murwin
Motorola BCS
January 2006

Data Over Cable System Interface Specification
Quality of Service
Management Information Base (DOCSIS-QoS MIB)

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Copyright (C) The Internet Society (2006).

Abstract

This document defines a basic set of managed objects for SNMP-based management of extended QoS features of Cable Modems (CMs) and Cable Modem Termination Systems (CMTSS) conforming to the Data over Cable System (DOCSIS) specifications versions 1.1 and 2.0.

Table of Contents

1. Introduction	2
1.1. The Internet-Standard Management Framework	2
1.2. Glossary	3
2. Overview	5
2.1. Textual Conventions	5
2.2. MIB Organization	5
2.2.1. docsIetfQosPktClassTable	9
2.2.2. docsIetfQosParamSetTable	10
2.2.2.1. Interoperation with DOCSIS 1.0	11
2.2.3. docsIetfQosServiceFlowTable	12
2.2.4. docsIetfQosServiceFlowStatsTable	13
2.2.5. docsIetfQosUpstreamStatsTable	14
2.2.6. docsIetfQosDynamicServiceStatsTable	14
2.2.7. docsIetfQosServiceFlowLogTable	14
2.2.8. docsIetfQosServiceClassTable	15
2.2.9. docsIetfQosServiceClassPolicyTable	15
2.2.10. docsIetfQosPHSTable	16
2.2.11. docsIetfQosCmtsMacToSrvFlowTable	16
3. Externally Administered Classification	16
4. DOCSIS and IPv4 Type-of-Service (ToS) Field	19
5. Definitions	20
6. Security Considerations	84
7. IANA Considerations	86
8. Acknowledgements	86
9. Normative References	86
10. Informative References	87

1. Introduction

This memo is a product of the IP over Cable Data Network (IPCDN) working group within the Internet Engineering Task Force (IETF).

1.1. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [15].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, RFC 2578 [1], STD 58, RFC 2579 [2] and STD 58, RFC 2580 [3].

1.2. Glossary

Active QPS	Active QoS Parameter Set (QPS). The set of QoS parameters that describe the current level of service provided to a Service Flow (SF).
Active SF	Active Service Flow. An SF with a non-empty Active QPS.
Admitted QPS	Admitted QoS Parameter Set. The set of QoS parameters that describe a level of service that the Service Flow is not currently using, but that it is guaranteed to receive upon the SF's request to make the set Active.
Admitted SF	A Service Flow with a non-empty Admitted QPS.
CATV	Cable Television.
CM	Cable Modem. A modem connecting a subscriber's LAN to the Cable Television (CATV) Radio Frequency (RF) network. DOCSIS CMs operate as a MAC layer bridge between the home LAN and the Cable Television (CATV) Radio Frequency (RF) network.
CMTS	Cable Modem Termination System. The "head-end" device providing connectivity between the RF network and the Internet.
Downstream	The direction from the head-end towards the subscriber.
DSA	Dynamic Service Addition. A DOCSIS MAC management message requesting the dynamic creation of a new Service Flow. New SFs are created with a three-message exchange of a DSA-REQ, DSA-RSP, and DSA-ACK.
DSC	Dynamic Service Change. A DOCSIS MAC management message requesting a change to the attributes of a Service Flow. SFs are changed with a three-message exchange of a DSC-REQ, DSC-RSP, and DSC-ACK.
DSD	Dynamic Service Delete. A DOCSIS MAC management message requesting the deletion of a Service Flow. SFs are deleted with a two-message exchange of a DSD-REQ and DSD-ACK.

Head-end	The origination point in most cable systems of the subscriber video signals. It is generally also the location of the CMTS.
PHS	Payload Header Suppression. A feature of DOCSIS 1.1 and 2.0 in which header bytes that are common in a sequence of packets of a Service Flow are replaced by a one-byte PHSI Index (PHSI) when transmitting the packet on the RF network.
primary SF	Primary Service Flow. All CMs have a Primary Upstream Service Flow and a Primary Downstream Service Flow. They provide a default path for forwarded packets that are not classified to any other Service Flow.
Provisioned QPS	A QoS Parameter Set describing an envelope of service within which a Service Flow is authorized to request admission. All existing Service Flows must have a non-empty Provisioned QPS; thus, all SFs are considered to be "Provisioned".
RF	Radio Frequency. In particular, this abbreviation refers to the radio frequencies for Cable Television (CATV).
SCN	Service Class Name. A named set of QoS parameters. A Service Flow may or may not be associated with a single named Service Class. A Service Class has as an attribute a QoS Parameter Set that is used as the default set of values for all Service Flows belonging to the Service Class.
SID	Service ID. A 16-bit unsigned integer assigned by the CMTS for an Upstream Service Flow with a non-empty Active QoS Parameter Set.
SF	Service Flow. A unidirectional stream of packets between the CM and CMTS. SFs are characterized as upstream or downstream. The SF is the fundamental unit of service provided on a DOCSIS CATV network.
SFID	Service Flow ID. A 32-bit unsigned integer assigned by the CMTS to each Service Flow.
Upstream	The direction from a subscriber CM to the head-end CMTS.

2. Overview

This MIB module provides a set of objects required for the management of DOCSIS 1.1 and 2.0 compliant Cable Modems (CM) and Cable Modem Termination Systems (CMTS). The specification is derived from the DOCSIS 2.0 Radio Frequency Interface specification [4]. Please note that the referenced DOCSIS specifications only requires Cable Modems to process IPv4 customer traffic. Design choices in this MIB module reflect those requirements. Future versions of the DOCSIS standard are expected to require support for IPv6 as well.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [5].

2.1. Textual Conventions

The textual convention "DocsIetfQosRfMacIfDirection" is defined to indicate the direction of a packet classifier relative to an interface. It takes the values of either downstream(1) or upstream(2).

The textual convention "DocsIetfQosBitRate" corresponds to the bits per second as defined for QoS Parameter Sets in DOCSIS 1.1 and 2.0. This definition includes all bits of the Ethernet MAC frame as transmitted on the RF network, starting with the Destination Address and ending with the Ethernet Frame Check Sequence (FCS). It does NOT include bits in the DOCSIS MAC header.

2.2. MIB Organization

The structure of the IPCDN QoS MIB module (DOCS-IETF-QOS-MIB) is summarized below:

```
docsIetfQosMIB
  docsIetfQosMIBObjects
    docsIetfQosPktClassTable
      docsIetfQosPktClassEntry
        docsIetfQosPktClassId
        docsIetfQosPktClassDirection
        docsIetfQosPktClassPriority
        docsIetfQosPktClassIpTosLow
        docsIetfQosPktClassIpTosHigh
        docsIetfQosPktClassIpTosMask
        docsIetfQosPktClassIpProtocol
        docsIetfQosPktClassInetAddressType
        docsIetfQosPktClassInetSourceAddr
        docsIetfQosPktClassInetSourceMask
```

```
docsIetfQosPktClassInetDestAddr
docsIetfQosPktClassInetDestMask
docsIetfQosPktClassSourcePortStart
docsIetfQosPktClassSourcePortEnd
docsIetfQosPktClassDestPortStart
docsIetfQosPktClassDestPortEnd
docsIetfQosPktClassDestMacAddr
docsIetfQosPktClassDestMacMask
docsIetfQosPktClassSourceMacAddr
docsIetfQosPktClassEnetProtocolType
docsIetfQosPktClassEnetProtocol
docsIetfQosPktClassUserPriLow
docsIetfQosPktClassUserPriHigh
docsIetfQosPktClassVlanId
docsIetfQosPktClassStateActive
docsIetfQosPktClassPkts
docsIetfQosPktClassBitMap
docsIetfQosParamSetTable
  docsIetfQosParamSetEntry
    docsIetfQosParamSetServiceClassName
    docsIetfQosParamSetPriority
    docsIetfQosParamSetMaxTrafficRate
    docsIetfQosParamSetMaxTrafficBurst
    docsIetfQosParamSetMinReservedRate
    docsIetfQosParamSetMinReservedPkt
    docsIetfQosParamSetActiveTimeout
    docsIetfQosParamSetAdmittedTimeout
    docsIetfQosParamSetMaxConcatBurst
    docsIetfQosParamSetSchedulingType
    docsIetfQosParamSetNomPollInterval
    docsIetfQosParamSetTolPollJitter
    docsIetfQosParamSetUnsolicitGrantSize
    docsIetfQosParamSetNomGrantInterval
    docsIetfQosParamSetTolGrantJitter
    docsIetfQosParamSetGrantsPerInterval
    docsIetfQosParamSetTosAndMask
    docsIetfQosParamSetTosOrMask
    docsIetfQosParamSetMaxLatency
    docsIetfQosParamSetType
    docsIetfQosParamSetRequestPolicyOct
    docsIetfQosParamSetBitMap
docsIetfQosServiceFlowTable
  docsIetfQosServiceFlowEntry
    docsIetfQosServiceFlowId
    docsIetfQosServiceFlowSID
    docsIetfQosServiceFlowDirection
    docsIetfQosServiceFlowPrimary
docsIetfQosServiceFlowStatsTable
```

- docsIetfQosServiceFlowStatsEntry
 - docsIetfQosServiceFlowPkts
 - docsIetfQosServiceFlowOctets
 - docsIetfQosServiceFlowTimeCreated
 - docsIetfQosServiceFlowTimeActive
 - docsIetfQosServiceFlowPHSUnknowns
 - docsIetfQosServiceFlowPolicedDropPkts
 - docsIetfQosServiceFlowPolicedDelayPkts
- docsIetfQosUpstreamStatsTable
 - docsIetfQosUpstreamStatsEntry
 - docsIetfQosSID
 - docsIetfQosUpstreamFragments
 - docsIetfQosUpstreamFragDiscards
 - docsIetfQosUpstreamConcatBursts
- docsIetfQosDynamicServiceStatsTable
 - docsIetfQosDynamicServiceStatsEntry
 - docsIetfQosIfDirection
 - docsIetfQosDSAReqs
 - docsIetfQosDSARsps
 - docsIetfQosDSAacks
 - docsIetfQosDSCReq
 - docsIetfQosDSCRsps
 - docsIetfQosDSCAcks
 - docsIetfQosDSDReq
 - docsIetfQosDSDRsps
 - docsIetfQosDynamicAdds
 - docsIetfQosDynamicAddFails
 - docsIetfQosDynamicChanges
 - docsIetfQosDynamicChangeFails
 - docsIetfQosDynamicDeletes
 - docsIetfQosDynamicDeleteFails
 - docsIetfQosDCCReq
 - docsIetfQosDCCRsp
 - docsIetfQosDCCAcks
 - docsIetfQosDCCs
 - docsIetfQosDCCFails
- docsIetfQosServiceFlowLogTable
 - docsIetfQosServiceFlowLogEntry
 - docsIetfQosServiceFlowLogIndex
 - docsIetfQosServiceFlowLogIfIndex
 - docsIetfQosServiceFlowLogSFID
 - docsIetfQosServiceFlowLogCmMac
 - docsIetfQosServiceFlowLogPkts
 - docsIetfQosServiceFlowLogOctets
 - docsIetfQosServiceFlowLogTimeDeleted
 - docsIetfQosServiceFlowLogTimeCreated
 - docsIetfQosServiceFlowLogTimeActive
 - docsIetfQosServiceFlowLogDirection

```
docsIetfQosServiceFlowLogPrimary
docsIetfQosServiceFlowLogServiceClassName
docsIetfQosServiceFlowLogPolicedDropPkts
docsIetfQosServiceFlowLogPolicedDelayPkts
docsIetfQosServiceFlowLogControl
docsIetfQosServiceClassTable
  docsIetfQosServiceClassEntry
    docsIetfQosServiceClassName
    docsIetfQosServiceClassStatus
    docsIetfQosServiceClassMaxTrafficRate
    docsIetfQosServiceClassMaxTrafficBurst
    docsIetfQosServiceClassMinReservedRate
    docsIetfQosServiceClassMinReservedPkt
    docsIetfQosServiceClassMaxConcatBurst
    docsIetfQosServiceClassNomPollInterval
    docsIetfQosServiceClassTolPollJitter
    docsIetfQosServiceClassUnsolicitGrantSize
    docsIetfQosServiceClassNomGrantInterval
    docsIetfQosServiceClassTolGrantJitter
    docsIetfQosServiceClassGrantsPerInterval
    docsIetfQosServiceClassMaxLatency
    docsIetfQosServiceClassActiveTimeout
    docsIetfQosServiceClassAdmittedTimeout
    docsIetfQosServiceClassSchedulingType
    docsIetfQosServiceClassRequestPolicy
    docsIetfQosServiceClassTosAndMask
    docsIetfQosServiceClassTosOrMask
    docsIetfQosServiceClassDirection
    docsIetfQosServiceClassStorageType
    docsIetfQosServiceClassDSCPOverwrite
docsIetfQosServiceClassPolicyTable
  docsIetfQosServiceClassPolicyEntry
    docsIetfQosServiceClassPolicyIndex
    docsIetfQosServiceClassPolicyName
    docsIetfQosServiceClassPolicyRulePriority
    docsIetfQosServiceClassPolicyStatus
    docsIetfQosServiceClassPolicyStorageType
docsIetfQosPHSTable
  docsIetfQosPHSEntry
    docsIetfQosPHSField
    docsIetfQosPHSMask
    docsIetfQosPHSSize
    docsIetfQosPHSVerify
    docsIetfQosPHSIndex
docsIetfQosCmtsMacToSrvFlowTable
  docsIetfQosCmtsMacToSrvFlowEntry
```

```
docsIetfQosCmtsCmMac  
docsIetfQosCmtsServiceFlowId  
docsIetfQosCmtsIfIndex
```

This MIB module is organized as 11 tables. Most tables are implemented in both the CM and CMTS; the docsIetfQosUpstreamStatsTable and docsIetfQosServiceFlowLogTable are implemented on the CMTS only.

2.2.1. docsIetfQosPktClassTable

The docsIetfQosPktClassTable reports the Service Flow Classifiers implemented by the managed device. The table is indexed by the tuple { ifIndex, docsIetfQosServiceFlowId, docsIetfQosPktClassId }. The ifIndex corresponds to a CATV MAC interface. Each CATV MAC interface has a set of Service Flows identified with a docsIetfQosServiceFlowId value that is unique for that interface. Each Service Flow may have a number of packet classifiers that map packets to the flow. The ClassifierId for the classifier is unique only within a particular Service Flow.

The semantics of packet classification are provided in [4]. Briefly, the DOCSIS MAC interface calls for matching packets based on values within the 802.2 (LLC), 802.3, IP, and/or UDP/TCP headers. Packets that map more than one classifier are prioritized according to their docsIetfQosPktClassPriority values. The docsIetfQosServiceFlowId (an index object) indicates to which Service Flow the packet is classified.

The docsIetfQosPktClassTable is distinct from the docsDevIpFilterTable of [6] in that docsIetfQosPktClassTable is intended only to reflect the state of the Service Flow Classifiers. Service Flow Classifiers may be created only via a CM configuration file or from the Dynamic Service Addition (DSA) messages. For this reason, docsIetfQosPktClassTable is read-only.

The docsDevIpFilterTable is intended for external policy-based administration of packet classifiers. See the section "Externally Administered Classification", below.

2.2.2. docsIetfQosParamSetTable

The docsIetfQosParamSetTable reports the values of QoS Parameter Set as defined in Section C.2.2 of [4].

In general, a Service Flow is associated with three different QoS Parameter Sets (QPSs): an "active" QPS, an "admitted" QPS, and a "provisioned" or "authorized" QPS. The relationship of these three sets is represented below:

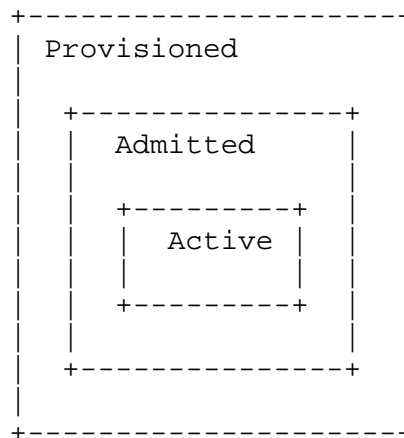


Figure 1: QoS Parameter Sets

The Provisioned QPS describes the maximum service envelope for which the SF is authorized. The Admitted QPS is the set of services for which a Service Flow has requested admission to the DOCSIS RF network, but which is not yet active. The Admitted QPS is used during the two-phase process of IP Telephony/PacketCable Service Flow admission to admit the bandwidth for a bidirectional voice call when the far end is ringing. Because ringing may occur for up to four minutes, this permits the bandwidth to be reserved but not actually consumed during this interval. The Active QPS is the set of services actually being used by the Service Flow. The DOCSIS v1.1 specification [4] defines what it means for a QPS envelope to be "within" another. In general, an inner QPS is considered "within" an outer QPS when all QoS parameters represent demands of equal or fewer resources of the network.

In addition to its use as an attribute of a Service Flow, a QPS is also an attribute of a Service Class. A DOCSIS CM configuration file or DSA message may request the creation of a new SF and give only the Service Class Name. The CMTS "expands the macro" of a Service Class Name creation by populating the Provisioned, Admitted, and/or Active QPSs of the Service Flow with the QPS of the Service Class Name. All

the QPSs of a Service Flow must be expansions of the same Service Class, and in this case the SF is said to "belong" to the Service Class. Changing the contents of a Service Class' QPS does not affect the QPS of any Service Flow earlier expanded from that Service Class name. Only the CMTS implements docsIetfQosServiceClassTable.

See [4], section 8, for a full description and the theory of operation of DOCSIS 1.1 QoS operation.

The docsIetfQosParamSetTable sets are indexed by { ifIndex, docsIetfQosServiceFlowId, docsIetfQosParamSetType}. ifIndex indicates a particular "DOCSIS MAC Domain". docsIetfQosServiceFlowId uniquely identifies a Service Flow on that MAC domain. The docsIetfQosParamSetType indicates whether the row describes an active, admitted, or provisioned QoS Parameter Set.

The docsIetfQosParamSetTable is read-only because it indicates the QoS Parameter Set contents as defined by DOCSIS signaling. The docsIetfQosServiceClassTable is read-create to permit managers to define a template of QoS Parameters that can be referenced by DOCSIS modems when creating their QoS Parameter Sets.

2.2.2.1. Interoperation with DOCSIS 1.0

The DOCS-IF-MIB [7] specifies a docsIfQosProfileTable to describe the set of Class Of Service (COS) parameters associated with a COS "profile". The docsIfCmServiceTable, which contains one entry per SID, references this table with a docsIfCmServiceQosProfile number.

The DOCSIS 1.1 and 2.0 CM registration process allows a modem to register as operating with DOCSIS 1.0, DOCSIS 1.1, or DOCSIS 2.0 functionality. For ease of expression, we call a modem registering with DOCSIS 1.0 functionality a "DOCSIS 1.0 modem", regardless of the modem's capabilities.

A CMTS or CM supporting DOCSIS 1.0, as well as DOCSIS 1.1, and/or DOCSIS 2.0 implements both the tables of [7] and the tables of this MIB module. The interoperation goal is that before modem registration, the DOCSIS 1.0 MIB [7] applies. After registration, either the DOCSIS 1.0 or DOCSIS 1.1/2.0 MIB applies, depending on the mode with which the modem registered. The specific interoperation rules are:

1. When a CM initially ranges, the CM implements a row in the DOCS-IF-MIB docsIfCmServiceTable, and the CMTS implements a row in the DOCS-IF-MIB docsIfCmtsServiceTable corresponding to the default upstream Service ID (SID) used for pre-registration

upstream traffic. For historical compatibility, a row may be created for the docsIfQosProfileTable with default values, which may be referenced by the docsIfCmServiceTable entries.

2. Both a CMTS and CM implementing this MIB MUST NOT implement docsIetfQosParamSetTable or docsIetfQosServiceFlowTable rows until after the CM registers with DOCSIS 1.1 or 2.0 modem operation.
3. When a modem registers with the CMTS as a "DOCSIS 1.1" or "DOCSIS 2.0" modem, any exclusively-referenced row in DOCS-IF-MIB docsIfQosProfileTable representing the modem's upstream QoS profile for pre-registration traffic MUST be removed. Multiply-referenced rows may remain. The docsIfCmServiceQosProfile object in the CM's row of docsIfCmServiceTable MUST be set to zero. The docsIfCmServiceTable row for the DOCSIS 1.1 or DOCSIS 2.0 modem continues to exist, and the various statistic objects in that row are incremented. The CMTS should retain a docsIfCmtsServiceTable entry for the DOCSIS 1.1 or DOCSIS 2.0 CM.
4. When a DOCSIS 1.1 or DOCSIS 2.0 modem registers, both the CMTS and CM represent all Service Flows described in the modem configuration file in docsIetfQosParamSetTable and docsIetfQosServiceFlowTable.
5. DOCSIS 1.0 modems do not have entries in the DOCS-IETF-QOS-MIB.

2.2.3. docsIetfQosServiceFlowTable

The docsIetfQosServiceFlowTable provides read-only information about all the Service Flows known by the device. It is indexed by the combination of { ifIndex, dosQosServiceFlowId }, where ifIndex corresponds to a CATV MAC interface and docsIetfQosServiceFlowId is the 32-bit integer assigned by the CMTS controlling the MAC domain. A CM typically has only a single CATV MAC interface, whereas a CMTS may have several. See [7] for a description of the ifIndex numbering for DOCSIS devices.

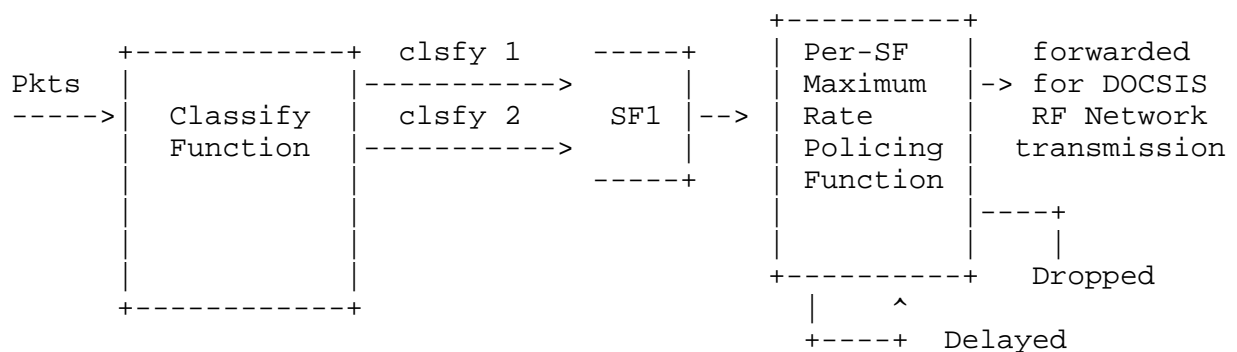
The table indicates whether a given SF is in the upstream or downstream direction, and whether it is the "primary" SF in that direction. The primary SF carries traffic that is not otherwise classified to any other SF in that direction.

2.2.4. docsIetfQosServiceFlowStatsTable

The docsIetfQosServiceFlowStatsTable provides statistics for all currently existing SFs known by the managed device. It provides basic packet and octet counters, as well as certain other SF-specific stats such as the time at which the flow was created and how many seconds it has been active.

The table also provides objects that can be used to fine-tune admission control decisions; namely, the number of packets dropped or delayed due to QoS policing decisions enforced by the managed device.

The model of the Service Flows stats table is that there exists a Service Flow Classification function followed by a Service Flow maximum rate Policing function for packets transmitted onto the DOCSIS RF network, as depicted below.



Packets intended for transmission onto the DOCSIS RF network (upstream or downstream) are first classified to a Service Flow by matching one of several possible classifiers associated with that Service Flow. The docsIetfQosPktClassPkts count includes the number of packets that match the classifier, regardless of the eventual disposition of the packet.

DOCSIS requires that each Service Flow be policed to maintain a maximum rate of transmission. This is performed by either dropping or delaying a packet on that Service Flow. The docsIetfQosServiceFlowPolicedDropPkts object counts the number of Service Flow packets dropped by the policing function. The docsIetfQosServiceFlowPolicedDelayPkts counts the number of packets delayed but still forwarded. The docsIetfQosServiceFlowPkts object counts the total number of packets forwarded beyond the policing function intended for eventual transmission onto the DOCSIS RF network. Although packets may later be dropped by other functions (e.g., a transmit queue overflow on a DOCSIS hardware transmitter), the docsIetfQos MIB per service-flow counters are not affected.

2.2.5. docsIetfQosUpstreamStatsTable

This table provides statistics that are measured only at the CMTS in the upstream direction. These include counts of fragmentation headers received, fragments discarded, and concatenation headers received.

2.2.6. docsIetfQosDynamicServiceStatsTable

This table provides read-only stats on the operation of the Dynamic Service state machines as specified in section 9.4 of [4]. It provides a set of 14 counters in each direction for a DOCSIS MAC layer interface. That is, each DOCSIS MAC layer interface has one row for downstream stats and a second row for upstream stats.

Eight of the counters are DSx packet type counts, one counter for each of the eight DSx packet types. For example, the docsIetfQosDSAREqs object in the upstream row at the CMTS counts the number of DSA-REQ messages received by the CMTS from that interface. The docsIetfQosDSAREqs object in the downstream row at the CMTS counts the number of DSA-REQ messages transmitted by the CMTS on that interface.

The remaining six counters per (interface, direction) combination count the number of successful and unsuccessful transactions that were initiated on the interface and direction. For example, the upstream docsIetfQosDynamicAdds on a CMTS is the number of successfully completed CM-initiated dynamic additions, because at the CMTS a CM-initiated DSA starts in the upstream direction. The downstream docsIetfQosDynamicAdds at a CMTS is the number of successful CMTS-initiated DSA transactions.

Dynamic service transactions can fail for a number of reasons, as listed in the state machines of section 9.4. Rather than include still more counters for each different failure reason, they are grouped into a single count, e.g., docsIetfQosDynamicAddFails. Again, this object exists in both directions, so that locally originated and remotely originated transaction failures are counted separately. Further troubleshooting of transaction failures will require vendor-specific queries and operation.

2.2.7. docsIetfQosServiceFlowLogTable

This table contains a log of the Service Flows that no longer exist in the docsIetfQosServiceFlowTable. It is intended to be periodically polled by traffic monitoring and billing agents. It is implemented only at the CMTS.

It contains a chronological log of SF session statistics, including a total count of packets and octets transferred on the SF. It includes time stamps of the SF creation and deletion time, and of its number of active seconds. The active second count is the count of seconds that the SF had a non-empty Active QoS Parameter Set, i.e., it was eligible to pass data. For unicast SFs, it includes the CM MAC address associated with the flow for billing reference purposes.

The maximum number of log records kept by a CMTS and the duration that a log record is maintained in the table are vendor-specific. An explicit control object is provided so that the monitoring application can explicitly delete records it has read.

2.2.8. docsIetfQoSServiceClassTable

This table defines the Service Class Name and references a QoS Parameter Set for each Service Class defined in a CMTS. It is indexed by the Service Class Name string itself. The table is read-create on a CMTS, and is not implemented in a CM. Each entry of the docsIetfQoSServiceClassTable should define a template for flows in a given direction (upstream or downstream). Some parameters of the docsIetfQoSServiceClassTable are specific to a particular direction, and so their values are not applicable when used as a template for flows in the other direction.

2.2.9. docsIetfQoSServiceClassPolicyTable

The docsIetfQoSServiceClassPolicyTable can be referenced by the docsDevFilterPolicyTable of [6] in order to have a "policy" that classifies packets to a named Service Class. This is one mechanism by which "external" entities (such as an SNMP manager) may control the classification of a packet for QoS purposes. Entries are indexed by a small-integer docsIetfQoSServiceClassPolicyIndex. They provide a Service Class Name and a Rule Priority. A policy referencing a row of this table intends the packet to be forwarded on a Service Flow "belonging" to the named Service Class. See section 3, "Externally Administered Classification", below.

This table is implemented on both the CM and CMTS, and is read-create on both.

2.2.10. docsIetfQosPHSTable

The Payload Header Suppression (PHS) feature of DOCSIS 1.1 and 2.0 permits packets to replace the unchanging bytes of the Ethernet, IP, and UDP headers with a one-byte index when transmitting on the cable network. This is especially useful for IP Telephony packets, where such suppression can result in almost twice the number of calls supported within the same upstream channel.

Each entry of the table corresponds to a PHS Rule as described in section 8.4 of [4]. The rules are identified by their corresponding Service Flow ID and docsIetfQosPktClassId. A PHS rule is associated with exactly one classifier. The table is therefore indexed by the tuple { ifIndex, docsIetfQosServiceFlowId, docsIetfQosPktClassId }.

This table is read-only, and MUST be implemented on both the CM and CMTS when PHS is supported.

2.2.11 docsIetfQosCmtsMacToSrvFlowTable

The docsIetfQosCmtsMacToSrvFlowTable describes the mapping of CM MAC addresses to the Service Flow IDs that are uniquely identified with that CM. External applications may collect statistics on all packets flowing through a CM by determining the SFID of all of its flows, and then collecting the statistics of packets and bytes for each flow.

Downstream multicast Service Flows are not indicated in the docsIetfQosCmtsMacToSrvFlowTable because they are not associated with only one CM.

3. Externally Administered Classification

DOCSIS 1.1 and 2.0 provide rich semantics for the classification of packets to Service Flows with the Service Flow Classifier table. Service Flow Classifiers may be created statically in the DOCSIS CM configuration file, or may be created dynamically with Dynamic Service Addition (DSA) and Dynamic Service Change (DSC) DOCSIS MAC messages.

Several major issues arose with the concept of externally administered classification; e.g., should an external SNMP manager be permitted to create classification rows? One problem was the coordination of classifier IDs because such an approach would require either separate classifier ID number spaces or objects to coordinate both internal and external classifier ID assignments. A more serious problem, however, was that external creation of SF Classifiers would require "knowledge" of the individual Service Flow ID for Service Flows by external applications. It was strongly felt by the

committee that SFIDs should remain internal DOCSIS objects, and not be transmitted as part of protocol flows, e.g., for IP packet telephony signaling. DOCSIS 1.1 introduced the concept of named Service Classes for ease of administration within a domain of CMs and CMTSS. What was desired was to permit external classification of packets to a Service Class, not to a particular Service Flow.

The DOCSIS committee therefore decided to use the already-defined IP Packet Filter Table [6] for the external classification of packets for QoS purposes. The docsDevIpPacketFilterTable defines similar packet matching criteria as does docsIetfQosPktClassTable, but it matches a packet to an arbitrary "policy set" instead of a particular Service Flow. One of the policies in the policy set then selects the Service Class of the SF on which to forward the packet. The docsIetfQosServiceClassPolicyTable of this MIB module defines the Service Class Name to which a packet is classified.

The interaction of external and internal packet classification is depicted below.

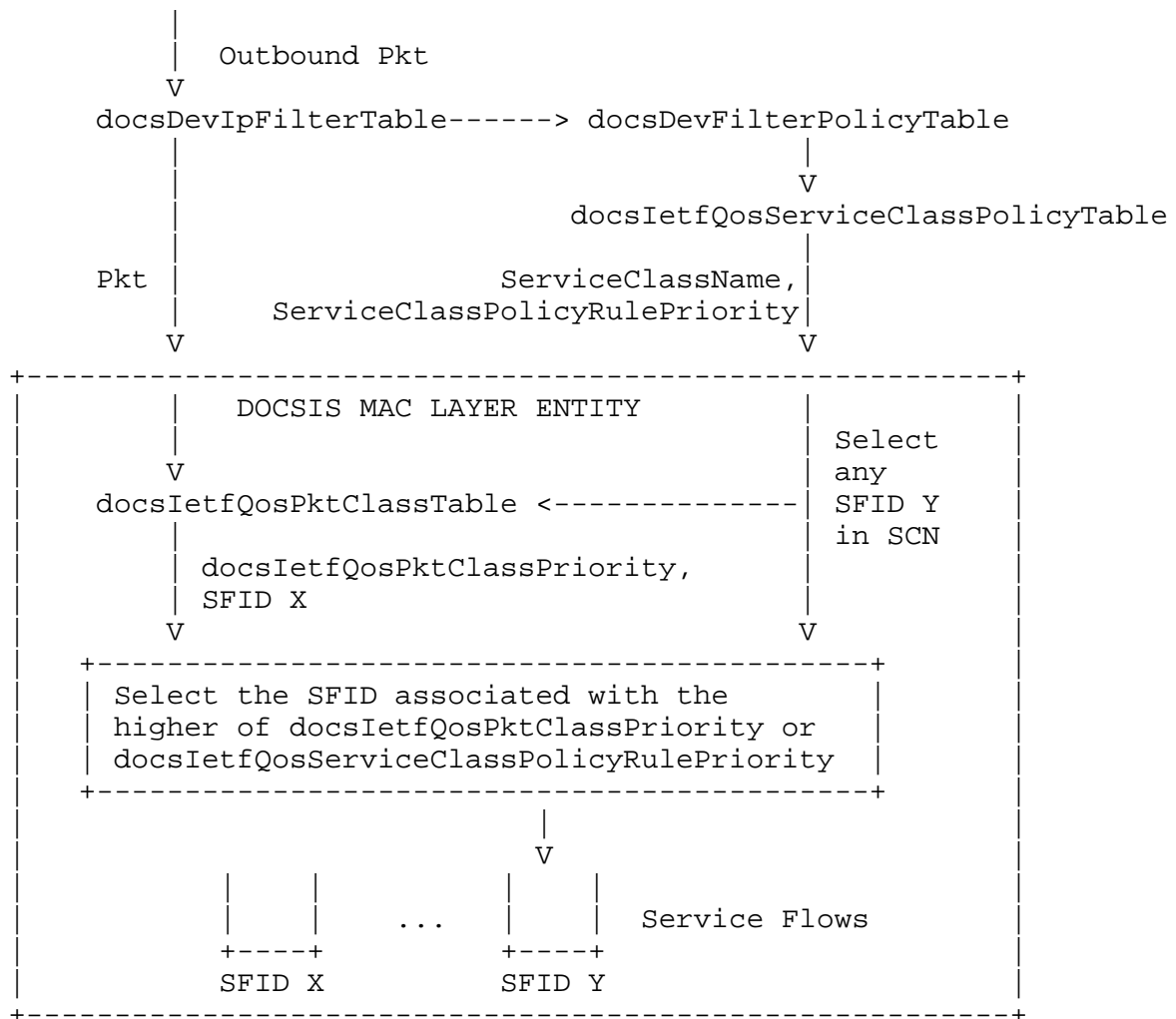


Figure 2: DOCSIS Packet Classification

The processing of an outgoing packet proceeds as follows:

1. The packet is first checked for matches with rows of the docsDevIpFilterTable. If it matches, the matching row provides a docsDevFilterPolicyId integer.
2. The docsDevFilterPolicyId indexes into one (or more) rows of docsDevFilterPolicyTable. Each row provides an arbitrary RowPointer (docsDevFilterPolicyPtr), corresponding to a policy to be applied to the packet.

3. This MIB module defines a `docsIetfQosServiceClassPolicyTable` whose entries may be pointed to by `docsDevFilterPolicyPtr` in order to classify packets administratively to a named DOCSIS Service Class. The `docsIetfQosServiceClassPolicyEntry` provides a Service Class Name (SCN) as `docsIetfQosServiceClassName` and a classification rule priority as `docsIetfQosServiceClassPolicyRulePriority`. These are submitted to the device's DOCSIS MAC Layer entity as a special form of the `MAC_DATA.request` primitive, as described in Section E.2.1 of [4].
4. The MAC Layer selects an SFID ("Y") of an active Service Flow belonging to the named class, choosing an SF arbitrarily if there is more than one.
5. The packet is then classified according to the `docsIetfQosPktClassTable`, which may classify the packet to a different SFID "X". Associated with the classifier is a `docsIetfQosPktClassPriority`.
6. In the event of a conflict between the SCN-determined SFID and the classified SFID, the greater of `docsIetfQosPktClassPriority` and `docsIetfQosServiceClassPolicyRulePriority` determines which SFID is selected to forward the packet.

A packet that does not match a `docsIetfQosServiceClassPolicyEntry` is directly submitted to the DOCSIS MAC layer, where the `docsIetfQosPktClassTable` selects the SID on which it is to be forwarded.

By convention (in [4]), the "internal" `docsIetfQosPktClassPriority` values should be in the range 64-191, while the "external" priorities may be either in the range 192-255 to override the internal classification or in the range 0-63 to be overridden by internal classification.

This classification mechanism applies both upstream from the CM and downstream from the CMTS.

4. DOCSIS and IPv4 Type-of-Service (ToS) Field

The DOCSIS-IETF-QOS-MIB MIB module relies on the DOCSIS MAC layer protocols and uses objects that reflect the IPv4 Type-of-Service (ToS) octet as defined in [14]. The applicability of these objects is limited to the DOCSIS access network. The past and current versions of the DOCSIS specifications for which this MIB module is defined do not reflect Differentiated Services [9] on the DOCSIS access network. However, with proper selection of values for these

objects, the network operator can enforce Differentiated Services Per-hop Behaviors (PHBs) on the DOCSIS Access Network, and can configure the modification of the DSCP for certain packet flows as they enter the metro network from the access network. Essentially this makes the DOCSIS access network TOS marking compatible with the wider use of DSCP outside DOCSIS networks. Note that because the entire IPv4 TOS octet may be available for modification via the latter mechanism (due to the current MAC level DOCSIS protocols and CLI interface configuration), it is possible that the DOCSIS network could be configured to modify the Explicit Congestion Notification (ECN) bits [10] of certain packets. This modification of the ECN bits is prevented by the MIB module's design. The MIB module prohibits the modification of the TOS octet (read-only objects: docsIetfQosPktClassIpTosLow, docsIetfQosPktClassIpTosHigh, docsIetfQosPktClassIpTosMask, docsIetfQosParamSetTosAndMask, docsIetfQosParamSetTosOrMask) and allows the DSCP field to be modified (read-create object: docsIetfQosServiceClassDSCPOverwrite).

5. Definitions

This MIB module refers to the SNMPv2-SMI [1] MIB module, SNMPv2-TC [2] MIB module, SNMPv2-CONF [3] MIB Module, DOCSIS RFI Specification SP-RFiv2.0-I06-040804 [4], INET-ADDRESS-MIB [8] MIB module, IF-MIB [11] MIB module, SNMP-FRAMEWORK-MIB [12] MIB module, and DIFFSERV-DSCP-TC [13] MIB module.

DOCS-IETF-QOS-MIB DEFINITIONS ::= BEGIN

IMPORTS

MODULE-IDENTITY,
OBJECT-TYPE,
Integer32,
Counter32,
Unsigned32,
Counter64,
mib-2
FROM SNMPv2-SMI

TEXTUAL-CONVENTION,
MacAddress,
RowStatus,
TruthValue,
TimeStamp,
StorageType
FROM SNMPv2-TC

OBJECT-GROUP,
MODULE-COMPLIANCE

```
FROM SNMPv2-CONF

ifIndex,
InterfaceIndex
FROM IF-MIB

InetAddressType,
InetAddress,
InetPortNumber
FROM INET-ADDRESS-MIB

DscpOrAny
FROM DIFFSERV-DSCP-TC

SnmpAdminString
FROM SNMP-FRAMEWORK-MIB;

docsIetfQosMIB MODULE-IDENTITY
    LAST-UPDATED      "200601230000Z" -- January 23, 2006
    ORGANIZATION      "IETF IP over Cable Data Network (IPCDN)
                        Working Group"
    CONTACT-INFO
        "
            Co-Author: Michael Patrick
            Postal:      Motorola BCS
                        111 Locke Drive
                        Marlborough, MA 01752-7214
                        U.S.A.
            Phone:       +1 508 786 7563
            E-mail:      michael.patrick@motorola.com

            Co-Author: William Murwin
            Postal:      Motorola BCS
                        111 Locke Drive
                        Marlborough, MA 01752-7214
                        U.S.A.
            Phone:       +1 508 786 7594
            E-mail:      w.murwin@motorola.com

            IETF IPCDN Working Group
            General Discussion: ipcdn@ietf.org
            Subscribe: http://www.ietf.org/mailman/listinfo/ipcdn
            Archive: ftp://ftp.ietf.org/ietf-mail-archive/ipcdn
            Co-chairs: Richard Woundy, Richard_Woundy@cable.comcast.com
                        Jean-Francois Mule, jfm@cablelabs.com"
        "
    DESCRIPTION
        "This is the management information for
        Quality Of Service (QOS) for DOCSIS 1.1 and 2.0."
```

Copyright (C) The Internet Society (2006). This version of this MIB module is part of RFC 4323; see the RFC itself for full legal notices."

REVISION "200601230000Z" -- January 23, 2006

DESCRIPTION

"Initial version, published as RFC 4323."

::= { mib-2 127 }

--

-- Placeholder for notifications/traps.

--

docsIetfQosNotifications OBJECT IDENTIFIER ::= { docsIetfQosMIB 0 }

docsIetfQosMIBObjects OBJECT IDENTIFIER ::= { docsIetfQosMIB 1 }

-- Textual Conventions

DocsIetfQosRfMacIfDirection ::= 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)
}

DocsIetfQosBitRate ::= 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

DocsIetfQosSchedulingType ::= 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)
    }

```

```

-----
--
-- Packet Classifier Table
--

```

docsIetfQosPktClassTable OBJECT-TYPE

```

    SYNTAX          SEQUENCE OF DocsIetfQosPktClassEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "This table 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 a row of this
                    table. 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 objects in this row correspond to a set of
                    Classifier Encoding parameters in a DOCSIS
                    MAC management message. The
                    docsIetfQosPktClassBitMap 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 DOCSIS 1.1 and 2.0 Classifier, the
                    corresponding object in this row reports a
                    value as specified in the DESCRIPTION section."
    ::= { docsIetfQosMIBObjects 1 }

```

docsIetfQosPktClassEntry OBJECT-TYPE

```

    SYNTAX          DocsIetfQosPktClassEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "An entry in this table provides a single packet
                    classifier rule. The index ifIndex is an ifType
                    of docsCableMacLayer(127)."
    INDEX {

```

```

        ifIndex,
        docsIetfQosServiceFlowId,
        docsIetfQosPktClassId
    }
    ::= { docsIetfQosPktClassTable 1 }

```

```

DocsIetfQosPktClassEntry ::= SEQUENCE {
    docsIetfQosPktClassId                Unsigned32,
    docsIetfQosPktClassDirection         DocsIetfQosRfMacIfDirection,
    docsIetfQosPktClassPriority           Integer32,
    docsIetfQosPktClassIpTosLow          OCTET STRING,
    docsIetfQosPktClassIpTosHigh         OCTET STRING,
    docsIetfQosPktClassIpTosMask         OCTET STRING,
    docsIetfQosPktClassIpProtocol        Integer32,
    docsIetfQosPktClassInetAddressType   InetAddressType,
    docsIetfQosPktClassInetSourceAddr     InetAddress,
    docsIetfQosPktClassInetSourceMask     InetAddress,
    docsIetfQosPktClassInetDestAddr       InetAddress,
    docsIetfQosPktClassInetDestMask       InetAddress,
    docsIetfQosPktClassSourcePortStart    InetPortNumber,
    docsIetfQosPktClassSourcePortEnd      InetPortNumber,
    docsIetfQosPktClassDestPortStart      InetPortNumber,
    docsIetfQosPktClassDestPortEnd        InetPortNumber,
    docsIetfQosPktClassDestMacAddr        MacAddress,
    docsIetfQosPktClassDestMacMask        MacAddress,
    docsIetfQosPktClassSourceMacAddr       MacAddress,
    docsIetfQosPktClassEnetProtocolType   INTEGER,
    docsIetfQosPktClassEnetProtocol       Integer32,
    docsIetfQosPktClassUserPriLow         Integer32,
    docsIetfQosPktClassUserPriHigh        Integer32,
    docsIetfQosPktClassVlanId             Integer32,
    docsIetfQosPktClassStateActive        TruthValue,
    docsIetfQosPktClassPkts               Counter64,
    docsIetfQosPktClassBitMap             BITS
}

```

```

docsIetfQosPktClassId      OBJECT-TYPE
    SYNTAX                  Unsigned32 (1..65535)
    MAX-ACCESS               not-accessible
    STATUS                   current
    DESCRIPTION              "Index assigned to packet classifier entry by
                             the CMTS, which is unique per Service Flow."
    REFERENCE                "SP-RFiv2.0-I06-040804, Appendix C.2.1.3.2"
    ::= { docsIetfQosPktClassEntry 1 }

```

```
docsIetfQosPktClassDirection OBJECT-TYPE
```

SYNTAX DocsIetfQosRfMacIfDirection
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Indicates the direction to which the classifier
 is applied."
 ::= { docsIetfQosPktClassEntry 2 }

docsIetfQosPktClassPriority OBJECT-TYPE

SYNTAX Integer32 (0..255)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The value 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 object reports the default
 value as defined above."
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.3.5"
 ::= { docsIetfQosPktClassEntry 3 }

docsIetfQosPktClassIpTosLow OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The low value of a range of TOS byte values.
 If the referenced parameter is not present
 in a classifier, this object 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 "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.1"
 ::= { docsIetfQosPktClassEntry 4 }

docsIetfQosPktClassIpTosHigh OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))
 MAX-ACCESS read-only

STATUS current

DESCRIPTION "The 8-bit high value of a range of TOS byte values.

If the referenced parameter is not present in a classifier, this object 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 "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.1"

::= { docsIetfQosPktClassEntry 5 }

docsIetfQosPktClassIpTosMask OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))

MAX-ACCESS read-only

STATUS current

DESCRIPTION "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 object 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 "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.1"

::= { docsIetfQosPktClassEntry 6 }

docsIetfQosPktClassIpProtocol OBJECT-TYPE

SYNTAX Integer32 (0..258)

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object 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 object reports the value of 258."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.2"
 ::= { docsIetfQosPktClassEntry 7 }

docsIetfQosPktClassInetAddressType OBJECT-TYPE

SYNTAX InetAddressType
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The type of the Internet address for docsIetfQosPktClassInetSourceAddr, docsIetfQosPktClassInetSourceMask, docsIetfQosPktClassInetDestAddr, and docsIetfQosPktClassInetDestMask.

If the referenced parameter is not present in a classifier, this object reports the value of ipv4(1)."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.3"
 ::= { docsIetfQosPktClassEntry 8 }

docsIetfQosPktClassInetSourceAddr OBJECT-TYPE

SYNTAX InetAddress
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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 docsIetfQosPktClassInetSourceMask value equals the docsIetfQosPktClassInetSourceAddr value.

The address type of this object is specified by docsIetfQosPktClassInetAddressType.

If the referenced parameter is not present in a classifier, this object reports the value of '00000000'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.3"
 ::= { docsIetfQosPktClassEntry 9 }

docsIetfQosPktClassInetSourceMask OBJECT-TYPE

SYNTAX InetAddress
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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
 docsIetfQosPktClassInetSourceMask value equals the
 docsIetfQosIpPktClassInetSourceAddr value.

The address type of this object is specified by
 docsIetfQosPktClassInetAddressType.

If the referenced parameter is not present
 in a classifier, this object reports the value of
 'FFFFFFFF'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.4"
 ::= { docsIetfQosPktClassEntry 10 }

docsIetfQosPktClassInetDestAddr OBJECT-TYPE

SYNTAX InetAddress
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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
 docsIetfQosPktClassInetDestMask value
 equals the docsIetfQosPktClassInetDestAddr value.

The address type of this object is specified by
 docsIetfQosPktClassInetAddressType.

If the referenced parameter is not present
 in a classifier, this object reports the value of
 '00000000'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.5"
 ::= { docsIetfQosPktClassEntry 11 }

docsIetfQosPktClassInetDestMask OBJECT-TYPE

SYNTAX InetAddress
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION "This object 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 docsIetfQosPktClassInetDestMask value equals the docsIetfQosIpPktClassInetDestAddr value.

The address type of this object is specified by docsIetfQosPktClassInetAddressType.

If the referenced parameter is not present in a classifier, this object reports the value of 'FFFFFFFF'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.6"

::= { docsIetfQosPktClassEntry 12 }

docsIetfQosPktClassSourcePortStart OBJECT-TYPE

SYNTAX InetPortNumber

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object specifies the low-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This object is irrelevant for non-TCP/UDP IP packets.

If the referenced parameter is not present in a classifier, this object reports the value of 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.7"

::= { docsIetfQosPktClassEntry 13 }

docsIetfQosPktClassSourcePortEnd OBJECT-TYPE

SYNTAX InetPortNumber

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object specifies the high-end inclusive range of TCP/UDP source port numbers to which a packet is compared. This object is irrelevant for non-TCP/UDP IP packets.

If the referenced parameter is not present in a classifier, this object reports the value of 65535."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.8"

::= { docsIetfQosPktClassEntry 14 }

docsIetfQosPktClassDestPortStart OBJECT-TYPE

SYNTAX InetPortNumber
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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 object reports the value of 0."
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.9"
 ::= { docsIetfQosPktClassEntry 15 }

docsIetfQosPktClassDestPortEnd OBJECT-TYPE

SYNTAX InetPortNumber
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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 object reports the value of 65535."
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.5.10"
 ::= { docsIetfQosPktClassEntry 16 }

docsIetfQosPktClassDestMacAddr 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 docsIetfQosPktClassDestMacMask equals the value of docsIetfQosPktClassDestMacAddr.

 If the referenced parameter is not present in a classifier, this object reports the value of '000000000000'H."
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.6.1"
 ::= { docsIetfQosPktClassEntry 17 }

docsIetfQosPktClassDestMacMask 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 docsIetfQosPktClassDestMacMask equals the value of docsIetfQosPktClassDestMacAddr.

If the referenced parameter is not present in a classifier, this object reports the value of '000000000000'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.6.1"
 ::= { docsIetfQosPktClassEntry 18 }

docsIetfQosPktClassSourceMacAddr 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 object.

If the referenced parameter is not present in a classifier, this object reports the value of 'FFFFFFFFFFFF'H."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.6.2"
 ::= { docsIetfQosPktClassEntry 19 }

docsIetfQosPktClassEnetProtocolType OBJECT-TYPE

SYNTAX INTEGER {
 none(0),
 ethertype(1),
 dsap(2),
 mac(3),
 all(4)
 }

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object indicates the format of the layer 3 protocol ID in the Ethernet packet. A value of none(0) means that the rule does not use the layer 3 protocol type as a matching criteria.

A value of ethertype(1) 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(2) 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(3) means that the rule applies only to MAC management messages for MAC management messages.

A value of all(4) means that the rule matches all Ethernet packets.

If the Ethernet frame contains an 802.1P/Q Tag header (i.e., EtherType 0x8100), this object applies to the embedded EtherType field within the 802.1P/Q header.

If the referenced parameter is not present in a classifier, this object reports the value of 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.6.3"
 ::= { docsIetfQosPktClassEntry 20 }

docsIetfQosPktClassEnetProtocol OBJECT-TYPE

SYNTAX Integer32 (0..65535)

MAX-ACCESS read-only

STATUS current

DESCRIPTION "If docsIetfQosEthPktClassProtocolType is none(0), this object is ignored when considering whether a packet matches the current rule.

If dosQosPktClassEnetProtocolType is ethertype(1), this object gives the 16-bit value of the EtherType that the packet must match in order to match the rule.

If docsIetfQosPktClassEnetProtocolType is dsap(2), the lower 8 bits of this object's value must match the DSAP byte of the packet in order to match the rule.

If docsIetfQosPktClassEnetProtocolType is mac(3), the lower 8 bits of this object'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 object 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 object is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.6.3"
 ::= { docsIetfQosPktClassEntry 21 }

docsIetfQosPktClassUserPriLow OBJECT-TYPE

SYNTAX Integer32 (0..7)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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 docsIetfQosPktClassPriLow to docsIetfQosPktClassPriHigh in order to match this rule.

If the referenced parameter is not present in the classifier, the value of this object is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.7.1"
 ::= { docsIetfQosPktClassEntry 22 }

docsIetfQosPktClassUserPriHigh OBJECT-TYPE

SYNTAX Integer32 (0..7)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "This object 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 docsIetfQosPktClassPriLow to docsIetfQosPktClassPriHigh in order to match this rule.

If the referenced parameter is not present in the classifier, the value of this object is reported as 7."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.7.1"
 ::= { docsIetfQosPktClassEntry 23 }

docsIetfQosPktClassVlanId OBJECT-TYPE

SYNTAX Integer32 (0 | 1..4094)

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object 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 object is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.7.2"
 ::= { docsIetfQosPktClassEntry 24 }

docsIetfQosPktClassStateActive OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object 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 object is reported as true(1)."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.1.3.6"
 ::= { docsIetfQosPktClassEntry 25 }

docsIetfQosPktClassPkts OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object 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 object."

```
::= { docsIetfQosPktClassEntry 26 }
```

docsIetfQosPktClassBitMap OBJECT-TYPE

```
SYNTAX          BITS {                                -- Reference SP-RFiv2.0-I06-040804
    rulePriority(0),      -- Appendix C.2.1.3.4
    activationState(1),   -- Appendix C.2.1.3.6
    ipTos(2),             -- Appendix C.2.1.5.1
    ipProtocol(3),        -- Appendix C.2.1.5.2
    ipSourceAddr(4),      -- Appendix C.2.1.5.3
    ipSourceMask(5),      -- Appendix C.2.1.5.4
    ipDestAddr(6),        -- Appendix C.2.1.5.5
    ipDestMask(7),        -- Appendix C.2.1.5.6
    sourcePortStart(8),   -- Appendix C.2.1.5.7
    sourcePortEnd(9),     -- Appendix C.2.1.5.8
    destPortStart(10),    -- Appendix C.2.1.5.9
    destPortEnd(11),      -- Appendix C.2.1.5.10
    destMac(12),          -- Appendix C.2.1.6.1
    sourceMac(13),        -- Appendix C.2.1.6.2
    ethertype(14),        -- Appendix C.2.1.6.3
    userPri(15),          -- Appendix C.2.1.7.1
    vlanId(16)            -- Appendix C.2.1.7.2
}
```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object 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 object 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 object is encoded as the octet string '030000'H."

```
::= { docsIetfQosPktClassEntry 27 }
```

```
--
```

```
-- QOS Parameter Set Table
```

```
--
```

docsIetfQosParamSetTable OBJECT-TYPE

SYNTAX	SEQUENCE OF DocsIetfQosParamSetEntry
MAX-ACCESS	not-accessible
STATUS	current
DESCRIPTION	"This table describes the set of DOCSIS 1.1 and 2.0 QOS parameters defined in a managed device.

The ifIndex index specifies a DOCSIS MAC Domain.
 The docsIetfQosServiceFlowId index specifies a particular Service Flow.
 The docsIetfQosParamSetType index indicates whether the active, admitted, or provisioned QOS Parameter Set is being described by the row.

Only the QOS Parameter Sets of DOCSIS 1.1 and 2.0 Service Flows are represented in this table.

DOCSIS 1.0 QOS service profiles are not represented in this table.

Each row corresponds to a DOCSIS QOS Parameter Set as signaled via DOCSIS MAC management messages. Each object in the row corresponds to one or part of one DOCSIS 1.1 Service Flow Encoding. The docsIetfQosParamSetBitMap object in the row 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 object in this row.

Many objects are not applicable, depending on the Service Flow direction or upstream scheduling type. The object value reported in this case is specified in the DESCRIPTION clause."

::= { docsIetfQosMIBObjects 2 }

docsIetfQosParamSetEntry OBJECT-TYPE

SYNTAX	DocsIetfQosParamSetEntry
MAX-ACCESS	not-accessible
STATUS	current
DESCRIPTION	"A unique set of QOS parameters."
INDEX {	
ifIndex, docsIetfQosServiceFlowId, docsIetfQosParamSetType	

```

    }
    ::= { docsIetfQosParamSetTable 1 }

```

```

DocsIetfQosParamSetEntry ::= SEQUENCE {
    docsIetfQosParamSetServiceClassName      SnmpAdminString,
    docsIetfQosParamSetPriority                Integer32,
    docsIetfQosParamSetMaxTrafficRate         DocsIetfQosBitRate,
    docsIetfQosParamSetMaxTrafficBurst       Unsigned32,
    docsIetfQosParamSetMinReservedRate       DocsIetfQosBitRate,
    docsIetfQosParamSetMinReservedPkt        Integer32,
    docsIetfQosParamSetActiveTimeout          Integer32,
    docsIetfQosParamSetAdmittedTimeout        Integer32,
    docsIetfQosParamSetMaxConcatBurst         Integer32,
    docsIetfQosParamSetSchedulingType         DocsIetfQosSchedulingType,
    docsIetfQosParamSetNomPollInterval        Unsigned32,
    docsIetfQosParamSetTolPollJitter          Unsigned32,
    docsIetfQosParamSetUnsolicitGrantSize     Integer32,
    docsIetfQosParamSetNomGrantInterval       Unsigned32,
    docsIetfQosParamSetTolGrantJitter         Unsigned32,
    docsIetfQosParamSetGrantsPerInterval      Integer32,
    docsIetfQosParamSetTosAndMask             OCTET STRING,
    docsIetfQosParamSetTosOrMask             OCTET STRING,
    docsIetfQosParamSetMaxLatency             Unsigned32,
    docsIetfQosParamSetType                   INTEGER,
    docsIetfQosParamSetRequestPolicyOct       OCTET STRING,
    docsIetfQosParamSetBitMap                 BITS
}

```

docsIetfQosParamSetServiceClassName OBJECT-TYPE

SYNTAX	SnmpAdminString
MAX-ACCESS	read-only
STATUS	current
DESCRIPTION	"Refers to 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, the default value of this object is a zero-length string."
REFERENCE	"SP-RFiv2.0-I06-040804, Appendix C.2.2.3.4"

```

::= { docsIetfQosParamSetEntry 1 }

```

docsIetfQosParamSetPriority OBJECT-TYPE

SYNTAX	Integer32 (0..7)
MAX-ACCESS	read-only
STATUS	current
DESCRIPTION	"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.

If the referenced parameter is not present in the corresponding DOCSIS QoS Parameter Set, the default value of this object is 0. If the parameter is not applicable, the reported value is 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.1"
::= { docsIetfQosParamSetEntry 2 }

docsIetfQosParamSetMaxTrafficRate OBJECT-TYPE

SYNTAX DocsIetfQosBitRate

MAX-ACCESS read-only

STATUS current

DESCRIPTION "Maximum sustained traffic rate allowed for this Service Flow in bits/sec. Must count all MAC frame data PDU 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 object applies to both upstream and downstream Service Flows.

If the referenced parameter is not present in the corresponding DOCSIS QoS Parameter Set, the default value of this object is 0. If the parameter is not applicable, it is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.2"
::= { docsIetfQosParamSetEntry 3 }

docsIetfQosParamSetMaxTrafficBurst OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-only

STATUS current

DESCRIPTION "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 docsIetfQosParamSetMaxTrafficRate to calculate maximum sustained traffic rate.

If the referenced parameter is not present in the corresponding DOCSIS QoS Parameter Set, the default value of this object for scheduling types bestEffort (2), nonRealTimePollingService(3), and realTimePollingService(4) is 3044.

If this parameter is not applicable, it is reported as 0.

"
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.3"
 ::= { docsIetfQosParamSetEntry 4 }

docsIetfQosParamSetMinReservedRate OBJECT-TYPE

SYNTAX DocsIetfQosBitRate
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 default
 value of 0 means that no bandwidth is reserved.

If the referenced parameter is not present in the
 corresponding DOCSIS QOS Parameter Set, the default
 value of this object is 0. If the parameter
 is not applicable, it is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.4"
 ::= { docsIetfQosParamSetEntry 5 }

docsIetfQosParamSetMinReservedPkt OBJECT-TYPE

SYNTAX Integer32 (0..65535)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Specifies an assumed minimum packet size in
 bytes for which the
 docsIetfQosParamSetMinReservedRate 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 default value is
 CMTS implementation dependent. In this case, the
 CMTS reports the default value it is using, 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 this object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.5"
 ::= { docsIetfQosParamSetEntry 6 }

docsIetfQosParamSetActiveTimeout OBJECT-TYPE

SYNTAX Integer32 (0..65535)
 UNITS "seconds"
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION "Specifies the maximum duration in seconds that resources remain unused on an active service flow before CMTS signals that both active and admitted parameters set are null. The default value of 0 signifies an infinite amount of time.

If the referenced parameter is not present in the corresponding DOCSIS QoS Parameter Set, the default value of this object is 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.6"

::= { docsIetfQosParamSetEntry 7 }

docsIetfQosParamSetAdmittedTimeout OBJECT-TYPE

SYNTAX Integer32 (0..65535)

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION "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, the default value of this object is 200.

"

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.5.7"

DEFVAL { 200 }

::= { docsIetfQosParamSetEntry 8 }

docsIetfQosParamSetMaxConcatBurst OBJECT-TYPE

SYNTAX Integer32 (0..65535)

MAX-ACCESS read-only

STATUS current

DESCRIPTION "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 in 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, the default value of this object for scheduling types bestEffort(2), nonRealTimePollingService(3), and

realTimePollingService(4) is 1522. If the parameter is not applicable, this object's value is reported as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.1"
 ::= { docsIetfQosParamSetEntry 9 }

docsIetfQosParamSetSchedulingType OBJECT-TYPE

SYNTAX DocsIetfQosSchedulingType
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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, the default value of this object is bestEffort(2). For QOS parameter sets of downstream Service Flows, this object's value is reported as undefined(1)."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.2"
 ::= { docsIetfQosParamSetEntry 10 }

docsIetfQosParamSetNomPollInterval OBJECT-TYPE

SYNTAX Unsigned32
 UNITS "microseconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Specifies the nominal interval in microseconds between successive unicast request opportunities on an upstream Service Flow.

This object applies only to upstream Service Flows with DocsIetfQosSchedulingType of value nonRealTimePollingService(3), realTimePollingService(4), and unsolicitedGrantServiceWithAD(5). The parameter is mandatory for realTimePollingService(4). If the parameter is omitted with nonRealTimePollingService(3), the CMTS uses an implementation-dependent value. If the parameter is omitted with unsolicitedGrantServiceWithAD(5), the CMTS uses as a default value 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, and 0 otherwise.

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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.4"
 ::= { docsIetfQosParamSetEntry 11 }

docsIetfQosParamSetTolPollJitter OBJECT-TYPE

SYNTAX Unsigned32
 UNITS "microseconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 DocsIetfQoS SchedulingType of realTimePollingService(4) or unsolicitedGrantServiceWithAD(5).

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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.5"
 ::= { docsIetfQosParamSetEntry 12 }

docsIetfQosParamSetUnsolicitGrantSize OBJECT-TYPE

SYNTAX Integer32 (0..65535)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 DocsIetfQoS SchedulingType of unsolicitedGrantServiceWithAD(5) 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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.6"
 ::= { docsIetfQosParamSetEntry 13 }

docsIetfQosParamSetNomGrantInterval OBJECT-TYPE

SYNTAX Unsigned32
 UNITS "microseconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 DocsIetfQoS SchedulingType of unsolicitedGrantServiceWithAD(5) 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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.7"
 ::= { docsIetfQosParamSetEntry 14 }

docsIetfQosParamSetTolGrantJitter OBJECT-TYPE

SYNTAX Unsigned32
 UNITS "microseconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 DocsIetfQoS SchedulingType of unsolicitedGrantServiceWithAD(5) 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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.8"
 ::= { docsIetfQosParamSetEntry 15 }

docsIetfQosParamSetGrantsPerInterval OBJECT-TYPE

SYNTAX Integer32 (0..127)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Specifies the number of data grants per Nominal Grant Interval
 (docsIetfQosParamSetNomGrantInterval)."

The referenced parameter is applicable only for upstream flows with a DocsIetfQoS SchedulingType of unsolicitedGrantServiceWithAD(5) 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 object's value as 0."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.9"
 ::= { docsIetfQosParamSetEntry 16 }

docsIetfQosParamSetTosAndMask OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Specifies the AND mask for the IP TOS byte for overwriting IP packet's TOS value. The IP packet TOS byte is bitwise ANDed with docsIetfQosParamSetTosAndMask, and the result is bitwise Ored with docsIetfQosParamSetTosOrMask and the result is written to the IP packet TOS byte. A value of 'FF'H for docsIetfQosParamSetTosAndMask and a value of '00'H for docsIetfQosParamSetTosOrMask 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). Network operators SHOULD avoid specifying values of docsIetfQosParamSetTosAndMask and docsIetfQosParamSetTosORMask that would result in the modification of the ECN bits.

In particular, operators should not use values of docsIetfQosParamSetTosAndMask that have either of the least-significant two bits set to 0. Similarly, operators should not use values of docsIetfQosParamSetTosORMask that have either of the least-significant two bits set to 1.

Even though this object is only enforced by the Cable Modem Termination System (CMTS), Cable Modems MUST report the value as signaled in the referenced parameter."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.10;
RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP;
RFC 3260, New Terminology and Clarifications for Diffserv."

::= { docsIetfQosParamSetEntry 17 }

docsIetfQosParamSetTosOrMask OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))

MAX-ACCESS read-only

STATUS current

DESCRIPTION "Specifies the OR mask for the IP TOS byte.

See the description of docsIetfQosParamSetTosAndMask 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). Network operators SHOULD avoid specifying values of docsIetfQosParamSetTosAndMask and docsIetfQosParamSetTosORMask that would result in the modification of the ECN bits."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.10;
RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP;
RFC 3260, New Terminology and Clarifications for

Diffserv."
 ::= { docsIetfQosParamSetEntry 18 }

docsIetfQosParamSetMaxLatency OBJECT-TYPE

SYNTAX Unsigned32
 UNITS "microseconds"
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "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 object only applies to downstream Service Flows."

If the referenced parameter is not present in the corresponding downstream DOCSIS QoS Parameter Set, the default value is 0. This parameter is not applicable to upstream DOCSIS QoS Parameter Sets, and its value is reported as 0 in this case."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.7.1"
 ::= { docsIetfQosParamSetEntry 19 }

docsIetfQosParamSetType OBJECT-TYPE

SYNTAX INTEGER {
 active (1),
 admitted (2),
 provisioned (3)
 }

MAX-ACCESS not-accessible
 STATUS current

DESCRIPTION "Defines the type of the QOS parameter set defined by this row. active(1) indicates the Active QOS parameter set, describing the service currently being provided by the DOCSIS MAC domain to the Service Flow. admitted(2) indicates the Admitted QOS Parameter Set, describing services reserved by the DOCSIS MAC domain for use by the service flow. provisioned (3) describes the QOS Parameter Set defined in the DOCSIS CM Configuration file for the Service Flow."

REFERENCE "SP-RFiv2.0-I06-040804, 8.1.5"
 ::= { docsIetfQosParamSetEntry 20 }

docsIetfQosParamSetRequestPolicyOct 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     "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.

If bit 0 is the least significant bit of the least significant (4th) octet, and if bit number is increased with significance, the bit definitions are defined as follows:

```

broadcastReqOpp(0):
    all CMs broadcast request opportunities

priorityReqMulticastReq(1):
    priority request multicast request
    opportunities

reqDataForReq(2):
    request/data opportunities for requests

reqDataForData(3):
    request/data opportunities for data

piggybackReqWithData(4):
    piggyback requests with data

concatenateData(5):
    concatenate data

fragmentData(6):
    fragment data

suppresspayloadheaders(7):
    suppress payload headers

```

dropPktsExceedUGSize(8):

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 "SP-RFIv2.0-I06-040804, Appendix C.2.2.6.3"
 ::= { docsIetfQosParamSetEntry 21 }

docsIetfQosParamSetBitMap OBJECT-TYPE

-- Each bit corresponds to a parameter
 -- from SP-RFI-v1.1-I10-037030,
 -- Appendix C in the indicated

SYNTAX

BITS {

-- section number.

trafficPriority(0), -- C.2.2.5.1
 maxTrafficRate(1), -- C.2.2.5.2
 maxTrafficBurst(2), -- C.2.2.5.3
 minReservedRate(3), -- C.2.2.5.4
 minReservedPkt(4), -- C.2.2.5.5
 activeTimeout(5), -- C.2.2.5.6
 admittedTimeout(6), -- C.2.2.5.7
 maxConcatBurst(7), -- C.2.2.6.1
 schedulingType(8), -- C.2.2.6.2
 requestPolicy(9), -- C.2.2.6.3
 nomPollInterval(10), -- C.2.2.6.4
 tolPollJitter(11), -- C.2.2.6.5
 unsolicitGrantSize(12), -- C.2.2.6.6
 nomGrantInterval(13), -- C.2.2.6.7
 tolGrantJitter(14), -- C.2.2.6.8
 grantsPerInterval(15), -- C.2.2.6.9
 tosOverwrite(16), -- C.2.2.6.10
 maxLatency(17) -- C.2.2.7.1

}

MAX-ACCESS

read-only

STATUS

current

DESCRIPTION

"This object 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 parameter described by the indicated reference section is present in the original request.

Note that when Service Class names are expanded, the registration or dynamic response message may contain parameters as expanded by the CMTS based

on a stored service class. These expanded parameters are not indicated by a 1 bit in this object.

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 object's value in the row.

Note that BITS objects are encoded most significant bit first. For example, if bits 1 and 16 are set, the value of this object is the octet string '400080'H."

```
::= { docsIetfQosParamSetEntry 22 }
```

```
--
```

```
-- Service Flow Table
```

```
--
```

```
docsIetfQosServiceFlowTable OBJECT-TYPE
```

```
SYNTAX          SEQUENCE OF DocsIetfQosServiceFlowEntry
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION     "This table describes the set of DOCSIS-QOS  
Service Flows in a managed device."
```

```
::= { docsIetfQosMIBObjects 3 }
```

```
docsIetfQosServiceFlowEntry OBJECT-TYPE
```

```
SYNTAX          DocsIetfQosServiceFlowEntry
```

```
MAX-ACCESS      not-accessible
```

```
STATUS          current
```

```
DESCRIPTION     "Describes a Service Flow.  
An entry in the table exists for each  
Service Flow ID. The ifIndex is an  
ifType of docsCableMacLayer(127)."
```

```
INDEX {  
    ifIndex,  
    docsIetfQosServiceFlowId  
}
```

```
::= { docsIetfQosServiceFlowTable 1 }
```

```
DocsIetfQosServiceFlowEntry ::= SEQUENCE {
```

```
    docsIetfQosServiceFlowId          Unsigned32,
```

```
    docsIetfQosServiceFlowSID         Unsigned32,
```

```
    docsIetfQosServiceFlowDirection  DocsIetfQosRfMacIfDirection,
```

```
    docsIetfQosServiceFlowPrimary     TruthValue
```

```
}
```

```

docsIetfQosServiceFlowId      OBJECT-TYPE
    SYNTAX                     Unsigned32 (1..4294967295)
    MAX-ACCESS                  not-accessible
    STATUS                      current
    DESCRIPTION                  "An index assigned to a Service Flow by CMTS."
    REFERENCE                   "SP-RFiv2.0-I06-040804, Appendix C.2.2.3.2"
    ::= { docsIetfQosServiceFlowEntry 1 }

docsIetfQosServiceFlowSID      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 object
                                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                   "SP-RFiv2.0-I06-040804, Appendix C.2.2.3.3"
    ::= { docsIetfQosServiceFlowEntry 2 }

docsIetfQosServiceFlowDirection OBJECT-TYPE
    SYNTAX                     DocsIetfQosRfMacIfDirection
    MAX-ACCESS                  read-only
    STATUS                      current
    DESCRIPTION                  "The direction of the Service Flow."
    REFERENCE                   "SP-RFiv2.0-I06-040804, Appendix C.2.1.1/2"
    ::= { docsIetfQosServiceFlowEntry 3 }

docsIetfQosServiceFlowPrimary OBJECT-TYPE
    SYNTAX                     TruthValue
    MAX-ACCESS                  read-only
    STATUS                      current
    DESCRIPTION                  "Object reflects whether Service Flow is the primary
                                or a secondary Service Flow.

                                A primary Service Flow is the default Service Flow
                                for otherwise unclassified traffic and all MAC
                                messages."
    REFERENCE                   "SP-RFiv2.0-I06-040804, Section 8.1 "
    ::= { docsIetfQosServiceFlowEntry 4 }

--
--  Service Flow Stats Table
--
docsIetfQosServiceFlowStatsTable OBJECT-TYPE
    SYNTAX                     SEQUENCE OF DocsIetfQosServiceFlowStatsEntry
    MAX-ACCESS                  not-accessible

```

```

STATUS          current
DESCRIPTION     "This table describes statistics associated with the
                  Service Flows in a managed device."
 ::= { docsIetfQosMIBObjects 4 }

```

docsIetfQosServiceFlowStatsEntry OBJECT-TYPE

```

SYNTAX          DocsIetfQosServiceFlowStatsEntry
MAX-ACCESS     not-accessible
STATUS         current
DESCRIPTION     "Describes a set of Service Flow statistics.
                  An entry in the table exists for each
                  Service Flow ID. The ifIndex is an
                  ifType of docsCableMaclayer(127)."
```

```

INDEX {
    ifIndex,
    docsIetfQosServiceFlowId
}
 ::= { docsIetfQosServiceFlowStatsTable 1 }

```

DocsIetfQosServiceFlowStatsEntry ::= SEQUENCE {

```

    docsIetfQosServiceFlowPkts          Counter64,
    docsIetfQosServiceFlowOctets        Counter64,
    docsIetfQosServiceFlowTimeCreated   TimeStamp,
    docsIetfQosServiceFlowTimeActive    Counter32,
    docsIetfQosServiceFlowPHSUnknowns   Counter32,
    docsIetfQosServiceFlowPolicedDropPkts Counter32,
    docsIetfQosServiceFlowPolicedDelayPkts Counter32
}

```

docsIetfQosServiceFlowPkts OBJECT-TYPE

```

SYNTAX          Counter64
MAX-ACCESS     read-only
STATUS         current
DESCRIPTION     "For outgoing Service Flows, this object counts the
                  number of Packet Data PDUs forwarded to this
                  Service Flow. For incoming upstream CMTS service
                  flows, this object 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 object's value as 0 for downstream
                  ServiceFlows. This object 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 object 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 object that is associated with the primary service flow.

This object does include packets counted by docsIetfQosServiceFlowPolicedDelayPkts, but does not include packets counted by docsIetfQosServiceFlowPolicedDropPkts and docsIetfQosServiceFlowPHSUnknowns.

This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this object."

```
::= { docsIetfQosServiceFlowStatsEntry 1 }
```

docsIetfQosServiceFlowOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION "The number of octets from the byte after the MAC header HCS to the end of the CRC for all packets counted in the docsIetfQosServiceFlowPkts object 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 the same ifIndex that indexes this object."

```
::= { docsIetfQosServiceFlowStatsEntry 2 }
```

docsIetfQosServiceFlowTimeCreated OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION "The value of sysUpTime when the service flow was created."

```
::= { docsIetfQosServiceFlowStatsEntry 3 }
```

docsIetfQosServiceFlowTimeActive OBJECT-TYPE

SYNTAX Counter32

UNITS "seconds"

MAX-ACCESS read-only

STATUS current

DESCRIPTION "The number of seconds that the service flow has been active.

This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this object."

::= { docsIetfQosServiceFlowStatsEntry 4 }

docsIetfQosServiceFlowPHSUnknowns OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION "For incoming upstream CMTS service flows, this object 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 object'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 objects value as 0.

All outgoing service flows report this object's value as 0.

This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this object."

::= { docsIetfQosServiceFlowStatsEntry 5 }

docsIetfQosServiceFlowPolicedDropPkts OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION "For outgoing service flows, this object counts the number of Packet Data PDUs classified to this service flow dropped due to:

- (1) implementation-dependent excessive delay while enforcing the Maximum Sustained Traffic Rate; 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 object reports 0 for incoming service flows.

This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this object."

```
::= { docsIetfQosServiceFlowStatsEntry 6 }
```

docsIetfQosServiceFlowPolicedDelayPkts OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION "This object counts only outgoing packets delayed in order to maintain the Maximum Sustained Traffic Rate. This object will always report a value of 0 for UGS flows because the Maximum Sustained Traffic Rate does not apply. This object is 0 for incoming service flows.

This counter's last discontinuity is the ifCounterDiscontinuityTime for the same ifIndex that indexes this object."

```
::= { docsIetfQosServiceFlowStatsEntry 7 }
```

--

-- Upstream Service Flow Stats Table (CMTS ONLY)

--

docsIetfQosUpstreamStatsTable OBJECT-TYPE

SYNTAX SEQUENCE OF DocsIetfQosUpstreamStatsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "This table describes statistics associated with upstream service flows. All counted frames must be received without a Frame Check Sequence (FCS) error."

```
::= { docsIetfQosMIBObjects 5 }
```

docsIetfQosUpstreamStatsEntry OBJECT-TYPE

SYNTAX DocsIetfQosUpstreamStatsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "Describes a set of upstream service flow statistics. An entry in the table exists for each upstream Service Flow in a managed device. The ifIndex is an ifType of docsCableMaclayer(127)."

```
INDEX {
```

```

        ifIndex,
        docsIetfQosSID
    }
 ::= { docsIetfQosUpstreamStatsTable 1 }

DocsIetfQosUpstreamStatsEntry ::= SEQUENCE {
    docsIetfQosSID                Unsigned32,
    docsIetfQosUpstreamFragments Counter32,
    docsIetfQosUpstreamFragDiscards Counter32,
    docsIetfQosUpstreamConcatBursts Counter32
}

docsIetfQosSID OBJECT-TYPE
    SYNTAX      Unsigned32 (1..16383)
    MAX-ACCESS   not-accessible
    STATUS      current
    DESCRIPTION  "Identifies a service ID for an admitted or active
                  upstream service flow."
    ::= { docsIetfQosUpstreamStatsEntry 1 }

docsIetfQosUpstreamFragments OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION  "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 the same ifIndex that
                  indexes this object."
    ::= { docsIetfQosUpstreamStatsEntry 2 }

docsIetfQosUpstreamFragDiscards OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION  "The number of upstream fragments discarded and not
                  assembled into a valid upstream packet.

                  This counter's last discontinuity is the
                  ifCounterDiscontinuityTime for the same ifIndex that
                  indexes this object."
    ::= { docsIetfQosUpstreamStatsEntry 3 }

docsIetfQosUpstreamConcatBursts OBJECT-TYPE
    SYNTAX      Counter32

```

```

MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of concatenation headers received on an
                upstream service flow.
                This counter's last discontinuity is the
                ifCounterDiscontinuityTime for the same ifIndex that
                indexes this object."
 ::= { docsIetfQosUpstreamStatsEntry 4 }

--
--  Dynamic Service Stats Table
--
docsIetfQosDynamicServiceStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIetfQosDynamicServiceStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "This table describes statistics associated with the
                Dynamic Service Flows in a managed device."
    ::= { docsIetfQosMIBObjects 6 }

docsIetfQosDynamicServiceStatsEntry OBJECT-TYPE
    SYNTAX      DocsIetfQosDynamicServiceStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "Describes a set of dynamic service flow statistics.
                Two entries exist for each DOCSIS MAC layer
                interface for the upstream and downstream
                direction.  On the CMTS, the downstream direction
                row indicates messages transmitted or transactions
                originated by the CMTS.  The upstream direction row
                indicates messages received or transaction
                originated by the CM.  On the CM, the downstream
                direction row indicates messages received or
                transactions originated by the CMTS.  The upstream
                direction row indicates messages transmitted by
                the CM or transactions originated by the CM.
                The ifIndex is an ifType of
                docsCableMaclayer(127)."
```

INDEX {

```

    ifIndex,
    docsIetfQosIfDirection
}
 ::= { docsIetfQosDynamicServiceStatsTable 1 }

DocsIetfQosDynamicServiceStatsEntry ::= SEQUENCE {
    docsIetfQosIfDirection          DocsIetfQosRfMacIfDirection,
    docsIetfQosDSAREqs              Counter32,
```

```

docsIetfQosDSARsps          Counter32,
docsIetfQosDSAACKs          Counter32,
docsIetfQosDSCReqs          Counter32,
docsIetfQosDSCRsps          Counter32,
docsIetfQosDSCACKs          Counter32,
docsIetfQosDSDReqs          Counter32,
docsIetfQosDSDRsps          Counter32,
docsIetfQosDynamicAdds      Counter32,
docsIetfQosDynamicAddFails  Counter32,
docsIetfQosDynamicChanges   Counter32,
docsIetfQosDynamicChangeFails Counter32,
docsIetfQosDynamicDeletes   Counter32,
docsIetfQosDynamicDeleteFails Counter32,
docsIetfQosDCCRReqs          Counter32,
docsIetfQosDCCRsps          Counter32,
docsIetfQosDCCACKs          Counter32,
docsIetfQosDCCS              Counter32,
docsIetfQosDCCFails          Counter32
}

```

docsIetfQosIfDirection OBJECT-TYPE

```

SYNTAX          DocsIetfQosRfMacIfDirection
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "The direction of interface."
 ::= { docsIetfQosDynamicServiceStatsEntry 1 }

```

docsIetfQosDSAReqs OBJECT-TYPE

```

SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of Dynamic Service Addition Requests,
                  including retries.

```

This counter's last discontinuity is the
ifCounterDiscontinuityTime for the same ifIndex that
indexes this object."

```
 ::= { docsIetfQosDynamicServiceStatsEntry 2 }

```

docsIetfQosDSARsps OBJECT-TYPE

```

SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of Dynamic Service Addition Responses,
                  including retries.

```

This counter's last discontinuity is the
ifCounterDiscontinuityTime for the same ifIndex that

```

        indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 3 }

docsIetfQosDSAacks OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Addition
                    Acknowledgements, including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 4 }

docsIetfQosDSCReqs OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Change Requests,
                    including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 5 }

docsIetfQosDSCRsps OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Change Responses,
                    including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 6 }

docsIetfQosDSCAcks OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Change
                    Acknowledgements, including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that

```

```

        indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 7 }

docsIetfQosDSDReqs OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Delete Requests,
                    including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 8 }

docsIetfQosDSDRsps OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of Dynamic Service Delete Responses,
                    including retries.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 9 }

docsIetfQosDynamicAdds OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of successful Dynamic Service Addition
                    transactions.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 10 }

docsIetfQosDynamicAddFails OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The number of failed Dynamic Service Addition
                    transactions.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
```

indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 11 }

docsIetfQosDynamicChanges OBJECT-TYPE

SYNTAX Counter32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The number of successful Dynamic Service Change transactions.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that
 indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 12 }

docsIetfQosDynamicChangeFails OBJECT-TYPE

SYNTAX Counter32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The number of failed Dynamic Service Change transactions.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that
 indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 13 }

docsIetfQosDynamicDeletes OBJECT-TYPE

SYNTAX Counter32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The number of successful Dynamic Service Delete transactions.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that
 indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 14 }

docsIetfQosDynamicDeleteFails OBJECT-TYPE

SYNTAX Counter32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "The number of failed Dynamic Service Delete transactions.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that

indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 15 }

docsIetfQosDCCReqs 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.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex
 that indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 16 }

docsIetfQosDCCRsp 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.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that
 indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 17 }

docsIetfQosDCCAck 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.

This counter's last discontinuity is the
 ifCounterDiscontinuityTime for the same ifIndex that
 indexes this object."

::= { docsIetfQosDynamicServiceStatsEntry 18 }

docsIetfQosDCCs 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.

                This counter's last discontinuity is the
                ifCounterDiscontinuityTime for the same ifIndex that
                indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 19 }

```

```

docsIetfQosDCCFails 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.

                    This counter's last discontinuity is the
                    ifCounterDiscontinuityTime for the same ifIndex that
                    indexes this object."
 ::= { docsIetfQosDynamicServiceStatsEntry 20 }

```

```

--
-- Service Flow Log Table (CMTS ONLY)
--
docsIetfQosServiceFlowLogTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DocsIetfQosServiceFlowLogEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "This table contains a log of the disconnected
                    Service Flows in a managed device."
 ::= { docsIetfQosMIBObjects 7 }

```

```

docsIetfQosServiceFlowLogEntry OBJECT-TYPE
    SYNTAX          DocsIetfQosServiceFlowLogEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "The information regarding a single disconnected
                    service flow."
    INDEX {
        docsIetfQosServiceFlowLogIndex
    }
 ::= { docsIetfQosServiceFlowLogTable 1 }

```

```

DocsIetfQosServiceFlowLogEntry ::= SEQUENCE {

```

docsIetfQosServiceFlowLogIndex	Unsigned32,
docsIetfQosServiceFlowLogIfIndex	InterfaceIndex,
docsIetfQosServiceFlowLogSFID	Unsigned32,
docsIetfQosServiceFlowLogCmMac	MacAddress,
docsIetfQosServiceFlowLogPkts	Counter64,
docsIetfQosServiceFlowLogOctets	Counter64,
docsIetfQosServiceFlowLogTimeDeleted	TimeStamp,
docsIetfQosServiceFlowLogTimeCreated	TimeStamp,
docsIetfQosServiceFlowLogTimeActive	Counter32,
docsIetfQosServiceFlowLogDirection	DocsIetfQosRfMacIfDirection,
docsIetfQosServiceFlowLogPrimary	TruthValue,
docsIetfQosServiceFlowLogServiceClassName	SnmpAdminString,
docsIetfQosServiceFlowLogPolicedDropPkts	Counter32,
docsIetfQosServiceFlowLogPolicedDelayPkts	Counter32,
docsIetfQosServiceFlowLogControl	INTEGER
}	

```
docsIetfQosServiceFlowLogIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION  "Unique index for a logged service flow."
    ::= { docsIetfQosServiceFlowLogEntry 1 }
```

```
docsIetfQosServiceFlowLogIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION  "The ifIndex of ifType docsCableMacLayer(127)
                  on the CMTS where the service flow was present."
    ::= { docsIetfQosServiceFlowLogEntry 2 }
```

```
docsIetfQosServiceFlowLogSFID OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION  "The index assigned to the service flow by the CMTS."
    ::= { docsIetfQosServiceFlowLogEntry 3 }
```

```
docsIetfQosServiceFlowLogCmMac OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION  "The MAC address for the cable modem associated with
                  the service flow."
    ::= { docsIetfQosServiceFlowLogEntry 4 }
```

```
docsIetfQosServiceFlowLogPkts OBJECT-TYPE
```

```
SYNTAX          Counter64
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of packets counted on this service flow
                after payload header suppression."
 ::= { docsIetfQosServiceFlowLogEntry 5 }
```

docsIetfQosServiceFlowLogOctets OBJECT-TYPE

```
SYNTAX          Counter64
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of octets counted on this service flow
                after payload header suppression."
 ::= { docsIetfQosServiceFlowLogEntry 6 }
```

docsIetfQosServiceFlowLogTimeDeleted OBJECT-TYPE

```
SYNTAX          TimeStamp
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The value of sysUpTime when the service flow
                was deleted."
 ::= { docsIetfQosServiceFlowLogEntry 7 }
```

docsIetfQosServiceFlowLogTimeCreated OBJECT-TYPE

```
SYNTAX          TimeStamp
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The value of sysUpTime when the service flow
                was created."
 ::= { docsIetfQosServiceFlowLogEntry 8 }
```

docsIetfQosServiceFlowLogTimeActive OBJECT-TYPE

```
SYNTAX          Counter32
UNITS           "seconds"
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The total time that the service flow was active."
 ::= { docsIetfQosServiceFlowLogEntry 9 }
```

docsIetfQosServiceFlowLogDirection OBJECT-TYPE

```
SYNTAX          DocsIetfQosRfMacIfDirection
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The value of docsIetfQosServiceFlowDirection
                for the service flow."
 ::= { docsIetfQosServiceFlowLogEntry 10 }
```

docsIetfQosServiceFlowLogPrimary OBJECT-TYPE

```

SYNTAX          TruthValue
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The value of docsIetfQosServiceFlowPrimary for the
                service flow."
 ::= { docsIetfQosServiceFlowLogEntry 11 }

```

docsIetfQosServiceFlowLogServiceClassName OBJECT-TYPE

```

SYNTAX          SnmpAdminString
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The value of docsIetfQosParamSetServiceClassName for
                the provisioned QOS Parameter Set of the
                service flow."
 ::= { docsIetfQosServiceFlowLogEntry 12 }

```

docsIetfQosServiceFlowLogPolicedDropPkts OBJECT-TYPE

```

SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The final value of
                docsIetfQosServiceFlowPolicedDropPkts for the
                service flow."
 ::= { docsIetfQosServiceFlowLogEntry 13 }

```

docsIetfQosServiceFlowLogPolicedDelayPkts OBJECT-TYPE

```

SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The final value of
                docsIetfQosServiceFlowPolicedDelayPkts for the
                service flow."
 ::= { docsIetfQosServiceFlowLogEntry 14 }

```

docsIetfQosServiceFlowLogControl OBJECT-TYPE

```

SYNTAX          INTEGER {
                active(1),
                destroy(6)
                }

MAX-ACCESS      read-write
STATUS          current
DESCRIPTION     "Setting this object to the value destroy(6) removes
                this entry from the table.

```

```

                Reading this object returns the value active(1)."
 ::= { docsIetfQosServiceFlowLogEntry 15 }

```

```

--
-- Service Class Table (CMTS ONLY)
--
docsIetfQosServiceClassTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DocsIetfQosServiceClassEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "This table describes the set of DOCSIS-QOS
                     Service Classes in a CMTS."
    ::= { docsIetfQosMIBObjects 8 }

docsIetfQosServiceClassEntry OBJECT-TYPE
    SYNTAX          DocsIetfQosServiceClassEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "A provisioned service class on a CMTS.
                     Each entry 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
                     docsIetfQosServiceClassDirection object."
    INDEX {
        docsIetfQosServiceClassName
    }
    ::= { docsIetfQosServiceClassTable 1 }

DocsIetfQosServiceClassEntry ::= SEQUENCE {
    docsIetfQosServiceClassName          SnmpAdminString,
    docsIetfQosServiceClassStatus        RowStatus,
    docsIetfQosServiceClassPriority       Integer32,
    docsIetfQosServiceClassMaxTrafficRate DocsIetfQosBitRate,
    docsIetfQosServiceClassMaxTrafficBurst Unsigned32,
    docsIetfQosServiceClassMinReservedRate DocsIetfQosBitRate,
    docsIetfQosServiceClassMinReservedPkt Integer32,
    docsIetfQosServiceClassMaxConcatBurst Integer32,
    docsIetfQosServiceClassNomPollInterval Unsigned32,
    docsIetfQosServiceClassTolPollJitter Unsigned32,
    docsIetfQosServiceClassUnsolicitGrantSize Integer32,

```

docsIetfQosServiceClassNomGrantInterval	Unsigned32,
docsIetfQosServiceClassTolGrantJitter	Unsigned32,
docsIetfQosServiceClassGrantsPerInterval	Integer32,
docsIetfQosServiceClassMaxLatency	Unsigned32,
docsIetfQosServiceClassActiveTimeout	Integer32,
docsIetfQosServiceClassAdmittedTimeout	Integer32,
docsIetfQosServiceClassSchedulingType	DocsIetfQosSchedulingType,
docsIetfQosServiceClassRequestPolicy	OCTET STRING,
docsIetfQosServiceClassTosAndMask	OCTET STRING,
docsIetfQosServiceClassTosOrMask	OCTET STRING,
docsIetfQosServiceClassDirection	DocsIetfQosRfMacIfDirection,
docsIetfQosServiceClassStorageType	StorageType,
docsIetfQosServiceClassDSCPOverwrite	DscpOrAny
}	

docsIetfQosServiceClassName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE (1..15))

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "Service Class Name. DOCSIS specifies that the maximum size is 16 ASCII characters including a terminating zero. The terminating zero is not represented in this SnmpAdminString syntax object."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.3.4"

::= { docsIetfQosServiceClassEntry 1 }

docsIetfQosServiceClassStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION "Used to create or delete rows in this table. There is no restriction on the ability to change values in this row while the row is active. Inactive rows need not be timed out."

::= { docsIetfQosServiceClassEntry 2 }

docsIetfQosServiceClassPriority OBJECT-TYPE

SYNTAX Integer32 (0..7)

MAX-ACCESS read-create

STATUS current

DESCRIPTION "Template for docsIetfQosParamSetPriority."

DEFVAL { 0 }

::= { docsIetfQosServiceClassEntry 3 }

docsIetfQosServiceClassMaxTrafficRate OBJECT-TYPE

SYNTAX DocsIetfQosBitRate

MAX-ACCESS read-create

STATUS current

```
DESCRIPTION      "Template for docsIetfQosParamSetMaxTrafficRate."
DEFVAL           { 0 }
::= { docsIetfQosServiceClassEntry 4 }
```

docsIetfQosServiceClassMaxTrafficBurst OBJECT-TYPE

```
SYNTAX           Unsigned32
MAX-ACCESS       read-create
STATUS           current
DESCRIPTION      "Template for docsIetfQosParamSetMaxTrafficBurst."
DEFVAL           { 3044 }
::= { docsIetfQosServiceClassEntry 5 }
```

docsIetfQosServiceClassMinReservedRate OBJECT-TYPE

```
SYNTAX           DocsIetfQosBitRate
MAX-ACCESS       read-create
STATUS           current
DESCRIPTION      "Template for docsIetfQosParamSetMinReservedRate."
DEFVAL           { 0 }
::= { docsIetfQosServiceClassEntry 6 }
```

docsIetfQosServiceClassMinReservedPkt OBJECT-TYPE

```
SYNTAX           Integer32 (0..65535)
MAX-ACCESS       read-create
STATUS           current
DESCRIPTION      "Template for docsIetfQosParamSetMinReservedPkt."
::= { docsIetfQosServiceClassEntry 7 }
```

docsIetfQosServiceClassMaxConcatBurst OBJECT-TYPE

```
SYNTAX           Integer32 (0..65535)
MAX-ACCESS       read-create
STATUS           current
DESCRIPTION      "Template for docsIetfQosParamSetMaxConcatBurst."
DEFVAL           { 1522 }
::= { docsIetfQosServiceClassEntry 8 }
```

docsIetfQosServiceClassNomPollInterval OBJECT-TYPE

```
SYNTAX           Unsigned32
UNITS            "microseconds"
MAX-ACCESS       read-create
STATUS           current
DESCRIPTION      "Template for docsIetfQosParamSetNomPollInterval."
DEFVAL           { 0 }
::= { docsIetfQosServiceClassEntry 9 }
```

docsIetfQosServiceClassTolPollJitter OBJECT-TYPE

```
SYNTAX           Unsigned32
UNITS            "microseconds"
MAX-ACCESS       read-create
```

```
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetTolPollJitter."
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 10 }
```

docsIetfQosServiceClassUnsolicitGrantSize OBJECT-TYPE

```
SYNTAX          Integer32 (0..65535)
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetUnsolicitGrantSize."
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 11 }
```

docsIetfQosServiceClassNomGrantInterval OBJECT-TYPE

```
SYNTAX          Unsigned32
UNITS           "microseconds"
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetNomGrantInterval."
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 12 }
```

docsIetfQosServiceClassTolGrantJitter OBJECT-TYPE

```
SYNTAX          Unsigned32
UNITS           "microseconds"
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetTolGrantJitter."
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 13 }
```

docsIetfQosServiceClassGrantsPerInterval OBJECT-TYPE

```
SYNTAX          Integer32 (0..127)
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetGrantsPerInterval."
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 14 }
```

docsIetfQosServiceClassMaxLatency OBJECT-TYPE

```
SYNTAX          Unsigned32
UNITS           "microseconds"
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Template for docsIetfQosParamSetClassMaxLatency."
REFERENCE      "SP-RFiv2.0-I06-040804, Appendix C.2.2.7.1"
DEFVAL         { 0 }
::= { docsIetfQosServiceClassEntry 15 }
```

```
docsIetfQosServiceClassActiveTimeout OBJECT-TYPE
    SYNTAX      Integer32 (0..65535)
    UNITS       "seconds"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION  "Template for docsIetfQosParamSetActiveTimeout."
    DEFVAL      { 0 }
    ::= { docsIetfQosServiceClassEntry 16 }

docsIetfQosServiceClassAdmittedTimeout OBJECT-TYPE
    SYNTAX      Integer32 (0..65535)
    UNITS       "seconds"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION  "Template for docsIetfQosParamSetAdmittedTimeout."
    DEFVAL      { 200 }
    ::= { docsIetfQosServiceClassEntry 17 }

docsIetfQosServiceClassSchedulingType OBJECT-TYPE
    SYNTAX      DocsIetfQosSchedulingType
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION  "Template for docsIetfQosParamSetSchedulingType."
    DEFVAL      { bestEffort }
    ::= { docsIetfQosServiceClassEntry 18 }

docsIetfQosServiceClassRequestPolicy OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(4))
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION  "Template for docsIetfQosParamSetRequestPolicyOct."
    DEFVAL      { '00000000'H } -- no bits are set
    ::= { docsIetfQosServiceClassEntry 19 }

docsIetfQosServiceClassTosAndMask OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(1))
    MAX-ACCESS   read-only
    STATUS      current
    DESCRIPTION  "Template for docsIetfQosParamSetTosAndMask.
    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).  Network operators SHOULD avoid
    specifying values of
    docsIetfQosServiceClassTosAndMask and
    docsIetfQosServiceClassTosOrMask that would result
    in the modification of the ECN bits."
```

In particular, operators should not use values of docsIetfQosServiceClassTosAndMask that have either of the least-significant two bits set to 0. Similarly, operators should not use values of docsIetfQosServiceClassTosOrMask that have either of the least-significant two bits set to 1."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.10;
RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP;
RFC 3260, New Terminology and Clarifications for Diffserv."

::= { docsIetfQosServiceClassEntry 20 }

docsIetfQosServiceClassTosOrMask OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(1))
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Template for docsIetfQosParamSetTosOrMask.
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). Network operators SHOULD avoid specifying values of docsIetfQosServiceClassTosAndMask and docsIetfQosServiceClassTosOrMask that would result in the modification of the ECN bits.

In particular, operators should not use values of docsIetfQosServiceClassTosAndMask that have either of the least-significant two bits set to 0. Similarly, operators should not use values of docsIetfQosServiceClassTosOrMask that have either of the least-significant two bits set to 1."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.6.10;
RFC 3168, The Addition of Explicit Congestion Notification (ECN) to IP;
RFC 3260, New Terminology and Clarifications for Diffserv."

::= { docsIetfQosServiceClassEntry 21 }

docsIetfQosServiceClassDirection OBJECT-TYPE

SYNTAX DocsIetfQosRfMacIfDirection
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Specifies whether the service class template applies to upstream or downstream service flows."
DEFVAL { upstream }

```
::= { docsIetfQosServiceClassEntry 22 }
```

```
docsIetfQosServiceClassStorageType OBJECT-TYPE
```

```
SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "This object 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 object."
DEFVAL { nonVolatile }
::= { docsIetfQosServiceClassEntry 23 }
```

```
docsIetfQosServiceClassDSCPOverwrite OBJECT-TYPE
```

```
SYNTAX          DscpOrAny
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "This object allows the overwrite of the DSCP
                 field per RFC 3260.
```

If this object is -1, then the corresponding entry's docsIetfQosServiceClassTosAndMask value MUST be 'FF'H and docsIetfQosServiceClassTosOrMask MUST be '00'H. Otherwise, this object is in the range of 0..63, and the corresponding entry's docsIetfQosServiceClassTosAndMask value MUST be '03'H and the docsIetfQosServiceClassTosOrMask MUST be this object's value shifted left by two bit positions."

```
REFERENCE      "RFC 3168, The Addition of Explicit Congestion
                 Notification (ECN) to IP;
                 RFC 3260, New Terminology and Clarifications for
                 Diffserv."
```

```
DEFVAL          { -1 }
::= { docsIetfQosServiceClassEntry 24 }
```

```
--
```

```
-- Service Class PolicyTable
```

```
--
```

```
docsIetfQosServiceClassPolicyTable OBJECT-TYPE
```

```
SYNTAX          SEQUENCE OF DocsIetfQosServiceClassPolicyEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "This table describes the set of DOCSIS-QOS
                 Service Class Policies.
```

This table is an adjunct to the

docsDevFilterPolicy table. Entries in the docsDevFilterPolicy table can point to specific rows in this table.

This table permits mapping a packet to a service class name of an active service flow so long as a classifier does not exist at a higher priority."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix E.2.1"
 ::= { docsIetfQosMIBObjects 9 }

docsIetfQosServiceClassPolicyEntry OBJECT-TYPE
 SYNTAX DocsIetfQosServiceClassPolicyEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "A service class name policy entry."
 INDEX {
 docsIetfQosServiceClassPolicyIndex
 }
 ::= { docsIetfQosServiceClassPolicyTable 1 }

DocsIetfQosServiceClassPolicyEntry ::= SEQUENCE {
 docsIetfQosServiceClassPolicyIndex Unsigned32,
 docsIetfQosServiceClassPolicyName SnmpAdminString,
 docsIetfQosServiceClassPolicyRulePriority Integer32,
 docsIetfQosServiceClassPolicyStatus RowStatus,
 docsIetfQosServiceClassPolicyStorageType StorageType
 }

docsIetfQosServiceClassPolicyIndex OBJECT-TYPE
 SYNTAX Unsigned32 (1..2147483647)
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "Index value to identify an entry in this table uniquely."
 ::= { docsIetfQosServiceClassPolicyEntry 1 }

docsIetfQosServiceClassPolicyName OBJECT-TYPE
 SYNTAX SnmpAdminString
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION "Service Class Name to identify the name of the service class flow to which the packet should be directed."
 REFERENCE "SP-RFiv2.0-I06-040804, Appendix E.2.1"
 ::= { docsIetfQosServiceClassPolicyEntry 2 }

docsIetfQosServiceClassPolicyRulePriority OBJECT-TYPE

```

SYNTAX          Integer32 (0..255)
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Service Class Policy rule priority for the
entry."
REFERENCE       "SP-RFiv2.0-I06-040804, Appendix C.2.1.3.5"
::= { docsIetfQosServiceClassPolicyEntry 3 }

```

docsIetfQosServiceClassPolicyStatus OBJECT-TYPE

```

SYNTAX          RowStatus
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "Used to create or delete rows in this table.
This object should not be deleted if it is
referenced by an entry in docsDevFilterPolicy.
The reference should be deleted first.
There is no restriction on the ability
to change values in this row while the row is
active. Inactive rows need not be timed out."
::= { docsIetfQosServiceClassPolicyEntry 4 }

```

docsIetfQosServiceClassPolicyStorageType OBJECT-TYPE

```

SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "This object 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 object."
DEFVAL { nonVolatile }
::= { docsIetfQosServiceClassPolicyEntry 5 }

```

--

-- Payload Header Suppression(PHS) Table

--

docsIetfQosPHSTable OBJECT-TYPE

```

SYNTAX          SEQUENCE OF DocsIetfQosPHSEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "This table describes the set of payload header
suppression entries."
::= { docsIetfQosMIBObjects 10 }

```

docsIetfQosPHSEntry OBJECT-TYPE

```

SYNTAX          DocsIetfQosPHSEntry
MAX-ACCESS      not-accessible
STATUS          current

```

DESCRIPTION "A payload header suppression entry.

The ifIndex is an ifType of docsCableMacLayer(127).
The index docsIetfQosServiceFlowId selects one
service flow from the cable MAC layer interface.
The docsIetfQosPktClassId index matches an
index of the docsIetfQosPktClassTable."

```
INDEX {
    ifIndex,
    docsIetfQosServiceFlowId,
    docsIetfQosPktClassId
}
 ::= { docsIetfQosPHSTable 1 }
```

```
DocsIetfQosPHSEntry ::= SEQUENCE {
    docsIetfQosPHSField      OCTET STRING,
    docsIetfQosPHSMask       OCTET STRING,
    docsIetfQosPHSSize       Integer32,
    docsIetfQosPHSVerify     TruthValue,
    docsIetfQosPHSIndex      Integer32
}
```

```
docsIetfQosPHSField      OBJECT-TYPE
    SYNTAX                 OCTET STRING (SIZE(0..255))
    MAX-ACCESS              read-only
    STATUS                  current
    DESCRIPTION             "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 object should be
the same as the value of docsIetfQosPHSSize."

```
REFERENCE                 "SP-RFiv2.0-I06-040804, Appendix C.2.2.10.1"
 ::= { docsIetfQosPHSEntry 1 }
```

```
docsIetfQosPHSMask       OBJECT-TYPE
    SYNTAX                 OCTET STRING(SIZE(0..32))
    MAX-ACCESS              read-only
    STATUS                  current
    DESCRIPTION             "Payload header suppression mask defines the
                           bit mask that is used in combination with the
                           docsIetfQosPHSField. 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 docsIetfQosPHSField, with the least

significant bit corresponding to the first byte of the docsIetfQosPHSField.

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 docsIetfQosPHSField, then the bit mask is extended with bit values of '1' to be the necessary length."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.10.3"
 ::= { docsIetfQosPHSEntry 2 }

docsIetfQosPHSSize OBJECT-TYPE
 SYNTAX Integer32 (0..255)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Payload header suppression size specifies the number of bytes in the header to be suppressed and restored."

The value of this object must match the number of bytes in the docsIetfQosPHSField."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.10.4"
 ::= { docsIetfQosPHSEntry 3 }

docsIetfQosPHSVerify OBJECT-TYPE
 SYNTAX TruthValue
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Payload header suppression verification value. If 'true', the sender must verify docsIetfQosPHSField is the same as what is contained in the packet to be suppressed."

REFERENCE "SP-RFiv2.0-I06-040804, Appendix C.2.2.10.5"
 ::= { docsIetfQosPHSEntry 4 }

docsIetfQosPHSIndex OBJECT-TYPE
 SYNTAX Integer32 (1..255)
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION "Payload header suppression index uniquely

```

        references the PHS rule for a given service flow."
REFERENCE      "SP-RFiv2.0-I06-040804, Appendix C.2.2.10.2"
 ::= { docsIetfQosPHSEntry 5 }

--
-- docsIetfQosCmtsMacToSrvFlowTable (CMTS Only)
--
docsIetfQosCmtsMacToSrvFlowTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF DocsIetfQosCmtsMacToSrvFlowEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION  "This table provides for referencing the service
                  flows associated with a particular cable modem.
                  This allows indexing into other docsIetfQos
                  tables that are indexed by docsIetfQosServiceFlowId
                  and ifIndex."
    ::= { docsIetfQosMIBObjects 11 }

docsIetfQosCmtsMacToSrvFlowEntry OBJECT-TYPE
    SYNTAX      DocsIetfQosCmtsMacToSrvFlowEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION  "An entry is created by CMTS for each service flow
                  connected to this CMTS."
    INDEX {
        docsIetfQosCmtsCmMac,
        docsIetfQosCmtsServiceFlowId
    }
    ::= { docsIetfQosCmtsMacToSrvFlowTable 1 }

DocsIetfQosCmtsMacToSrvFlowEntry ::= SEQUENCE {
    docsIetfQosCmtsCmMac      MacAddress,
    docsIetfQosCmtsServiceFlowId  Unsigned32,
    docsIetfQosCmtsIfIndex    InterfaceIndex
}

docsIetfQosCmtsCmMac OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION  "The MAC address for the referenced CM."
    ::= { docsIetfQosCmtsMacToSrvFlowEntry 1 }

docsIetfQosCmtsServiceFlowId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS   not-accessible
    STATUS       current

```

```

DESCRIPTION      "An index assigned to a service flow by CMTS."
 ::= { docsIetfQosCmtsMacToSrvFlowEntry 2 }

docsIetfQosCmtsIfIndex OBJECT-TYPE
    SYNTAX          InterfaceIndex
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The ifIndex of ifType docsCableMacLayer(127)
                    on the CMTS that is connected to the Cable Modem."
    ::= { docsIetfQosCmtsMacToSrvFlowEntry 3 }

--
-- Conformance definitions
--
docsIetfQosConformance OBJECT IDENTIFIER
    ::= { docsIetfQosMIB 2 }

docsIetfQosGroups          OBJECT IDENTIFIER
    ::= { docsIetfQosConformance 1 }

docsIetfQosCompliances     OBJECT IDENTIFIER
    ::= { docsIetfQosConformance 2 }

docsIetfQosCompliance MODULE-COMPLIANCE
    STATUS      current
    DESCRIPTION
        "The compliance statement for MCNS Cable Modems and
        Cable Modem Termination Systems that implement DOCSIS
        Service Flows."

MODULE -- docsIetfQosMIB
    MANDATORY-GROUPS { docsIetfQosBaseGroup }

    GROUP docsIetfQosCmtsGroup
    DESCRIPTION
        "This group is mandatory for Cable Modem Termination
        Systems (CMTS) and is not implemented for Cable Modems
        (CM)."
```

```

    GROUP docsIetfQosParamSetGroup
    DESCRIPTION
        "This group is mandatory for Cable Modem Termination
        Systems (CMTS) and Cable Modems.  Cable modems only
        implement objects in this group as read-only."
```

```

    GROUP docsIetfQosSrvClassPolicyGroup
    DESCRIPTION
        "This group is optional for Cable Modem Termination
```

Systems (CMTS) and Cable Modems. This group is relevant if policy-based service flow classification is implemented. See docsDevPolicyTable in DOCS-CABLE-DEVICE-MIB for more details."

GROUP docsIetfQosServiceClassGroup

DESCRIPTION

"This group is mandatory for a Cable Modem Termination System (CMTS) that implements expansion of Service Class Names in a QOS Parameter Set. This group is not implemented on the Cable Modems."

OBJECT docsIetfQosPktClassPkts

DESCRIPTION

"This object only needs to be implemented in entries that are classifying packets and not policing packets."

OBJECT docsIetfQosPktClassInetAddressType

SYNTAX InetAddressType { ipv4(1) }

DESCRIPTION

"An implementation is only required to support IPv4 address."

OBJECT docsIetfQosPktClassInetSourceAddr

SYNTAX InetAddress (SIZE(4))

DESCRIPTION

"An implementation is only required to support IPv4 address."

OBJECT docsIetfQosPktClassInetSourceMask

SYNTAX InetAddress (SIZE(4))

DESCRIPTION

"An implementation is only required to support IPv4 address."

OBJECT docsIetfQosPktClassInetDestAddr

SYNTAX InetAddress (SIZE(4))

DESCRIPTION

"An implementation is only required to support IPv4 address."

OBJECT docsIetfQosPktClassInetDestMask

SYNTAX InetAddress (SIZE(4))

DESCRIPTION

"An implementation is only required to support IPv4 address."

OBJECT docsIetfQosServiceClassStorageType

```
SYNTAX StorageType { nonVolatile(3) }
DESCRIPTION
    "An implementation is only required to support nonvolatile
    storage."
```

```
OBJECT docsIetfQosServiceClassPolicyStorageType
SYNTAX StorageType { nonVolatile(3) }
DESCRIPTION
    "An implementation is only required to support nonvolatile
    storage."
```

```
::= { docsIetfQosCompliances 1 }
```

```
docsIetfQosBaseGroup OBJECT-GROUP
OBJECTS {
    docsIetfQosPktClassDirection,
    docsIetfQosPktClassPriority,
    docsIetfQosPktClassIpTosLow,
    docsIetfQosPktClassIpTosHigh,
    docsIetfQosPktClassIpTosMask,
    docsIetfQosPktClassIpProtocol,
    docsIetfQosPktClassSourcePortStart,
    docsIetfQosPktClassSourcePortEnd,
    docsIetfQosPktClassDestPortStart,
    docsIetfQosPktClassDestPortEnd,
    docsIetfQosPktClassDestMacAddr,
    docsIetfQosPktClassDestMacMask,
    docsIetfQosPktClassSourceMacAddr,
    docsIetfQosPktClassEnetProtocolType,
    docsIetfQosPktClassEnetProtocol,
    docsIetfQosPktClassUserPriLow,
    docsIetfQosPktClassUserPriHigh,
    docsIetfQosPktClassVlanId,
    docsIetfQosPktClassStateActive,
    docsIetfQosPktClassPkts,
    docsIetfQosPktClassBitMap,
    docsIetfQosPktClassInetAddressType,
    docsIetfQosPktClassInetSourceAddr,
    docsIetfQosPktClassInetSourceMask,
    docsIetfQosPktClassInetDestAddr,
    docsIetfQosPktClassInetDestMask,

    docsIetfQosServiceFlowSID,
    docsIetfQosServiceFlowDirection,
    docsIetfQosServiceFlowPrimary,

    docsIetfQosServiceFlowPkts,
    docsIetfQosServiceFlowOctets,
```

```
docsIetfQosServiceFlowTimeCreated,
docsIetfQosServiceFlowTimeActive,
docsIetfQosServiceFlowPHSUnknowns,
docsIetfQosServiceFlowPolicedDropPkts,
docsIetfQosServiceFlowPolicedDelayPkts,
```

```
docsIetfQosDSAREqs,
docsIetfQosDSARsps,
docsIetfQosDSAACKs,
docsIetfQosDSCReq,
docsIetfQosDSCRsps,
docsIetfQosDSCACKs,
docsIetfQosDSDReq,
docsIetfQosDSDRsps,
docsIetfQosDynamicAdd,
docsIetfQosDynamicAddFails,
docsIetfQosDynamicChange,
docsIetfQosDynamicChangeFails,
docsIetfQosDynamicDelete,
docsIetfQosDynamicDeleteFails,
docsIetfQosDCCReq,
docsIetfQosDCCRsp,
docsIetfQosDCCACK,
docsIetfQosDCC,
docsIetfQosDCCFails,
```

```
docsIetfQosPHSField,
docsIetfQosPHSMask,
docsIetfQosPHSSize,
docsIetfQosPHSVerify,
docsIetfQosPHSIndex
}
```

```
STATUS current
```

```
DESCRIPTION
```

```
"Group of objects implemented in both Cable Modems and
Cable Modem Termination Systems."
```

```
::= { docsIetfQosGroups 1 }
```

```
docsIetfQosParamSetGroup OBJECT-GROUP
OBJECTS {
docsIetfQosParamSetServiceClassName,
docsIetfQosParamSetPriority,
docsIetfQosParamSetMaxTrafficRate,
docsIetfQosParamSetMaxTrafficBurst,
docsIetfQosParamSetMinReservedRate,
docsIetfQosParamSetMinReservedPkt,
docsIetfQosParamSetActiveTimeout,
docsIetfQosParamSetAdmittedTimeout,
```

```

docsIetfQosParamSetMaxConcatBurst,
docsIetfQosParamSetSchedulingType,
docsIetfQosParamSetNomPollInterval,
docsIetfQosParamSetTolPollJitter,
docsIetfQosParamSetUnsolicitGrantSize,
docsIetfQosParamSetNomGrantInterval,
docsIetfQosParamSetTolGrantJitter,
docsIetfQosParamSetGrantsPerInterval,
docsIetfQosParamSetTosAndMask,
docsIetfQosParamSetTosOrMask,
docsIetfQosParamSetMaxLatency,
docsIetfQosParamSetRequestPolicyOct,
docsIetfQosParamSetBitMap
}
STATUS    current
DESCRIPTION
    "Group of objects implemented in both Cable Modems and
    Cable Modem Termination Systems for QoS Parameter Sets."
 ::= { docsIetfQosGroups 2 }

```

```

docsIetfQosCmtsGroup OBJECT-GROUP
    OBJECTS {

```

```

docsIetfQosUpstreamFragments,
docsIetfQosUpstreamFragDiscards,
docsIetfQosUpstreamConcatBursts,

docsIetfQosServiceFlowLogIfIndex,
docsIetfQosServiceFlowLogSFID,
docsIetfQosServiceFlowLogCmMac,
docsIetfQosServiceFlowLogPkts,
docsIetfQosServiceFlowLogOctets,
docsIetfQosServiceFlowLogTimeDeleted,
docsIetfQosServiceFlowLogTimeCreated,
docsIetfQosServiceFlowLogTimeActive,
docsIetfQosServiceFlowLogDirection,
docsIetfQosServiceFlowLogPrimary,
docsIetfQosServiceFlowLogServiceClassName,
docsIetfQosServiceFlowLogPolicedDropPkts,
docsIetfQosServiceFlowLogPolicedDelayPkts,
docsIetfQosServiceFlowLogControl,

```

```

docsIetfQosCmtsIfIndex -- docsIetfQosCmtsMacToSrvFlowTable required
}
STATUS    current
DESCRIPTION

```

```
    "Group of objects implemented only in the CMTS."  
 ::= { docsIetfQosGroups 3 }
```

```
docsIetfQosSrvClassPolicyGroup OBJECT-GROUP  
  OBJECTS {  
    docsIetfQosServiceClassPolicyName,  
    docsIetfQosServiceClassPolicyRulePriority,  
    docsIetfQosServiceClassPolicyStatus,  
    docsIetfQosServiceClassPolicyStorageType  
  }  
  STATUS current  
  DESCRIPTION  
    "Group of objects implemented in both Cable Modems and  
    Cable Modem Termination Systems when supporting policy-based  
    service flows."  
 ::= { docsIetfQosGroups 4 }
```

```
docsIetfQosServiceClassGroup OBJECT-GROUP  
  OBJECTS {  
    docsIetfQosServiceClassStatus,  
    docsIetfQosServiceClassPriority,  
    docsIetfQosServiceClassMaxTrafficRate,  
    docsIetfQosServiceClassMaxTrafficBurst,  
    docsIetfQosServiceClassMinReservedRate,  
    docsIetfQosServiceClassMinReservedPkt,  
    docsIetfQosServiceClassMaxConcatBurst,  
    docsIetfQosServiceClassNomPollInterval,  
    docsIetfQosServiceClassTolPollJitter,  
    docsIetfQosServiceClassUnsolicitGrantSize,  
    docsIetfQosServiceClassNomGrantInterval,  
    docsIetfQosServiceClassTolGrantJitter,  
    docsIetfQosServiceClassGrantsPerInterval,  
    docsIetfQosServiceClassMaxLatency,  
    docsIetfQosServiceClassActiveTimeout,  
    docsIetfQosServiceClassAdmittedTimeout,  
    docsIetfQosServiceClassSchedulingType,  
    docsIetfQosServiceClassRequestPolicy,  
    docsIetfQosServiceClassTosAndMask,  
    docsIetfQosServiceClassTosOrMask,  
    docsIetfQosServiceClassDirection,  
    docsIetfQosServiceClassStorageType,  
    docsIetfQosServiceClassDSCPOverwrite  
  }  
  STATUS current  
  DESCRIPTION  
    "Group of objects implemented only in Cable Modem  
    Termination Systems when supporting expansion of Service  
    Class Names in a QOS Parameter Set"
```

```
::= { docsIetfQosGroups 5 }
```

END

6. Security Considerations

This MIB module relates to an agent that will provide metropolitan public Internet access. As such, improper manipulation of the objects represented by this MIB module may result in denial of service to a large number of end-users [6]. Manipulation of the docsIetfQosServiceClassTable and docsIetfQosServiceClassPolicyTable may allow an end-user to increase his or her service levels, or affect other end-users in either a positive or negative manner. In addition, manipulation of docsIetfQosServiceFlowLogControl could allow an attacker to remove logs of packet and byte counts forwarded on a Service Flow. If such logs were used for billing, the attacker would obtain free service.

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- o The docsIetfQosServiceClassTable provides a template of QOS parameters such as maximum rate limits for a named service class. Changing these parameters would allow an attacker to obtain an unauthorized class of service.
- o The docsIetfQosServiceClassPolicyTable applies CMTS vendor proprietary policies for packet forwarding, including dropping, scheduling, notification, or other policies. Changing this table could allow an attacker to deny service to all subscribers of the CMTS or could grant the attacker unauthorized forwarding policies.
- o The docsIetfQosServiceFlowLogControl object controls the deletion of entries in the docsIetfQosServiceFlowLogTable, which acts as a historical "detail record" of DOCSIS Service Flow packets and bytes transmitted. Such records may be used for billing purposes, so the unauthorized deletion of the records can result in free service.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to

control even GET access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- o Unauthorized SNMP GET access of the docsIetfQosPktClassTable or docsIetfQosPHSTable can allow an attacker to learn IP addresses permitted to have enhanced quality of service, for possible spoofing. This table typically contains the IP addresses involved in voice-over-IP sessions, for example.
- o Unauthorized SNMP GET access of the docsIetfQosParamSetTable allows an attacker to learn the names of Service Classes that are permitted to have enhanced QoS service, and the values of that enhanced service. That name can be referenced in an unauthorized DOCSIS cable modem configuration file to obtain enhanced service.
- o Unauthorized SNMP GET access of the docsIetfQosServiceFlowTable can tell an attacker when Service Flows are active, e.g., when a voice-over-IP call is in progress.

Unauthorized SNMP GET access of the docsIetfQosServiceFlowLogTable can expose private information about network usage.

- o Unauthorized SNMP GET access of the docsIetfQosServiceFlowStatsTable, docsIetfQosUpstreamStatsTable, docsIetfQosDynamicServiceStatsTable, docsIetfQosServiceFlowLogTable, and docsIetfQosCmtsMacToSrvFlowTable can tell an attacker the volume of traffic to and from any Service Flow in the system, resulting in loss of privacy of the amount and direction of data transfer.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module. It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [15], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy). Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP

entity giving access to an instance of this MIB module, is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

7. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER Value
docsIetfQosMIB	{ mib-2 127 }

8. Acknowledgements

The authors gratefully acknowledge the comments and suggestions of the IP over Cable Data Network (IPCDN) Working Group (especially the co-chairs Richard Woundy and Jean-Francois Mule) as well as the contributions of the Operation and Management Area Director, Bert Wijnen.

9. Normative References

- [1] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [2] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [3] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [4] "Data-Over-Cable Service Interface Specifications: Radio Frequency Interface Specification SP-RFiv2.0-I06-040804", DOCSIS, August 2004, <http://www.cablelabs.com/specifications/archives/>.
- [5] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [6] St. Johns, M., "Cable Device Management Information Base for DOCSIS compliant Cable Modems and Cable Modem Termination Systems", RFC 2669, August 1999.

- [7] St. Johns, M., "Radio Frequency (RF) Interface Management Information Base for MCNS/DOCSIS compliant RF interfaces", RFC 2670, August 1999.
- [8] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.
- [9] Grossman, D., "New Terminology and Clarifications for Diffserv", RFC 3260, April 2002.
- [10] Ramakrishnan, K., Floyd, S., and D. Black, "The Addition of Explicit Congestion Notification (ECN) to IP", RFC 3168, September 2001.
- [11] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.
- [12] Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks", STD 62, RFC 3411, December 2002.
- [13] Baker, F., Chan, K., and A. Smith, "Management Information Base for the Differentiated Services Architecture", RFC 3289, May 2002.
- [14] Postel, J., "Internet Protocol", STD 5, RFC 791, September 1981.

10. Informative References

- [15] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

Authors' Addresses

Michael Patrick
Motorola Broadband Communications Sector
111 Locke Drive
Marlborough, MA 01752

Phone: (508) 786-7563
EMail: michael.patrick@motorola.com

William Murwin
Motorola Broadband Communications Sector
111 Locke Drive
Marlborough, MA 01752

Phone: (508) 786-7594
EMail: w.murwin@motorola.com

Full Copyright Statement

Copyright (C) The Internet Society (2006).

This document is subject to the rights, licenses and restrictions contained in BCP 78, and except as set forth therein, the authors retain all their rights.

This document and the information contained herein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Intellectual Property

The IETF takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights. Information on the procedures with respect to rights in RFC documents can be found in BCP 78 and BCP 79.

Copies of IPR disclosures made to the IETF Secretariat and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard. Please address the information to the IETF at ietf-ipr@ietf.org.

Acknowledgement

Funding for the RFC Editor function is provided by the IETF Administrative Support Activity (IASA).

