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

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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 version 1.1 and 2.0.
1. Introduction

This memo is a product of the IP over Cable Data Network (IPCDN) working group within the Internet Engineering Task Force (IETF). Comments are solicited and should be addressed to the working group’s mailing list at ipcdn@ietf.org and/or the authors.

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 [19].

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 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 which the Service Flow is not currently using, but which 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 TV

CM              Cable Modem, a modem connecting a subscriber’s LAN the CATV RF network. DOCSIS CMs operate as a MAC layer bridge between the home LAN and the 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.

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, hence all SFs are considered to be "Provisioned".

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 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 Flows

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 1.1 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 [?].

2.1 Textual Conventions

The textual convention "DocsQosRfMacIfDirection" 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 "DocsQosBitRate" 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 includes 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:
docsQosMIB
  docsQosMIBObjects
    docsQosPktClassTable
      docsQosPktClassEntry
        docsQosPktClassId
        docsQosPktClassDirection
        docsQosPktClassPriority
        docsQosPktClassIpTosLow
        docsQosPktClassIpTosHigh
        docsQosPktClassIpTosMask
        docsQosPktClassIpProtocol
        docsQosPktClassInetAddressType
        docsQosPktClassInetSourceAddr
        docsQosPktClassInetSourceMask
        docsQosPktClassInetDestAddr
        docsQosPktClassInetDestMask
        docsQosPktClassSourcePortStart
        docsQosPktClassSourcePortEnd
        docsQosPktClassDestPortStart
        docsQosPktClassDestPortEnd
        docsQosPktClassDestMacAddr
        docsQosPktClassDestMacMask
        docsQosPktClassSourceMacAddr
        docsQosPktClassEnetProtocolType
        docsQosPktClassEnetProtocol
        docsQosPktClassUserPriLow
        docsQosPktClassUserPriHigh
        docsQosPktClassVlanId
        docsQosPktClassStateActive
        docsQosPktClassPkts
        docsQosPktClassBitMap
    docsQosParamSetTable
      docsQosParamSetEntry
        docsQosParamSetServiceClassName
        docsQosParamSetPriority
        docsQosParamSetMaxTrafficRate
        docsQosParamSetMaxTrafficBurst
        docsQosParamSetMinReservedRate
        docsQosParamSetMinReservedPkts
        docsQosParamSetActiveTimeout
        docsQosParamSetAdmittedTimeout
        docsQosParamSetMaxConcatBurst
        docsQosParamSetSchedulingType
        docsQosParamSetNomPollInterval
        docsQosParamSetTolPollJitter
        docsQosParamSetUnsolicitGrantSize
        docsQosParamSetNomGrantInterval
        docsQosParamSetTolGrantJitter
        docsQosParamSetGrantsPerInterval
        docsQosParamSetTosAndMask
        docsQosParamSetTosOrMask
docsQosParamSetMaxLatency
docsQosParamSetType
docsQosParamSetRequestPolicyOct
docsQosParamSetBitMap
docsQosServiceFlowTable
docsQosServiceFlowEntry
docsQosServiceFlowId
docsQosServiceFlowSID
docsQosServiceFlowDirection
docsQosServiceFlowPrimary
docsQosServiceFlowStatsTable
docsQosServiceFlowStatsEntry
docsQosServiceFlowPkts
docsQosServiceFlowOctets
docsQosServiceFlowTimeCreated
docsQosServiceFlowTimeActive
docsQosServiceFlowPHSUnknowns
docsQosServiceFlowPolicedDropPkts
docsQosServiceFlowPolicedDelayPkts
docsQosServiceFlowStatsTable
docsQosUpstreamStatsTable
docsQosUpstreamStatsEntry
docsQosSID
docsQosUpstreamFragments
docsQosUpstreamFragDiscards
docsQosUpstreamConcatBursts
docsQosDynamicServiceStatsTable
docsQosDynamicServiceStatsEntry
docsQosIfDirection
docsQosDSARqs
docsQosDSARsps
docsQosDSAACKs
docsQosDSACKs
docsQosDSCRqs
docsQosDSCRsps
docsQosDSACKs
docsQosDSRqs
docsQosDSRqsps
docsQosDynamicAdds
docsQosDynamicAddFails
docsQosDynamicChanges
docsQosDynamicChangeFails
docsQosDynamicDeletes
docsQosDynamicDeleteFails
docsQosDCCReqs
docsQosDCCRqsps
docsQosDCCACKs
docsQosDCCs
docsQosDCCFails
docsQosServiceFlowLogTable
docsQosServiceFlowLogEntry
docsQosServiceFlowLogIfIndex
docsQosServiceFlowLogIfIndex
docsQosServiceFlowLogSFID
docsQosServiceFlowLogCmMac
docsQosServiceFlowLogPkts
docsQosServiceFlowLogOctets
docsQosServiceFlowLogTimeDeleted
docsQosServiceFlowLogTimeCreated
docsQosServiceFlowLogTimeActive
docsQosServiceFlowLogDirection
docsQosServiceFlowLogPrimary
docsQosServiceFlowLogServiceClassName
docsQosServiceFlowLogPolicedDropPkts
docsQosServiceFlowLogPolicedDelayPkts
docsQosServiceFlowLogControl

docsQosServiceClassTable

docsQosServiceClassEntry

docsQosServiceClassName

docsQosServiceClassStatus

docsQosServiceClassMaxTrafficRate

docsQosServiceClassMaxTrafficBurst

docsQosServiceClassMinReservedRate

docsQosServiceClassMinReservedPkt

docsQosServiceClassMaxConcatBurst

docsQosServiceClassNomPollInterval

docsQosServiceClassToIPollJitter

docsQosServiceClassUnsolicitGrantSize

docsQosServiceClassNomGrantInterval

docsQosServiceClassToIGrantJitter

docsQosServiceClassGrantsPerInterval

docsQosServiceClassMaxLatency

docsQosServiceClassActiveTimeout

docsQosServiceClassAdmittedTimeout

docsQosServiceClassSchedulingType

docsQosServiceClassRequestPolicy

docsQosServiceClassTosAndMask

docsQosServiceClassTosOrMask

docsQosServiceClassDirection

docsQosServiceClassStorageType

docsQosServiceClassDSCPOverwrite

docsQosServiceClassPolicyTable

docsQosServiceClassPolicyEntry

docsQosServiceClassPolicyIndex

docsQosServiceClassPolicyName

docsQosServiceClassPolicyRulePriority

docsQosServiceClassPolicyStatus

docsQosServiceClassPolicyStorageType

docsQosPHSTable

docsQosPHSEntry

docsQosPHSField

docsQosPHSMask

docsQosPHSSize

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

2.2.1 docsQosPktClassTable

The docsQosPktClassTable reports the Service Flow Classifiers implemented by the managed device. The table is indexed by the tuple \{ ifIndex, docsQosServiceFlowId, docsQosPktClassId \}. The ifIndex corresponds to an CATV MAC interface. Each CATV MAC interface has a set of Service Flows, identified with a docsQosServiceFlowId 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 which map more than one classifier are prioritized according to their docsQosPktClassPriority value. The docsQosServiceFlowId (an index object) indicates to which Service Flow the packet is classified.

The docsQosPktClassTable is distinct from the docsDevIpFilterTable of \[9\] in that docsQosPktClassTable 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, docsQosPktClassTable 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 docsQosParamSetTable

The docsQosParamSetTable 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:

![Diagram of QoS Parameter Sets]

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. Since 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 to be "within" an outer QPS when all QoS parameters represent demands of equal or fewer resources of the network.

In addition to their use as attributes 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 of 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 docsQosServiceClassTable.


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

The docsQosParamSetTable is read-only, because it indicates the QoS Parameter Set contents as defined by DOCSIS signaling. The docsQosServiceClassTable 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 [10] 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 either 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 both DOCSIS 1.0, DOCSIS 1.1, and DOCSIS 2.0 implements both the tables of [10] and the tables of this MIB module. The interoperation goal is that before modem registration, the DOCSIS 1.0 MIB [10] 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 docsQosParamSetTable or docsQosServiceFlowTable 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 docsQosProfileTable representing the modems 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 docsQosParamSetTable and docsQosServiceFlowTable.

5. DOCSIS 1.0 modems do not have entries in the DOCS-IF-QOS-MIB.

2.2.3 docsQosServiceFlowTable

The docsQosServiceFlowTable provides read-only information about all of the Service Flows known by the device. It is indexed by the combination of { ifIndex, docsQosServiceFlowId }, where ifIndex corresponds to a CATV MAC interface and docsQosServiceFlowId is the 32-bit integer assigned by the CMTS controlling the MAC domain. A CM typically has only a single CATV MAC interface, while a CMTS may have several. See [10] 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 docsQosServiceFlowStatsTable

The docsQosServiceFlowStatsTable 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 which 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.

```
+----------+ clsfy 1 +-----+ Per-SF   \ forwarded
Pktss     |        |      | Maximum |-> for DOCSIS
-----+ Classify |        |       | SF1    | Rate     |
Function | clsfy 2   |        |        |        | Policing |
|         |          |       |        |        | transmission |
|         |          |       |        |        | Function |----+
|         |          |       |        |        |     ^ | Dropped |
|         |          |       |        |        |       | Delayed |
```

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 docsQosPktClassPkts 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 docsQosServiceFlowPoliciedDropPkts object counts the number of Service Flow packets dropped by the policing function. The docsQosServiceFlowPoliciedDelayPkts counts the number of packet delayed but still forwarded. The docsQosServiceFlowPkts object counts the total number of packets forwarded beyond the policing function intended for eventual transmission onto the DOCSIS RF network. Although packets may be latter dropped by other functions (e.g. a transmit queue overflow on a DOCSIS hardware transmitter), the docsQos MIB per service-flow counters are not affected in this case.
2.2.5 docsQosUpstreamStatsTable

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

2.2.6 docsQosDynamicServiceStatsTable

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 docsQosDSAReqs object in the upstream row at the CMTS counts the number of DSA-REQ messages received by the CMTS from that interface. The docsQosDSAReqs 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 docsQosDynamicAdds 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 docsQosDynamicAdds 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 docsQosDynamicAddFails. Again, this object exists in both directions, so that locally originated vs remotely originated transaction failures are counted separately. Further troubleshooting of transaction failures will require vendor-specific queries and operation.

2.2.7 docsQosServiceFlowLogTable

This table contains a log of the Service Flows no longer existing in the docsQosServiceFlowTable. 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, as well as 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 is vendor-specific. An explicit control object is provided so that the monitoring application can explicitly delete records it has read.

2.2.8 docsQosServiceClassTable

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 docsQosServiceClassTable should define a template for flows in a given direction (upstream or downstream). Some parameters of the docsQosServiceClassTable 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 docsQosServiceClassPolicyTable

The docsQosServiceClassPolicyTable can be referenced by the docsDevFilterPolicyTable of [9] in order to have a "policy" that classifies packets to a named Service Class. This is one mechanism by which "external" entities (like an SNMP manager) may control the classification of packet for QoS purposes. Entries are indexed by a small integer docsQosServiceClassPolicyIndex. 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 the section "Externally Administered Classification", below.

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

2.2.10 docsQosPHSTable

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 docsQosPktClassId. A PHS rule is associated with exactly one classifier. The table is therefore indexed by the tuple (ifIndex, docsQosServiceFlowId, docsQosPktClassId).

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

2.2.11 docsQosCmtsMacToSrvFlowTable

The docsQosCmtsMacToSrvFlowTable provides 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 docsQosCmtsMacToSrvFlowTable 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 it 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, i.e. should an external SNMP manager be permitted to create classification rows? One problem was the co-ordination of classifier IDs, since such an approach would require either separate classifier ID number spaces or objects to co-ordinate both internal and external classifier ID assignments. A more serious problem, however, was the requirement 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 an internal DOCSIS object, 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 CMTSSs. What was desired was to permit external classification of
packets to a Service Class, not a particular Service Flow.

The DOCSIS committee therefore decided to use the already-defined IP Packet Filter Table [9] for the external classification of packets for QoS purposes. The docsDevIpPacketFilterTable defines similar packet matching criteria as docsQosPktClassTable, 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 docsQosServiceClassPolicyTable 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.
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 docsQosServiceClassPolicyTable whose entries may be pointed to by docsDevFilterPolicyPtr

Figure 2: DOCSIS Packet Classification
in order to administratively classify packets to a named DOCSIS Service Class. The docsQosServiceClassPolicyEntry provides a Service Class Name (SCN) as docsQosServiceClassPolicyName and a classification rule priority as docsQosServiceClassPolicyRulePriority. 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 docsQosPktClassTable, which may classify the packet to a different SFID "X". Associated with the classifier is a docsQosPktClassPriority.

6. In the event of a conflict between the SCN-determined SFID and the classified SFID, the greater of docsQosPktClassPriority and docsQosServiceClassPolicyRulePriority determines which SFID is selected to forward the packet.

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

By convention (in [4]), the "internal" docsQosPktClassPriority values should be in the range of 64-191, while the "external" priorities may be either in the range 192-255 to override the internal classification or 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 [18]. 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 [13] 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 making the DOCSIS access network TOS marking compatible with the wider use of DSCP outside DOCSIS networks. It should be noted 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), there is the possibility that the DOCSIS network could be configured to modify the Explicit Congestion Notification (ECN) bits [14] 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: docsQosPktClassIpTosLow, docsQosPktClassIpTosHigh docsQosPktClassIpTosMask, docsQosParamSetTosAndMask, docsQosParamSetTosOrMask) and allows the DSCP field to be modified (read-create object: docsQosServiceClassDSCPOverwrite).
5. Definitions

-- QoS Extension MIB for DOCSIS Systems

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

IMPORTS
   MODULE-IDENTITY,
   OBJECT-TYPE,
   Integer32,
   Counter32,
   Unsigned32,
   Counter64
      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

   docsIfMib
      FROM DOCS-IF-MIB

   InetAddressType,
   InetAddress,
   InetPortNumber
      FROM INET-ADDRESS-MIB

   DscpOrAny
      FROM DIFFSERV-DSCP-TC

   SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB;

docsQosMIB   MODULE-IDENTITY
   LAST-UPDATED  "200409230000Z" -- September 23, 2004
   ORGANIZATION  "IETF IP over Cable Data Network (IPCDN)
                 Working Group"

Expires March 2005
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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.comacst.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."

REVISION        "200409230000Z" -- September 23, 2004
DESCRIPTION
"Initial version, published as RFC xxxx."
 ::= { docsIfMib xx } -- xx to be assigned by IANA

docsQosMIBObjects OBJECT IDENTIFIER ::= { docsQosMIB 1 }

-- Textual Conventions
DocsQosRfMacIfDirection ::= 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)
  }

DocsQosBitRate ::= 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

DocsQosSchedulingType ::= 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
--
docsQosPktClassTable OBJECT-TYPE
SYNTAX          SEQUENCE OF DocsQosPktClassEntry
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 docsQosPktClassBitMap 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.
"
 ::= { docsQosMIBObjects 1 }

docsQosPktClassEntry OBJECT-TYPE
SYNTAX DocsQosPktClassEntry
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,
   docsQosServiceFlowId,
   docsQosPktClassId
}
 ::= { docsQosPktClassTable 1 }

DocsQosPktClassEntry ::= SEQUENCE {
   docsQosPktClassId                  Unsigned32,
   docsQosPktClassDirection           DocsQosRfMacIfDirection,
   docsQosPktClassPriority            Integer32,
   docsQosPktClassIpTosLow            OCTET STRING,
   docsQosPktClassIpTosHigh           OCTET STRING,
   docsQosPktClassIpTosMask           OCTET STRING,
   docsQosPktClassIpProtocol          Integer32,
   docsQosPktClassInetAddressType     InetAddressType,
   docsQosPktClassInetSourceAddr      InetAddress,
   docsQosPktClassInetSourceMask      InetAddress,
   docsQosPktClassInetDestAddr        InetAddress,
   docsQosPktClassInetDestMask        InetAddress,
   docsQosPktClassSourcePortStart     InetPortNumber,
   docsQosPktClassSourcePortEnd       InetPortNumber,
   docsQosPktClassDestPortStart       InetPortNumber,
   docsQosPktClassDestPortEnd         InetPortNumber,
   docsQosPktClassDestMacAddr         MacAddress,
   docsQosPktClassDestMacMask         MacAddress,
   docsQosPktClassSourceMacAddr       MacAddress,
   docsQosPktClassSourceMacAddr       MacAddress,
   docsQosPktClassEnetProtocolType    INTEGER,
   docsQosPktClassEnetProtocol        Integer32,
   docsQosPktClassUserPriLow          Integer32,
   docsQosPktClassUserPriHigh         Integer32,
   docsQosPktClassVlanId              Integer32,
   docsQosPktClassStateActive         TruthValue,
   docsQosPktClassPkts                Counter64,
   docsQosPktClassBitMap              BITS
}
docsQosPktClassId 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-RF1v1.1-I10-037030, Appendix C.2.1.3.2"
::= { docsQosPktClassEntry 1 }

docsQosPktClassDirection OBJECT-TYPE
SYNTAX          DocsQosRfMacIfDirection
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "Indicates the direction to which the classifier
is applied."
::= { docsQosPktClassEntry 2 }

docsQosPktClassPriority 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-RF1v1.1-I10-037030, Appendix C.2.1.3.5"
::= { docsQosPktClassEntry 3 }

docsQosPktClassIpTosLow 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 a 8 bit
octet as defined by the DOCSIS Specification
for packet classification."
REFERENCE       "SP-RF1v1.1-I10-037030, Appendix C.2.1.5.1"
docsQosPktClassIpTosHigh 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 a 8 bit octet as defined by the DOCSIS Specification for packet classification."
REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.1"

::= { docsQosPktClassEntry 5 }

docsQosPktClassIpTosMask 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 check 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 a 8 bit octet as defined by the DOCSIS Specification for packet classification."
REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.1"

::= { docsQosPktClassEntry 6 }

docsQosPktClassIpProtocol 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-RFIv1.1-I10-037030, Appendix C.2.1.5.2"
 ::= { docsQosPktClassEntry 7 }

docsQosPktClassInetAddressType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The type of the internet address for docsQosPktClassInetSourceAddr, docsQosPktClassInetSourceMask, docsQosPktClassInetDestAddr, and docsQosPktClassInetDestMask."

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

REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.3"
 ::= { docsQosPktClassEntry 8 }

docsQosPktClassInetSourceAddr 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 docsQosPktClassInetSourceMask value equals the docsQosPktClassInetSourceAddr value."

The address type of this object is specified by docsQosPktClassInetAddressType.

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

REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.3"
 ::= { docsQosPktClassEntry 9 }

docsQosPktClassInetSourceMask OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object specifies which bits of a packet’s IP Source Address that are compared to match this rule. An IP packet matches the rule when the packet source address bitwise ANDed with the docsQosPktClassInetSourceMask value equals the docsQosIpPktClassInetSourceAddr value.

The address type of this object is specified by docsQosPktClassInetAddressType.

If the referenced parameter is not present in a classifier, this object reports the value of ‘FFFFFFFF’H.”
REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.4"
::= { docsQosPktClassEntry 10 }

docsQosPktClassInetDestAddr 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 docsQosPktClassInetDestMask value equals the docsQosPktClassInetDestAddr value.

The address type of this object is specified by docsQosPktClassInetAddressType.

If the referenced parameter is not present in a classifier, this object reports the value of ‘00000000’H.”
REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.5"
::= { docsQosPktClassEntry 11 }

docsQosPktClassInetDestMask OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object specifies which bits of a packet’s IP Destination Address that are compared to match this rule. An IP packet matches the rule when the packet destination address bitwise ANDed with the docsQosPktClassInetDestMask value equals the docsQosIpPktClassInetDestAddr value."
The address type of this object is specified by docsQosPktClassInetAddressType.

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

REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.1.5.6"
::= { docsQosPktClassEntry 12 }

docsQosPktClassSourcePortStart 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-RFIv1.1-I10-037030, Appendix C.2.1.5.7"
::= { docsQosPktClassEntry 13 }

docsQosPktClassSourcePortEnd 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-RFIv1.1-I10-037030, Appendix C.2.1.5.8"
::= { docsQosPktClassEntry 14 }

docsQosPktClassDestPortStart 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-RFIv1.1-I10-037030, Appendix C.2.1.5.9"
docsQosPktClassDestPortEnd 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-RFIv1.1-I10-037030, Appendix C.2.1.5.10"
::= { docsQosPktClassEntry 15 }

docsQosPktClassDestMacAddr OBJECT-TYPE
SYNTAX          MacAddress
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION    "An Ethernet packet matches an entry when its
destination MAC address bitwise ANDed with
docsQosPktClassDestMacMask equals the value of
docsQosPktClassDestMacAddr.

If the referenced parameter is not present
in a classifier, this object reports the value of
‘000000000000’H.
"
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.1.6.1"
::= { docsQosPktClassEntry 16 }

docsQosPktClassDestMacMask OBJECT-TYPE
SYNTAX          MacAddress
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION    "An Ethernet packet matches an entry when its
destination MAC address bitwise ANDed with
docsQosPktClassDestMacMask equals the value of
docsQosPktClassDestMacAddr.

If the referenced parameter is not present
in a classifier, this object reports the value of
‘000000000000’H.
"
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.1.6.1"
::= { docsQosPktClassEntry 17 }

docsQosPktClassSourceMacAddr 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
docsQosPktClassSourceMacMask equals the value of
docsQosPktClassSourceMacAddr.

If the referenced parameter is not present
in a classifier, this object reports the value of
‘000000000000’H.
"
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.1.6.1"
::= { docsQosPktClassEntry 18 }
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-RFIv1.1-I10-037030, Appendix C.2.1.6.2"
 ::= { docsQosPktClassEntry 19 }

docsQosPktClassEnetProtocolType 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 which contains an
EtherType value. Ethertype values are contained
in packets using the Dec-Intel-Xerox (DIX)
ceapsulation 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-RFIv1.1-I10-037030, Appendix C.2.1.6.3"
::= { docsQosPktClassEntry 20 }

docsQosPktClassEnetProtocol OBJECT-TYPE
SYNTAX        Integer32 (0..65535)
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION   "If docsQosEthPktClassProtocolType is none(0), this object is ignored when considering whether a packet matches the current rule.

If docsQosPktClassEnetProtocolType 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 docsQosPktClassEnetProtocolType 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 docsQosPktClassEnetProtocolType is mac(3), the lower 8 bits of this object value represent a lower bound (inclusive) of MAC management message type codes matched, and the upper 8 bits of this object value 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-RFIv1.1-I10-037030, Appendix C.2.1.6.3"
::= { docsQosPktClassEntry 21 }

docsQosPktClassUserPriLow 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 docsQosPktClassPriLow and docsQosPktClassPriHigh 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-RFIv1.1-I10-037030, Appendix C.2.1.7.1"
::= { docsQosPktClassEntry 22 }

docsQosPktClassUserPriHigh 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 docsQosPktClassPriLow and docsQosPktClassPriHigh 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-RFIv1.1-I10-037030, Appendix C.2.1.7.1"
::= { docsQosPktClassEntry 23 }

docsQosPktClassVlanId 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-RFIv1.1-I10-037030, Appendix C.2.1.7.2"
::= { docsQosPktClassEntry 24 }

docsQosPktClassStateActive 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-RFIv1.1-I10-037030, Appendix C.2.1.3.6"
::= { docsQosPktClassEntry 25 }

docsQosPktClassPkts 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 same ifIndex that indexes this object."
::= { docsQosPktClassEntry 26 }

docsQosPktClassBitMap OBJECT-TYPE
SYNTAX BITS {
  rulePriority(0), -- Reference SP-RFIv1.1-I10-037030
  activationState(1), -- Appendix C.2.1.3.4
  ipTos(2), -- Appendix C.2.1.3.6
  ipProtocol(3), -- Appendix C.2.1.5.1
  ipSourceAddr(4), -- Appendix C.2.1.5.2
  ipSourceMask(5), -- Appendix C.2.1.5.3
  ipDestAddr(6), -- Appendix C.2.1.5.4
  ipDestMask(7), -- Appendix C.2.1.5.5
  sourcePortStart(8), -- Appendix C.2.1.5.6
  sourcePortEnd(9), -- Appendix C.2.1.5.7
  destPortStart(10), -- Appendix C.2.1.5.8
  destPortEnd(11), -- Appendix C.2.1.5.9
  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 0 otherwise.

Note that BITS are encoded most significant bit first, so that if e.g. bits 6 and 7 are set, this object is encoded as the octet string ‘030000’H.’

::= { docsQosPktClassEntry 27 }

--
-- QOS Parameter Set Table
--
docsQosParamSetTable OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosParamSetEntry
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 docsQosServiceFlowId index specifies a particular Service Flow. The docsQosParamSetType 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 docsQosParamSetBitMap 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.

 ::= { docsQosMIBObjects 2 }

docsQosParamSetEntry OBJECT-TYPE
SYNTAX DocsQosParamSetEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A unique set of QOS parameters."
INDEX {
   ifIndex, docsQosServiceFlowId, docsQosParamSetType
}
 ::= { docsQosParamSetTable 1 }

DocsQosParamSetEntry ::= SEQUENCE {
   docsQosParamSetServiceClassName   SnmpAdminString,
   docsQosParamSetPriority           Integer32,
   docsQosParamSetMaxTrafficRate     DocsQosBitRate,
   docsQosParamSetMaxTrafficBurst    Unsigned32,
   docsQosParamSetMinReservedRate    DocsQosBitRate,
   docsQosParamSetMinReservedPkt     Integer32,
   docsQosParamSetActiveTimeout      Integer32,
   docsQosParamSetAdmittedTimeout    Integer32,
   docsQosParamSetMaxConcatBurst     Integer32,
   docsQosParamSetSchedulingType     DocsQosSchedulingType,
   docsQosParamSetNomPollInterval    Unsigned32,
   docsQosParamSetTolPollJitter      Unsigned32,
   docsQosParamSetNomUnsolicitGrantSize Integer32,
   docsQosParamSetNomGrantInterval   Unsigned32,
   docsQosParamSetTolGrantJitter     Unsigned32,
   docsQosParamSetGrantsPerInterval  Integer32,
   docsQosParamSetTosAndMask         OCTET STRING,
   docsQosParamSetTosOrMask          OCTET STRING,
   docsQosParamSetMaxLatency         Unsigned32,
   docsQosParamSetType               INTEGER,
   docsQosParamSetRequestPolicyOct   OCTET STRING,
docsQosParamSetBitMap

}  

 docsQosParamSetServiceClassName OBJECT-TYPE
SYNTAX          SnmpAdminString
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION    "Refers to the Service Class Name that 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-RFIv1.1-I10-037030, Appendix C.2.2.3.4"
::= { docsQosParamSetEntry 1 }

 docsQosParamSetPriority 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 with 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-RFIv1.1-I10-037030, Appendix C.2.2.5.1"
::= { docsQosParamSetEntry 2 }

 docsQosParamSetMaxTrafficRate OBJECT-TYPE
SYNTAX          DocsQosBitRate
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-RFIv1.1-I10-037030, Appendix C.2.2.5.2" ::= { docsQosParamSetEntry 3 }

docsQosParamSetMaxTrafficBurst 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 docsQosParamSetMaxTrafficRate 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-RFIv1.1-I10-037030, Appendix C.2.2.5.3" ::= { docsQosParamSetEntry 4 }

docsQosParamSetMinReservedRate OBJECT-TYPE
SYNTAX DocsQosBitRate
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 has the meaning 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-RFIv1.1-I10-037030, Appendix C.2.2.5.4" ::= { docsQosParamSetEntry 5 }

docsQosParamSetMinReservedPkt OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies an assumed minimum packet size in bytes for which the docsQosParamSetMinReservedRate
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-RFIv1.1-I10-037030, Appendix C.2.2.5.5"
::= { docsQosParamSetEntry 6 }
docsQosParamSetActiveTimeout 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-RFIv1.1-I10-037030, Appendix C.2.2.5.6"
::= { docsQosParamSetEntry 7 }
docsQosParamSetAdmittedTimeout 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."
docsQosParamSetMaxConcatBurst OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies the maximum concatenated burst in bytes which 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-RFIv1.1-I10-037030, Appendix C.2.2.6.1"
::= { docsQosParamSetEntry 9 }

docsQosParamSetNomPollInterval OBJECT-TYPE
SYNTAX Unsigned32
UNITS "microseconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies the nominal interval in microseconds between successive nominal unicast request
Expires March 2005                                 [Page 40]
opportunities on an upstream Service Flow.

This object applies only to upstream Service Flows with DocsQosSchedulingType of value nonRealTimePollingService(3), realTimePollingService(4), and unsolictedGrantServiceWithAD(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 unsolictedGrantServiceWithAD(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-RFIv1.1-I10-037030, Appendix C.2.2.6.4"
 ::= { docsQosParamSetEntry 11 }

docsQosParamSetTolPollJitter 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 DocsQosSchedulingType of realTimePollingService(4) or unsolictedGrantServiceWithAD(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-RFIv1.1-I10-037030, Appendix C.2.2.6.5"
::= { docsQosParamSetEntry 12 }

docsQosParamSetUnsolicitGrantSize 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 end of
the MAC frame.

The referenced parameter is applicable only
for upstream flows with a DocsQosSchedulingType of
of unsolicitedGrantServicewithAD(5) or
unsolicitedGrantService(6), and 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-RFIv1.1-I10-037030, Appendix C.2.2.6.6"
::= { docsQosParamSetEntry 13 }

docsQosParamSetNomGrantInterval 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 DocsQosSchedulingType of
of unsolicitedGrantServicewithAD(5) or
unsolicitedGrantService(6), and 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.

"
docsQosParamSetTolGrantJitter 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 DocsQosSchedulingType of of unsolicitedGrantServiceWithAD(5) or unsolicitedGrantService(6), and 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-RFIv1.1-I10-037030, Appendix C.2.2.6.7"
 ::= { docsQosParamSetEntry 14 }

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

The referenced parameter is applicable only for upstream flows with a DocsQosSchedulingType of of unsolicitedGrantServiceWithAD(5) or unsolicitedGrantService(6), and 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-RFIv1.1-I10-037030, Appendix C.2.2.6.8"
 ::= { docsQosParamSetEntry 15 }

Reference
docsQosParamSetTosAndMask OBJECT-TYPE
SYNTAX            OCTET STRING (SIZE(1))
MAX-ACCESS        read-only
STATUS            current
DESCRIPTION       "Specifies the AND mask for IP TOS byte for
overwriting IP packets TOS value. The IP packets TOS
byte is bitwise ANDed with docsQosParamSetTosAndMask
and result is bitwise ORed with
docsQosParamSetTosOrMask and result is written to IP
packet TOS byte.
A value of 'FF’H for docsQosParamSetTosAndMask and
a value of ‘00’H for docsQosParamSetTosOrMask means
that 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 docsQosParamSetTosAndMask and
docsQosParamSetTosOrMask which would result in the
modification of the ECN bits.
In particular, operators should not use values of
docsQosParamSetTosAndMask which have either of the
least-significant two bits set to 0. Similarly,
operators should not use values of
docsQosParamSetTosOrMask which have either of the
least-significant two bits set to 1.
Even though the 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-RFIv1.1-I10-037030, 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."
::= { docsQosParamSetEntry 17 }

docsQosParamSetTosOrMask OBJECT-TYPE
SYNTAX            OCTET STRING (SIZE(1))
MAX-ACCESS        read-only
STATUS            current
DESCRIPTION       "Specifies the OR mask for IP TOS byte.

See the description of docsQosParamSetTosAndMask
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 docsQosParamSetTosAndMask and docsQosParamSetTosORMask which would result in the modification of the ECN bits.

REFERENCE
"SP-RFIv1.1-I10-037030, 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."

::= { docsQosParamSetEntry 18 }

docsQosParamSetMaxLatency 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 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-RFIv1.1-I10-037030, Appendix C.2.2.7.1"

::= { docsQosParamSetEntry 19 }

docsQosParamSetType 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-RFIv1.1-I10-037030, 8.1.5"

::= { docsQosParamSetEntry 20 }

docsQosParamSetRequestPolicyOct OBJECT-TYPE
SYNTAX     OCTET STRING (SIZE(4))
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.

Calling bit 0 the least significant bit of the least significant (4th) octet, and increasing bit number with significance, the bit definitions are as defined below:

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 mean that Service Flow must drop packet 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-RFIv1.1-I10-037030, Appendix C.2.2.6.3"
::= { docsQosParamSetEntry 21 }

docsQosParamSetBitMap 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 calls for default values to 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.

"::= { docsQosParamSetEntry 22 }

--
-- Service Flow Table
--
docsQosServiceFlowTable OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosServiceFlowEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table describes the set of DOCSIS-QOS Service Flows in a managed device."
 ::= { docsQosMIBObjects 3 }

docsQosServiceFlowEntry OBJECT-TYPE
SYNTAX DocsQosServiceFlowEntry
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, docsQosServiceFlowId
}
 ::= { docsQosServiceFlowTable 1 }
DocsQosServiceFlowEntry ::= SEQUENCE {
    docsQosServiceFlowId          Unsigned32,  
    docsQosServiceFlowSID         Unsigned32,  
    docsQosServiceFlowDirection   DocsQosRfMacIfDirection,  
    docsQosServiceFlowPrimary     TruthValue
}

docsQosServiceFlowId    OBJECT-TYPE
SYNTAX          Unsigned32 (1..4294967295)
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION    "An index assigned to a Service Flow by CMTS."
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.2.3.2"
 ::= { docsQosServiceFlowEntry 1 }

docsQosServiceFlowSID OBJECT-TYPE
SYNTAX          Unsigned32 (0..16383)
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION    "Service Identifier (SID) assigned to an admitted or active Service Flow. This 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-RFIv1.1-I10-037030, Appendix C.2.2.3.3"
 ::= { docsQosServiceFlowEntry 2 }

docsQosServiceFlowDirection OBJECT-TYPE
SYNTAX          DocsQosRfMacIfDirection
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION    "The direction of the Service Flow."
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.1.1/2"
 ::= { docsQosServiceFlowEntry 3 }

docsQosServiceFlowPrimary 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-RFIv1.1-I10-037030, Section 8.1"
 ::= { docsQosServiceFlowEntry 4 }

--

--  Service Flow Stats Table

Expires March 2005
docsQosServiceFlowStatsTable OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosServiceFlowStatsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table describes statistics associated with the Service Flows in a managed device."
::= { docsQosMIBObjects 4 }

DocsQosServiceFlowStatsEntry OBJECT-TYPE
SYNTAX DocsQosServiceFlowStatsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "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 {
  docsQosServiceFlowStatsTable1
}
::= { docsQosServiceFlowStatsTable1 1 }

DocsQosServiceFlowStatsEntry ::= SEQUENCE {
  docsQosServiceFlowPkts Counter64,
  docsQosServiceFlowOctets Counter64,
  docsQosServiceFlowTimeCreated TimeStamp,
  docsQosServiceFlowTimeActive Counter32,
  docsQosServiceFlowPHSUnknowns Counter32,
  docsQosServiceFlowPoliciedDropPkts Counter32,
  docsQosServiceFlowPoliciedDelayPkts Counter32
}

docsQosServiceFlowPkts 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 CMTS incoming upstream service flows, this object counts the number of Packets 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 Service Flows. 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 docsQosServiceFlowPolicedDelayPkts, but does not include packets counted by docsQosServiceFlowPolicedDropPkts and docsQosServiceFlowPHSUnknowns.

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

::= { docsQosServiceFlowStatsEntry 1 }

docsQosServiceFlowOctets 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 docsQosServiceFlowPkts object for this row. Note that this counts the octets after payload header suppression and before payload header expansion has been applied.

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

::= { docsQosServiceFlowStatsEntry 2 }

docsQosServiceFlowTimeCreated OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The value of sysUpTime when the service flow was created."

::= { docsQosServiceFlowStatsEntry 3 }

docsQosServiceFlowTimeActive OBJECT-TYPE
SYNTAX Counter32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of seconds that the service flow has been active."
This counter’s last discontinuity is the
ifCounterDiscontinuityTime for same ifIndex that
indexes this object.

::= { docsQosServiceFlowStatsEntry 4 }

docsQosServiceFlowPHSUnknowns OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "For CMTS incoming upstream 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 count 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 same ifIndex that
indexes this object.

::= { docsQosServiceFlowStatsEntry 5 }

docsQosServiceFlowPolicedDropPkt 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 interface of
this service flow. This object reports 0 for
incoming service flows.

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

docsQosServiceFlowPolicedDelayPkts 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 same ifIndex that
indexes this object."
 ::= { docsQosServiceFlowStatsEntry 7 }

--
-- Upstream Service Flow Stats Table (CMTS ONLY)
--

docsQosUpstreamStatsTable OBJECT-TYPE
SYNTAX          SEQUENCE OF DocsQosUpstreamStatsEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "This table describes statistics associated with
upstream service flows. All counted frames must
be received without an Frame Check Sequence (FCS)
error."
 ::= { docsQosMIBObjects 5 }

docsQosUpstreamStatsEntry OBJECT-TYPE
SYNTAX          DocsQosUpstreamStatsEntry
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,
   docsQosSID
}
 ::= { docsQosUpstreamStatsTable 1 }

DocsQosUpstreamStatsEntry ::= SEQUENCE {
   docsQosSID                            Unsigned32,
   docsQosUpstreamFragments              Counter32,
   docsQosUpstreamFragDiscards           Counter32,
}
docsQosUpstreamConcatBursts Counter32

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

docsQosUpstreamFragments 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 same ifIndex that indexes this object."
 ::= { docsQosUpstreamStatsEntry 2 }

docsQosUpstreamFragDiscards 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 same ifIndex that indexes this object."
 ::= { docsQosUpstreamStatsEntry 3 }

docsQosUpstreamConcatBursts 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 same ifIndex that indexes this object."
 ::= { docsQosUpstreamStatsEntry 4 }

--
-- Dynamic Service Stats Table

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

docsQosDynamicServiceStatsEntry OBJECT-TYPE
SYNTAX       DocsQosDynamicServiceStatsEntry
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,
   docsQosIfDirection
}
::= { docsQosDynamicServiceStatsTable 1 }

DocsQosDynamicServiceStatsEntry ::= SEQUENCE {
   docsQosIfDirection                         DocsQosRfMacIfDirection,
   docsQosDSAReqs                              Counter32,
   docsQosDSARsps                              Counter32,
   docsQosDSAACKs                              Counter32,
   docsQosDSACKs                               Counter32,
   docsQosDSCReqs                              Counter32,
   docsQosDSRsp                                Counter32,
   docsQosDSCacks                              Counter32,
   docsQosDSReq                                Counter32,
   docsQosDSRsp                                Counter32,
   docsQosDynamicAdds                         Counter32,
   docsQosDynamicAddFails                      Counter32,
   docsQosDynamicChanges                      Counter32,
   docsQosDynamicChangeFails                   Counter32,
   docsQosDynamicDeletes                      Counter32,
   docsQosDynamicDeleteFails                   Counter32,
   docsQosDCCReqs                              Counter32,
}

Expires March 2005
docsQosDCCRsps OBJECT-TYPE
SYNTAXOBJECT-TYPE
Counter32,
docsQosDCCAcks OBJECT-TYPE
Counter32,
docsQosDCCs OBJECT-TYPE
Counter32,
docsQosDCCFails OBJECT-TYPE
Counter32
}
docsQosIfDirection OBJECT-TYPE
SYNTAXDocsQosRfMacIfDirection
MAX-ACCESSnot-accessible
STATUScurrent
DESCRIPTION"The direction of interface."
::= { docsQosDynamicServiceStatsEntry 1 }
docsQosDSAReqs OBJECT-TYPE
SYNTAXCounter32
MAX-ACCESSread-only
STATUScurrent
DESCRIPTION"The number of Dynamic Service Addition Requests,
including retries.
This counter’s last discontinuity is the
ifCounterDiscontinuityTime for same ifIndex that
indexes this object."
::= { docsQosDynamicServiceStatsEntry 2 }
docsQosDSARsps OBJECT-TYPE
SYNTAXCounter32
MAX-ACCESSread-only
STATUScurrent
DESCRIPTION"The number of Dynamic Service Addition Responses,
including retries.
This counter’s last discontinuity is the
ifCounterDiscontinuityTime for same ifIndex that
indexes this object."
::= { docsQosDynamicServiceStatsEntry 3 }
docsQosDSAAcks OBJECT-TYPE
SYNTAXCounter32
MAX-ACCESSread-only
STATUScurrent
DESCRIPTION"The number of Dynamic Service Addition
Acknowledgements, including retries.
This counter’s last discontinuity is the
ifCounterDiscontinuityTime for same ifIndex that
indexes this object."
::= { docsQosDynamicServiceStatsEntry 4 }
docsQosDSCReqs OBJECT-TYPE
SYNTAXCounter32
MAX-ACCESSread-only
STATUScurrent
DESCRIPTION"The number of Dynamic Service Addition Requests,
including retries.
This counter’s last discontinuity is the
ifCounterDiscontinuityTime for same ifIndex that
indexes this object."
::= { docsQosDynamicServiceStatsEntry 5 }
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 same ifIndex that indexes this object."
::= { docsQosDynamicServiceStatsEntry 5 }

docsQosDSCRsp 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 same ifIndex that indexes this object."
::= { docsQosDynamicServiceStatsEntry 6 }

docsQosDSCAck 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 same ifIndex that indexes this object."
::= { docsQosDynamicServiceStatsEntry 7 }

docsQosDSDReq 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 same ifIndex that indexes this object."
::= { docsQosDynamicServiceStatsEntry 8 }

docsQosDSDRsp 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 same ifIndex that
indexes this object.

::= { docsQosDynamicServiceStatsEntry 9 }

docsQosDynamicAdds 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 same ifIndex that
indexes this object.

::= { docsQosDynamicServiceStatsEntry 10 }

docsQosDynamicAddFails 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 same ifIndex that
indexes this object.

::= { docsQosDynamicServiceStatsEntry 11 }

docsQosDynamicChanges 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 same ifIndex that
indexes this object.

::= { docsQosDynamicServiceStatsEntry 12 }

docsQosDynamicChangeFails 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
Expires March 2005                                 [Page 58]
ifCounterDiscontinuityTime for same ifIndex that indexes this object.

::= { docsQosDynamicServiceStatsEntry 13 }

docsQosDynamicDeletes 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 same ifIndex that indexes this object."

::= { docsQosDynamicServiceStatsEntry 14 }

docsQosDynamicDeleteFails 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 same ifIndex that indexes this object."

::= { docsQosDynamicServiceStatsEntry 15 }

docsQosDCCReqs OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of Dynamic Channel Change Request messages traversing an interface. This count is nonzero only on downstream direction rows. This count should include number of retries.

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

::= { docsQosDynamicServiceStatsEntry 16 }

docsQosDCCRsp 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 number of retries.
This counter's last discontinuity is the ifCounterDiscontinuityTime for same ifIndex that indexes this object.

::= { docsQosDynamicServiceStatsEntry 17 }

**docsQosDCCAcks** OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of Dynamic Channel Change Acknowledgement messages traversing an interface. This count is nonzero only on downstream direction rows. This count should include number of retries.

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

::= { docsQosDynamicServiceStatsEntry 18 }

**docsQosDCCs** 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 same ifIndex that indexes this object."

::= { docsQosDynamicServiceStatsEntry 19 }

**docsQosDCCFails** OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of failed Dynamic Channel Change transactions. This count is nonzero only on downstream direction rows.

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

::= { docsQosDynamicServiceStatsEntry 20 }

--
-- Service Flow Log Table (CMTS ONLY)
--
**docsQosServiceFlowLogTable** OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosServiceFlowLogEntry

Expires March 2005
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "This table contains a log of the disconnected
Service Flows in a managed device."
::= { docsQosMIBObjects 7 }
docsQosServiceFlowLogEntry OBJECT-TYPE
SYNTAX          DocsQosServiceFlowLogEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "The information regarding a single disconnected
service flow."
INDEX {
   docsQosServiceFlowLogIndex
}
::= { docsQosServiceFlowLogTable 1 }
DocsQosServiceFlowLogEntry ::= SEQUENCE {
   docsQosServiceFlowLogIndex                 Unsigned32,
docsQosServiceFlowLogIfIndex               InterfaceIndex,
docsQosServiceFlowLogSFID                  Unsigned32,
docsQosServiceFlowLogCmMac                 MacAddress,
docsQosServiceFlowLogPkts                  Counter64,
docsQosServiceFlowLogOctets                Counter64,
docsQosServiceFlowLogTimeDeleted           TimeStamp,
docsQosServiceFlowLogTimeCreated           TimeStamp,
docsQosServiceFlowLogTimeActive            Counter32,
docsQosServiceFlowLogDirection             DocsQosRfMacIfDirection,
docsQosServiceFlowLogPrimary               TruthValue,
docsQosServiceFlowLogServiceClassName      SnmpAdminString,
docsQosServiceFlowLogPolicedDropPkts       Counter32,
docsQosServiceFlowLogPolicedDelayPkts      Counter32,
docsQosServiceFlowLogControl               INTEGER
}
docsQosServiceFlowLogIndex OBJECT-TYPE
SYNTAX          Unsigned32 (1..4294967295)
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "Unique index for a logged service flow."
::= { docsQosServiceFlowLogEntry 1 }
docsQosServiceFlowLogIfIndex 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."
::= { docsQosServiceFlowLogEntry 2 }
docsQosServiceFlowLogSFID OBJECT-TYPE

Expires March 2005 [Page 61]
SYNTAX    Unsigned32 (1..4294967295)
MAX-ACCESS read-only
STATUS    current
DESCRIPTION "The index assigned to the service flow by the CMTS."
::= { docsQosServiceFlowLogEntry 3 }

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

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

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

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

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

docsQosServiceFlowLogTimeActive OBJECT-TYPE
SYNTAX    Counter32
UNITS     "seconds"
MAX-ACCESS read-only
STATUS    current
DESCRIPTION  "The total time that service flow was active."
::= { docsQosServiceFlowLogEntry 9 }

docsQosServiceFlowLogDirection OBJECT-TYPE
SYNTAX   DocsQosRfMacIfDirection
MAX-ACCESS read-only
STATUS    current
DESCRIPTION  "The value of docsQosServiceFlowDirection for the service flow."
::= { docsQosServiceFlowLogEntry 10 }

docsQosServiceFlowLogPrimary OBJECT-TYPE
SYNTAX   TruthValue
MAX-ACCESS read-only
STATUS    current
DESCRIPTION  "The value of docsQosServiceFlowPrimary for the service flow."
::= { docsQosServiceFlowLogEntry 11 }

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

docsQosServiceFlowLogPolicedDropPkts OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION  "The final value of docsQosServiceFlowPolicedDropPkts for the service flow."
::= { docsQosServiceFlowLogEntry 13 }

docsQosServiceFlowLogPolicedDelayPkts OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION  "The final value of docsQosServiceFlowPolicedDelayPkts for the service flow."
::= { docsQosServiceFlowLogEntry 14 }

docsQosServiceFlowLogControl 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 return the value active(1)."
 ::= { docsQosServiceFlowLogEntry 15 }

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

docsQosServiceClassEntry OBJECT-TYPE
SYNTAX          DocsQosServiceClassEntry
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
docsQosServiceClassDirection object.
"

INDEX {
   docsQosServiceClassName
}
 ::= { docsQosServiceClassTable 1 }

DocsQosServiceClassEntry ::= SEQUENCE {
   docsQosServiceClassName               SnmpAdminString,
   docsQosServiceClassStatus             RowStatus,
   docsQosServiceClassPriority           Integer32,
   docsQosServiceClassMaxTrafficRate     DocsQosBitRate,
   docsQosServiceClassMaxTrafficBurst    Unsigned32,
   docsQosServiceClassMinReservedRate    DocsQosBitRate,
docsQosServiceClassMinReservedPkt     Integer32,
docsQosServiceClassMaxConcatBurst     Integer32,
docsQosServiceClassNomPollInterval    Unsigned32,
docsQosServiceClassTolPollJitter     Unsigned32,
docsQosServiceClass unsolicitGrantSize     Integer32,
docsQosServiceClassNomGrantInterval   Unsigned32,
docsQosServiceClassTolGrantJitter    Unsigned32,
docsQosServiceClassGrantsPerInterval  Integer32,
docsQosServiceClassMaxLatency        Unsigned32,
docsQosServiceClassActiveTimeout     Integer32,
docsQosServiceClassAdmittedTimeout    Integer32,
docsQosServiceClassSchedulingType    DocsQosSchedulingType,
docsQosServiceClassRequestPolicy     OCTET STRING,
docsQosServiceClassTosAndMask        OCTET STRING,
docsQosServiceClassTosOrMask         OCTET STRING,
docsQosServiceClassDirection         DocsQosRfMacIfDirection,
docsQosServiceClassStorageType       StorageType,
docsQosServiceClassDSCPOverwrite     DscpOrAny

}
SYNTAX         DocsQosBitRate
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetMaxTrafficRate."
DEFVAL         { 0 }
 ::= ( docsQosServiceClassEntry 4 )

docsQosServiceClassMaxTrafficBurst OBJECT-TYPE
SYNTAX         Unsigned32
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetMaxTrafficBurst."
DEFVAL         { 3044 }
 ::= ( docsQosServiceClassEntry 5 )

docsQosServiceClassMinReservedRate OBJECT-TYPE
SYNTAX         DocsQosBitRate
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetMinReservedRate."
DEFVAL         { 0 }
 ::= ( docsQosServiceClassEntry 6 )

docsQosServiceClassMinReservedPkt OBJECT-TYPE
SYNTAX         Integer32 (0..65535)
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetMinReservedPkt."
 ::= ( docsQosServiceClassEntry 7 )

docsQosServiceClassMaxConcatBurst OBJECT-TYPE
SYNTAX         Integer32 (0..65535)
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetMaxConcatBurst."
DEFVAL         { 1522 }
 ::= ( docsQosServiceClassEntry 8 )

docsQosServiceClassNomPollInterval OBJECT-TYPE
SYNTAX         Unsigned32
UNITS          "microseconds"
MAX-ACCESS     read-create
STATUS         current
DESCRIPTION    "Template for docsQosParamSetNomPollInterval."
DEFVAL         { 0 }
 ::= ( docsQosServiceClassEntry 9 )

docsQosServiceClassTolPollJitter OBJECT-TYPE
SYNTAX         Unsigned32
UNITS          "microseconds"
MAX-ACCESS     read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetTolPollJitter."
DEFVAL { 0 }
::= { docsQosServiceClassEntry 10 }

docsQosServiceClassUnsolicitGrantSize OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetUnsolicitGrantSize."
DEFVAL { 0 }
::= { docsQosServiceClassEntry 11 }

docsQosServiceClassNomGrantInterval OBJECT-TYPE
SYNTAX Unsigned32
UNITS "microseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetNomGrantInterval."
DEFVAL { 0 }
::= { docsQosServiceClassEntry 12 }

docsQosServiceClassTolGrantJitter OBJECT-TYPE
SYNTAX Unsigned32
UNITS "microseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetTolGrantJitter."
DEFVAL { 0 }
::= { docsQosServiceClassEntry 13 }

docsQosServiceClassGrantsPerInterval OBJECT-TYPE
SYNTAX Integer32 (0..127)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetGrantsPerInterval."
DEFVAL { 0 }
::= { docsQosServiceClassEntry 14 }

docsQosServiceClassMaxLatency OBJECT-TYPE
SYNTAX Unsigned32
UNITS "microseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetClassMaxLatency."
REFERENCE "SP-RFIv1.1-I10-037030, Appendix C.2.2.7.1"
DEFVAL { 0 }
::= { docsQosServiceClassEntry 15 }

docsQosServiceClassActiveTimeout OBJECT-TYPE
SYNTAX Integer32 (0..65535)

Expires March 2005
UNITS "seconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetActiveTimeout."
DEFVAL { 0 }
 ::= { docsQosServiceClassEntry 16 }

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

docsQosServiceClassSchedulingType OBJECT-TYPE
SYNTAX DocsQosSchedulingType
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Template for docsQosParamSetSchedulingType."
DEFVAL { bestEffort }
 ::= { docsQosServiceClassEntry 18 }

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

docsQosServiceClassTosAndMask OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(1))
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Template for docsQosParamSetTosAndMask."
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 docsQosServiceClassTosAndMask and docsQosServiceClassTosOrMask which would result in the modification of the ECN bits.

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

REFERENCE
"SP-RFIv1.1-I10-037030, 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."

::= { docsQosServiceClassEntry 20 }

docsQosServiceClassTosOrMask OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(1))
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Template for docsQosParamSetTosOrMask.
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 docsQosServiceClassTosAndMask and
docsQosServiceClassTosOrMask which would result in
the modification of the ECN bits.

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

REFERENCE
"SP-RFIv1.1-I10-037030, 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."

::= { docsQosServiceClassEntry 21 }

docsQosServiceClassDirection OBJECT-TYPE
SYNTAX DocsQosRfMacIfDirection
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Specifies whether the service class template
applies to upstream or downstream service flows."
DEFVAL { upstream }
::= { docsQosServiceClassEntry 22 }

docsQosServiceClassStorageType 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 if this
row is backed up by non-volatile or permanent
storage. 'permanent' entries need not allow writable access to any object."

DEFVAL { nonVolatile } ::= { docsQosServiceClassEntry 23 }

docsQosServiceClassDSCPOverwrite 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 than the corresponding entry’s docsQosServiceClassTosAndMask value MUST be 'FF'H and docsQosServiceClassTosOrMask MUST be '00'H. Otherwise, this object is in the range of 0..63 and the corresponding entry’s docsQosServiceClassTosAndMask value MUST be '03'H and the docsQosServiceClassTosOrMask MUST be this object’s value shifted left by two bit positions."


DEFVAL        { -1 } ::= { docsQosServiceClassEntry 24 }

--
-- Service Class PolicyTable
--

docsQosServiceClassPolicyTable OBJECT-TYPE
SYNTAX       SEQUENCE OF DocsQosServiceClassPolicyEntry
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 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-RFIv1.1-I10-037030, Appendix E.2.1"
 ::= { docsQosMIBObjects 9 }

docsQosServiceClassPolicyEntry OBJECT-TYPE
SYNTAX          DocsQosServiceClassPolicyEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "A service class name policy entry."
INDEX {
    docsQosServiceClassPolicyIndex
}
::= { docsQosServiceClassPolicyTable 1 }

DocsQosServiceClassPolicyEntry ::= SEQUENCE {
    docsQosServiceClassPolicyIndex        Unsigned32,
    docsQosServiceClassPolicyName         SnmpAdminString,
    docsQosServiceClassPolicyRulePriority Integer32,
    docsQosServiceClassPolicyStatus       RowStatus,
    docsQosServiceClassPolicyStorageType  StorageType
}

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

docsQosServiceClassPolicyName 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-RFIv1.1-I10-037030, Appendix E.2.1"
::= { docsQosServiceClassPolicyEntry 2 }

docsQosServiceClassPolicyRulePriority OBJECT-TYPE
SYNTAX          Integer32 (0..255)
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION    "Service Class Policy rule priority for the
entry."
REFERENCE      "SP-RFIv1.1-I10-037030, Appendix C.2.1.3.5"
::= { docsQosServiceClassPolicyEntry 3 }

docsQosServiceClassPolicyStatus 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
reference 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."

::= { docsQosServiceClassPolicyEntry 4 }

docsQosServiceClassPolicyStorageType 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 if this
row is backed up by non-volatile or permanent
storage. 'permanent' entries need not allow
writable access to any object."
DEFVAL { nonVolatile }
::= { docsQosServiceClassPolicyEntry 5 }

--
-- Payload Header Suppression (PHS) Table
--
docsQosPHSTable OBJECT-TYPE
SYNTAX SEQUENCE OF DocsQosPHSEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table describes set of payload header
suppression entries."
::= { docsQosMIBObjects 10 }
docsQosPHSEntry OBJECT-TYPE
SYNTAX DocsQosPHSEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A payload header suppression entry.
The ifIndex is an ifType of docsCableMaclayer(127).
The index docsQosServiceFlowId selects one
service flow from the cable MAC layer interface.
The docsQosPktClassId index matches an
index of the docsQosPktClassTable.
"
INDEX {
    ifIndex,
    docsQosServiceFlowId,
    docsQosPktClassId
}
::= { docsQosPHSTable 1 }

DocsQosPHSEntry ::= SEQUENCE {
    docsQosPHSField          OCTET STRING,
    docsQosPHSMask           OCTET STRING,
    docsQosPHSSize           Integer32,

Expires March 2005
docsQosPHSVerify  TruthValue,
docsQosPHSIndex  Integer32
}

docsQosPHSField  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 which must be suppressed/restored by the sending/receiving device.

The number of octets in this object should be the same as the value of docsQosPHSSize."
REFERENCE  "SP-RFIv1.1-I10-037030, Appendix C.2.2.10.1"
::= { docsQosPHSEntry 1 }

docsQosPHSMask  OBJECT-TYPE
SYNTAX  OCTET STRING (SIZE(0..32))
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION  "Payload header suppression mask defines the bit mask which used in combination with the docsQosPHSField defines which bytes in header must be suppressed/restored by the sending or receiving device.

Each bit of this bit mask corresponds to a byte in the docsQosPHSField, with the least significant bit corresponding to first byte of the docsQosPHSField.

Each bit of the bit mask specifies whether of not the corresponding byte should be suppressed in the packet. A bit value of ‘1’ indicates that the byte should be suppressed by the sending device and restored by the receiving device. A bit value of ‘0’ indicates that the byte should not be suppressed by the sending device or restored by the receiving device.

If the bit mask does not contain a bit for each byte in the docsQosPHSField then the bit mask is extended with bit values of ‘1’ to be the necessary length."
REFERENCE  "SP-RFIv1.1-I10-037030, Appendix C.2.2.10.3"
::= { docsQosPHSEntry 2 }

docsQosPHSSize  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 docsQosPHSField."
REFERENCE       "SP-RFIv1.1-I10-037030, Appendix C.2.2.10.4"
 ::= { docsQosPHSEntry 3 }

-- docsQosCmtsMacToSrvFlowTable (CMTS Only)
--
docsQosCmtsMacToSrvFlowTable OBJECT-TYPE
SYNTAX          SEQUENCE OF DocsQosCmtsMacToSrvFlowEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION    "This table provide for referencing the service
flows associated with a particular cable modem. This
allows for indexing into other docsQos tables that are indexed by docsQosServiceFlowId
and ifIndex."
 ::= { docsQosMIBObjects 11 }
docsQosCmtsMacToSrvFlowEntry OBJECT-TYPE
SYNTAX          DocsQosCmtsMacToSrvFlowEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION    "An entry is created by CMTS for each service flow
INDEX {
    docsQosCmtsCmMac,
    docsQosCmtsServiceFlowId
} ::= { docsQosCmtsMacToSrvFlowTable 1 }

DocsQosCmtsMacToSrvFlowEntry ::= SEQUENCE {
    docsQosCmtsCmMac                MacAddress,
    docsQosCmtsServiceFlowId        Unsigned32,
    docsQosCmtsIfIndex              InterfaceIndex
}

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

docsQosCmtsServiceFlowId OBJECT-TYPE
SYNTAX          Unsigned32 (1..4294967295)
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION    "An index assigned to a service flow by CMTS."
 ::= { docsQosCmtsMacToSrvFlowEntry 2 }

docsQosCmtsIfIndex 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."
 ::= { docsQosCmtsMacToSrvFlowEntry 3 }

--
-- Placeholder for notifications/traps.
--
docsQosNotification OBJECT IDENTIFIER ::= { docsQosMIB 2 }

--
-- Conformance definitions
--
docsQosConformance OBJECT IDENTIFIER ::= { docsQosMIB 3 }
docsQosGroups OBJECT IDENTIFIER ::= { docsQosConformance 1 }
docsQosCompliances OBJECT IDENTIFIER ::= { docsQosConformance 2 }
docsQosCompliance MODULE-COMPLIANCE
    STATUS    current

Expires March 2005
DESCRIPTION
"The compliance statement for MCNS Cable Modems and Cable Modem Termination Systems that implement DOCSIS Service Flows."

MODULE -- docsQosMIB
MANDATORY-GROUPS { docsQosBaseGroup }

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

GROUP docsQosParamSetGroup
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 docsQosSrvClassPolicyGroup
DESCRIPTION
"This group is optional for Cable Modem Termination Systems (CMTS) and Cable Modems. This group only needs to be implement if policy based service flow classification is implemented. See docsDevPolicyTable in DOCS-CABLE-DEVICE-MIB for more details."

GROUP docsQosServiceClassGroup
DESCRIPTION
"The docsQosServiceClassTable group of objects."

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

OBJECT docsQosPktClassInetAddressType
SYNTAX InetAddressType { ipv4(1) }
DESCRIPTION
"An implementation is only required to support IPv4 address."

OBJECT docsQosPktClassInetSourceAddr
SYNTAX InetAddress (SIZE(4))
DESCRIPTION
"An implementation is only required to support IPv4 address."

OBJECT docsQosPktClassInetSourceMask
SYNTAX InetAddress (SIZE(4))
DESCRIPTION
"An implementation is only required to support IPv4 address."

OBJECT  docsQosPktClassInetDestAddr
SYNTAX InetAddress (SIZE(4))
DESCRIPTION
"An implementation is only required to support IPv4 address."

OBJECT  docsQosPktClassInetDestMask
SYNTAX InetAddress (SIZE(4))
DESCRIPTION
"An implementation is only required to support IPv4 address."

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

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

::= { docsQosCompliances 1 }

docsQosBaseGroup OBJECT-GROUP
OBJECTS {
docsQosPktClassDirection,
docsQosPktClassPriority,
docsQosPktClassIpTosLow,
docsQosPktClassIpTosHigh,
docsQosPktClassIpTosMask,
docsQosPktClassIpProtocol,
docsQosPktClassSourcePortStart,
docsQosPktClassSourcePortEnd,
docsQosPktClassDestPortStart,
docsQosPktClassDestPortEnd,
docsQosPktClassDestMacAddr,
docsQosPktClassDestMacMask,
docsQosPktClassSourceMacAddr,
docsQosPktClassEnetProtocolType,
docsQosPktClassEnetProtocol,
docsQosPktClassUserPriLow,
docsQosPktClassUserPriHigh,
docsQosPktClassVlanId,
docsQosPktClassStateActive,
docsQosPktClassPkts,
docsQosPktClassBitMap,
docsQosPktClassInetAddressType,
docsQosPktClassInetSourceAddr,
docsQosPktClassInetSourceMask,
docsQosPktClassInetDestAddr,
docsQosPktClassInetDestMask,

docsQosServiceFlowSID,
docsQosServiceFlowDirection,
docsQosServiceFlowPrimary,

docsQosServiceFlowPktts, -- not sure if CM should implement
docsQosServiceFlowOctets,
docsQosServiceFlowTimeCreated,
docsQosServiceFlowTimeActive,
docsQosServiceFlowPHSUn-knowns,
docsQosServiceFlowPolicedDropPktts,
docsQosServiceFlowPolicedDelayPktts,

docsQosDSAReqs,
docsQosDSARsps,
docsQosDSAcks,
docsQosDSRReqs,
docsQosDSRrsps,
docsQosDSRAcks,
docsQosDSRAcks,
docsQosDSRrsps,
docsQosDynamicAdds,
docsQosDynamicAddFails,
docsQosDynamicChanges,
docsQosDynamicChangeFails,
docsQosDynamicDeleteFails,
docsQosDCCReqs,
docsQosDCCRrsps,
docsQosDCCAcks,
docsQosDCCs,
docsQosDCCFails,

docsQosPHSField,
docsQosPHSMask,
docsQosPHSSize,
docsQosPHSVerify,
docsQosPHSIndex

}  

STATUS current

DESCRIPTION

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

::= { docsQosGroups 1 }
docsQosParamSetGroup OBJECT-GROUP
  OBJECTS {
    docsQosParamSetServiceClassName,
    docsQosParamSetPriority,
    docsQosParamSetMaxTrafficRate,
    docsQosParamSetMaxTrafficBurst,
    docsQosParamSetMinReservedRate,
    docsQosParamSetMinReservedPkt,
    docsQosParamSetActiveTimeout,
    docsQosParamSetAdmittedTimeout,
    docsQosParamSetMaxConcatBurst,
    docsQosParamSetSchedulingType,
    docsQosParamSetNomPollInterval,
    docsQosParamSetTolPollJitter,
    docsQosParamSetUnsolicitGrantSize,
    docsQosParamSetNomGrantInterval,
    docsQosParamSetTolGrantJitter,
    docsQosParamSetGrantsPerInterval,
    docsQosParamSetTosAndMask,
    docsQosParamSetTosOrMask,
    docsQosParamSetMaxLatency,
    docsQosParamSetRequestPolicyOct,
    docsQosParamSetBitMap
  }
STATUS current
DESCRIPTION
  "Group of objects implemented in both Cable Modems and
  Cable Modem Termination Systems for QOS parameter sets."
::= { docsQosGroups 2 }

docsQosCmtsGroup OBJECT-GROUP
  OBJECTS {
    docsQosUpstreamFragments,
    docsQosUpstreamFragDiscards,
    docsQosUpstreamConcatBursts,
    docsQosServiceFlowLogIfIndex,
    docsQosServiceFlowLogSFID,
    docsQosServiceFlowLogCmMac,
    docsQosServiceFlowLogPkts,
    docsQosServiceFlowLogOctets,
    docsQosServiceFlowLogTimeDeleted,
    docsQosServiceFlowLogTimeCreated,
    docsQosServiceFlowLogTimeActive,
    docsQosServiceFlowLogDirection,
    docsQosServiceFlowLogPrimary,
    docsQosServiceFlowLogServiceClassName,
    docsQosServiceFlowLogPolicedDropPkts,
    docsQosServiceFlowLogPolicedDelayPkts,
docsQosServiceFlowLogControl,

docsQosCmtsIfIndex -- docsQosCmtsMacToSrvFlowTable required

}  
STATUS  current
DESCRIPTION
"Mandatory group of objects implemented only in the CMTS."
::= { docsQosGroups 3 }

docsQosSrvClassPolicyGroup OBJECT-GROUP
OBJECTS {
  docsQosServiceClassPolicyName,
  docsQosServiceClassPolicyRulePriority,
  docsQosServiceClassPolicyStatus,
  docsQosServiceClassPolicyStorageType
}  
STATUS  current
DESCRIPTION
"Group of objects implemented in both Cable Modems and
Cable Modem Termination Systems when supporting policy based
service flows."
::= { docsQosGroups 4 }

docsQosServiceClassGroup OBJECT-GROUP
OBJECTS {
  docsQosServiceClassStatus,
  docsQosServiceClassPriority,
  docsQosServiceClassMaxTrafficRate,
  docsQosServiceClassMaxTrafficBurst,
  docsQosServiceClassMinReservedRate,
  docsQosServiceClassMinReservedPkt,
  docsQosServiceClassMaxConcatBurst,
  docsQosServiceClassNomPollInterval,
  docsQosServiceClassTolPollJitter,
  docsQosServiceClassUnsolicitGrantSize,
  docsQosServiceClassNomGrantInterval,
  docsQosServiceClassTolGrantJitter,
  docsQosServiceClassGrantsPerInterval,
  docsQosServiceClassMaxLatency,
  docsQosServiceClassActiveTimeout,
  docsQosServiceClassAdmittedTimeout,
  docsQosServiceClassSchedulingType,
  docsQosServiceClassRequestPolicy,
  docsQosServiceClassTosAndMask,
  docsQosServiceClassTosOrMask,
  docsQosServiceClassDirection,
  docsQosServiceClassStorageType,
  docsQosServiceClassDSCPOverwrite
}  
STATUS  current
DESCRIPTION
"The docsQosServiceClassTable objects. If a CMTS implements expansion of Service Class Names in a QOS Parameter Set, this group is mandatory on the CMTS. If the CMTS does not support Service Class Names, this group may be unimplemented in the CMTS. This group is not implemented on the CM."

::= { docsQosGroups 5 }

END
6. Security Considerations

This MIB module relates to an agent which 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 [9]. Manipulation of the docsQosServiceClassTable and docsQosServiceClassPolicyTable may allow an end-user to increase their service levels, or affect other end-users in either a positive or negative manner. In addition, manipulation of docsQosServiceFlowLogControl 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:

- The docsQosServiceClassTable 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 unauthorized class of service.

- The docsQosServiceClassPolicyTable 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 grant the attacker unauthorized forwarding policies.

- The docsQosServiceFlowLogControl object controls the deletion of entries in the docsQosServiceFlowLogTable, 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:

- Unauthorized SNMP GET access of the docsQosPktClassTable or
docsQosPHSTable 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.

- Unauthorized SNMP GET access of the docsQosParamSetTable allows an attacker to learn the names of Service Classes which 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.

- Unauthorized SNMP GET access of the docsQosServiceFlowTable 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 docsQosServiceFlowStatsTable, docsQosUpstreamStatsTable, docsQosDynamicServiceStatsTable, docsQosServiceFlogLogTable, and docsQosCmtsMacToSrvFlowTable 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 [19], 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 ---------
|----------------|----------------------------------
|----------------|----------------------------------
| docsQosMIB     | { docsIfMib xx }                 |

Editor’s Note (to be removed prior to publication): the IANA is
requested to assign a value for yy under the docsIfMib subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace yy (here and in the MIB module) with the assigned value and to remove this note.

8. Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

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

9. Normative References


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Expires March 2005


10. Informative References

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