                   Management Information Base for the
                   Differentiated Services Architecture

Status of this Memo

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Abstract

   This memo describes an SMIv2 (Structure of Management Information
   version 2) MIB for a device implementing the Differentiated Services
   Architecture. It may be used both for monitoring and configuration
   of a router or switch capable of Differentiated Services
   functionality.

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1. The SNMP Management Framework

   The SNMP Management Framework presently consists of five major
   components:

      o An overall architecture, described in [RFC 2571].

      o Mechanisms for describing and naming objects and events for the
         purpose of management. The first version of this Structure of
         Management Information (SMI) is called SMIv1 and is described
         in [RFC 1155], [RFC 1212] and [RFC 1215]. The second version,
         called SMIv2, is described in [RFC 2578], RFC 2579 [RFC 2579]
         and [RFC 2580].

      o Message protocols for transferring management information. The
         first version of the SNMP message protocol is called SNMPv1 and
         is described in [RFC 1157]. A second version of the SNMP
         message protocol, which is not an Internet standards track
         protocol, is called SNMPv2c and is described in [RFC 1901] and
         [RFC 1906]. The third version of the message protocol is
         called SNMPv3 and is described in [RFC 1906], [RFC 2572] and
         [RFC 2574].

      o Protocol operations for accessing management information. The
         first set of protocol operations and associated PDU formats is
         described in [RFC 1157]. A second set of protocol operations
         and associated PDU formats is described in [RFC 1905].

      o A set of fundamental applications described in [RFC 2573] and
         the view-based access control mechanism described in [RFC
         2575].

   A more detailed introduction to the current SNMP Management Framework
   can be found in [RFC 2570].

   Managed objects are accessed via a virtual information store, termed
   the Management Information Base or MIB. Objects in the MIB are
   defined using the mechanisms defined in the SMI.

   This memo specifies a MIB module that is compliant to the SMIv2. A
   MIB conforming to the SMIv1 can be produced through the appropriate
   translations. The resulting translated MIB must be semantically
   equivalent, except where objects or events are omitted because there
   is no translation is possible (use of Counter64). Some machine-
   readable information in SMIv2 will be converted into textual
   descriptions in SMIv1 during the translation process. However, this
   loss of machine readable information is not considered to change the
   semantics of the MIB.

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

2. Relationship to other working group documents

   The Differentiated Services Working Group and related working groups
   developed other documents, notably the Informal Management Model and
   the policy configuration paradigm of SNMPCONF. The relationship
   between the MIB and those documents is clarified here.

2.1. Relationship to the Informal Management Model for Differentiated
      Services Router

   This MIB is similar in design to [MODEL], although it can be used to
   build functional data paths that the model would not well describe.
   The model conceptually describes ingress and egress interfaces of an
   n-port router, which may find some interfaces at a network edge and
   others facing into the network core. It describes the configuration
   and management of a Differentiated Services interface in terms of one
   or more Traffic Conditioning Blocks (TCB), each containing, arranged
   in the specified order, by definition, zero or more classifiers,
   meters, actions, algorithmic droppers, queues and schedulers.
   Traffic may be classified, and classified traffic may be metered.
   Each stream of traffic identified by a combination of classifiers and
   meters may have some set of actions performed on it; it may have
   dropping algorithms applied and it may ultimately be stored into a
   queue before being scheduled out to its next destination, either onto
   a link or to another TCB. At times, the treatment for a given packet
   must have any of those elements repeated. [MODEL] models this by
   cascading multiple TCBs, while this MIB describes the policy by
   directly linking the functional data path elements.

   The MIB represents this cascade by following the "Next" attributes of
   the various elements. They indicate what the next step in
   Differentiated Services processing will be, whether it be a
   classifier, meter, action, algorithmic dropper, queue, scheduler or a
   decision to now forward a packet.

   The higher level concept of a TCB is not required in the
   parameterization or in the linking together of the individual
   elements, hence it is not used in the MIB itself and is only
   mentioned in the text for relating the MIB with the [MODEL]. Rather,
   the MIB models the individual elements that make up the TCBs.

   This MIB uses the notion of a Data Path to indicate the
   Differentiated Services processing a packet may experience. The Data
   Path a packet will initially follow is an attribute of the interface

in question. The Data Path Table provides a starting point for each
direction (ingress or egress) on each interface. A Data Path Table
Entry indicates the first of possible multiple elements that will
apply Differentiated Services treatment to the packet.

2.2. Relationship to other MIBs and Policy Management

This MIB provides for direct reporting and manipulation of detailed
functional elements. These elements consist of a structural element
and one or more parameter-bearing elements. While this can be
cumbersome, it allows the reuse of parameters. For example, a
service provider may offer three varieties of contracts, and
configure three parameter elements. Each such data path on the
system may then refer to these sets of parameters. The
diffServDataPathTable couples each direction on each interface with
the specified data path linkage. The concept of "interface" is as
defined by InterfaceIndex/ifIndex of the IETF Interfaces MIB [IF-
MIB].

Other MIBs and data structure definitions for policy management
mechanisms, other than SNMP/SMIv2 are likely to exist in the future
for the purpose of abstracting the model in other ways. An example
is the Differentiated Services Policy Information Base, [DSPIB].

In particular, abstractions in the direction of less detailed
definitions of Differentiated Services functionality are likely e.g.
some form of "Per-Hop Behavior"-based definition involving a template
of detailed object values which is applied to specific instances of
objects in this MIB semi-automatically.

Another possible direction of abstraction is one using a concept of
"roles" (often, but not always, applied to interfaces). In this
case, it may be possible to re-use the object definitions in this
MIB, especially the parameterization tables. The Data Path table
will help in the reuse of the data path linkage tables by having the
interface specific information centralized, allowing easier
mechanical replacement of ifIndex by some sort of "roleIndex". This
work is ongoing.

The reuse of parameter blocks on a variety of functional data paths
is intended to simplify network management. In many cases, one could
also re-use the structural elements as well; this has the unfortunate
side-effect of re-using the counters, so that monitoring information
is lost. For this reason, the re-use of structural elements is not
generally recommended.

3. MIB Overview

   The Differentiated Services Architecture does not specify how an
   implementation should be assembled. The [MODEL] describes a general
   approach to implementation design, or to user interface design. Its
   components could, however, be assembled in a different way. For
   example, traffic conforming to a meter might be run through a second
   meter, or reclassified.

   This MIB models the same functional data path elements, allowing the
   network manager to assemble them in any fashion that meets the
   relevant policy. These data path elements include Classifiers,
   Meters, Actions of various sorts, Queues, and Schedulers.

   In many of these tables, a distinction is drawn between the structure
   of the policy (do this, then do that) and the parameters applied to
   specific policy elements. This is to facilitate configuration, if
   the MIB is used for that. The concept is that a set of parameters,
   such as the values that describe a specific token bucket, might be
   configured once and applied to many interfaces.

   The RowPointer Textual Convention is therefore used in two ways in
   this MIB. It is defined for the purpose of connecting an object to
   an entry dynamically; the RowPointer object identifies the first
   object in the target Entry, and in so doing points to the entire
   entry. In this MIB, it is used as a connector between successive
   functional data path elements, and as the link between the policy
   structure and the parameters that are used. When used as a
   connector, it says what happens "next"; what happens to classified
   traffic, to traffic conforming or not conforming to a meter, and so
   on. When used to indicate the parameters applied in a policy, it
   says "specifically" what is meant; the structure points to the
   parameters of its policy.

   The use of RowPointers as connectors allows for the simple extension
   of the MIB. The RowPointers, whether "next" or "specific", may point
   to Entries defined in other MIB modules. For example, the only type
   of meter defined in this MIB is a token bucket meter; if another type
   of meter is required, another MIB could be defined describing that
   type of meter, and diffServMeterSpecific could point to it.
   Similarly, if a new action is required, the "next" pointer of the
   previous functional datapath element could point to an Entry defined
   in another MIB, public or proprietary.

3.1. Processing Path

   An interface has an ingress and an egress direction, and will
   generally have a different policy in each direction. As traffic
   enters an edge interface, it may be classified, metered, counted, and
   marked. Traffic leaving the same interface might be remarked
   according to the contract with the next network, queued to manage the
   bandwidth, and so on. As [MODEL] points out, the functional datapath
   elements used on ingress and egress are of the same type, but may be
   structured in very different ways to implement the relevant policies.

3.1.1. diffServDataPathTable - The Data Path Table

   Therefore, when traffic arrives at an ingress or egress interface,
   the first step in applying the policy is determining what policy
   applies. This MIB does that by providing a table of pointers to the
   first functional data path element, indexed by interface and
   direction on that interface. The content of the
   diffServDataPathEntry is a single RowPointer, which points to that
   functional data path element.

   When diffServDataPathStart in a direction on an interface is
   undefined or is set to zeroDotZero, the implication is that there is
   no specific policy to apply.

3.2. Classifier

   Classifiers are used to differentiate among types of traffic. In the
   Differentiated Services architecture, one usually discusses a
   behavior aggregate identified by the application of one or more
   Differentiated Services Code Points (DSCPs). However, especially at
   network edges (which include hosts and first hop routers serving
   hosts), traffic may arrive unmarked or the marks may not be trusted.
   In these cases, one applies a Multi-Field Classifier, which may
   select an aggregate as coarse as "all traffic", as fine as a specific
   microflow identified by IP Addresses, IP Protocol, and TCP or UDP
   ports, or variety of slices in between.

   Classifiers can be simple or complex. In a core interface, one would
   expect to find simple behavior aggregate classification to be used.
   However, in an edge interface, one might first ask what application
   is being used, meter the arriving traffic, and then apply various
   policies to the non-conforming traffic depending on the Autonomous
   System number advertising the destination address. To accomplish
   such a thing, traffic must be classified, metered, and then
   reclassified. To this end, the MIB defines separate classifiers,
   which may be applied at any point in processing, and may have
   different content as needed.

The MIB also allows for ambiguous classification in a structured
fashion. In the end, traffic classification must be unambiguous; one
must know for certain what policy to apply to any given packet.
However, writing an unambiguous specification is often tedious, while
writing a specification in steps that permits and excludes various
kinds of traffic may be simpler and more intuitive. In such a case,
the classification "steps" are enumerated; all classification
elements of one precedence are applied as if in parallel, and then
all classification elements of the next precedence.

This MIB defines a single classifier parameter entry, the Multi-field
Classifier. A degenerate case of this multi-field classifier is a
Behavior Aggregate classifier. Other classifiers may be defined in
other MIB modules, to select traffic from a given layer two neighbor
or a given interface, traffic whose addresses belong to a given BGP
Community or Autonomous System, and so on.

3.2.1. diffServClfrElementTable - The Classifier Element Table

A classifier consists of classifier elements. A classifier element
identifies a specific set of traffic that forms part of a behavior
aggregate; other classifier elements within the same classifier may
identify other traffic that also falls into the behavior aggregate.
For example, in identifying AF traffic for the aggregate AF1, one
might implement separate classifier elements for AF11, AF12, and AF13
within the same classifier and pointing to the same subsequent meter.

Generally, one would expect the Data Path Entry to point to a
classifier (which is to say, a set of one or more classifier
elements), although it may point to something else when appropriate.
Reclassification in a functional data path is achieved by pointing to
another Classifier Entry when appropriate.

A classifier element is a structural element, indexed by classifier
ID and element ID. It has a precedence value, allowing for
structured ambiguity as described above, a "specific" pointer that
identifies what rule is to be applied, and a "next" pointer directing
traffic matching the classifier to the next functional data path
element. If the "next" pointer is zeroDotZero, the indication is
that there is no further differentiated services processing for this
behavior aggregate. However, if the "specific" pointer is
zeroDotZero, the device is misconfigured. In such a case, the
classifier element should be operationally treated as if it were not
present.

When the MIB is used for configuration, diffServClfrNextFree and
diffServClfrElementNextFree always contain legal values for
diffServClfrId and diffServClfrElementId that are not currently used

in the system's configuration. The values are validated when
creating diffServClfrId and diffServClfrElementId, and in the event
of a failure (which would happen if two managers simultaneously
attempted to create an entry) must be re-read.

3.2.2. diffServMultiFieldClfrTable - The Multi-field Classifier Table

This MIB defines a single parameter type for classification, the
Multi-field Classifier. As a parameter, a filter may be specified
once and applied to many interfaces, using
diffServClfrElementSpecific. This filter matches:

     o IP source address prefix, including host, CIDR Prefix, and "any
        source address"

     o IP destination address prefix, including host, CIDR Prefix, and
        "any destination address"

     o IPv6 Flow ID

     o IP protocol or "any"

     o TCP/UDP/SCTP source port range, including "any"

     o TCP/UDP/SCTP destination port range, including "any"

     o Differentiated Services Code Point

Since port ranges, IP prefixes, or "any" are defined in each case, it
is clear that a wide variety of filters can be constructed. The
Differentiated Services Behavior Aggregate filter is a special case
of this filter, in which only the DSCP is specified.

Other MIB modules may define similar filters in the same way. For
example, a filter for Ethernet information might define source and
destination MAC addresses of "any", Ethernet Packet Type, IEEE 802.2
SAPs, and IEEE 802.1 priorities. A filter related to policy routing
might be structured like the diffServMultiFieldClfrTable, but contain
the BGP Communities of the source and destination prefix rather than
the prefix itself, meaning "any prefix in this community". For such
a filter, a table similar to diffServMultiFieldClfrTable is
constructed, and diffServClfrElementSpecific is configured to point
to it.

When the MIB is used for configuration,
diffServMultiFieldClfrNextFree always contains a legal value for
diffServMultiFieldClfrId that is not currently used in the system's
configuration.

3.3. Metering Traffic

As discussed in [MODEL], a meter and a shaper are functions that
operate on opposing ends of a link. A shaper schedules traffic for
transmission at specific times in order to approximate a particular
line speed or combination of line speeds. In its simplest form, if
the traffic stream contains constant sized packets, it might transmit
one packet per unit time to build the equivalent of a CBR circuit.
However, various factors intervene to make the approximation inexact;
multiple classes of traffic may occasionally schedule their traffic
at the same time, the variable length nature of IP traffic may
introduce variation, and factors in the link or physical layer may
change traffic timing. A meter integrates the arrival rate of
traffic and determines whether the shaper at the far end was
correctly applied, or whether the behavior of the application in
question is naturally close enough to such behavior to be acceptable
under a given policy.

A common type of meter is a Token Bucket meter, such as [srTCM] or
[trTCM]. This type of meter assumes the use of a shaper at a
previous node; applications which send at a constant rate when
sending may conform if the token bucket is properly specified. It
specifies the acceptable arrival rate and quantifies the acceptable
variability, often by specifying a burst size or an interval; since
rate = quantity/time, specifying any two of those parameters implies
the third, and a large interval provides for a forgiving system.
Multiple rates may be specified, as in AF, such that a subset of the
traffic (up to one rate) is accepted with one set of guarantees, and
traffic in excess of that but below another rate has a different set
of guarantees. Other types of meters exist as well.

One use of a meter is when a service provider sells at most, a
certain bit rate to one of its customers, and wants to drop the
excess. In such a case, the fractal nature of normal Internet
traffic must be reflected in large burst intervals, as TCP frequently
sends packet pairs or larger bursts, and responds poorly when more
than one packet in a round trip interval is dropped. Applications
like FTP contain the effect by simply staying below the target bit
rate; this type of configuration very adversely affects transaction
applications like HTTP, however. Another use of a meter is in the AF
specification, in which excess traffic is marked with a related DSCP
and subjected to slightly more active queue depth management. The

application is not sharply limited to a contracted rate in such a
case, but can be readily contained should its traffic create a
burden.

3.3.1. diffServMeterTable - The Meter Table

The Meter Table is a structural table, specifying a specific
functional data path element. Its entry consists essentially of
three RowPointers - a "succeed" pointer, for traffic conforming to
the meter, a "fail" pointer, for traffic not conforming to the meter,
and a "specific" pointer, to identify the parameters in question.
This structure is a bow to SNMP's limitations; it would be better to
have a structure with N rates and N+1 "next" pointers, with a single
algorithm specified. In this case, multiple meter entries connected
by the "fail" link are understood to contain the parameters for a
specified algorithm, and traffic conforming to a given rate follows
their "succeed" paths. Within this MIB, only Token Bucket parameters
are specified; other varieties of meters may be designed in other MIB
modules.

When the MIB is used for configuration, diffServMeterNextFree always
contains a legal value for diffServMeterId that is not currently used
in the system's configuration.

3.3.2. diffServTBParamTable - The Token Bucket Parameters Table

The Token Bucket Parameters Table is a set of parameters that define
a Token Bucket Meter. As a parameter, a token bucket may be
specified once and applied to many interfaces, using
diffServMeterSpecific. Specifically, several modes of [srTCM] and
[trTCM] are addressed. Other varieties of meters may be specified in
other MIB modules.

In general, if a Token Bucket has N rates, it has N+1 potential
outcomes - the traffic stream is slower than and therefore conforms
to all of the rates, it fails the first few but is slower than and
therefore conforms to the higher rates, or it fails all of them. As
such, multi-rate meters should specify those rates in monotonically
increasing order, passing through the diffServMeterFailNext from more
committed to more excess rates, and finally falling through
diffServMeterFailNext to the set of actions that apply to traffic
which conforms to none of the specified rates. diffServTBParamType
in the first entry indicates the algorithm being used. At each rate,
diffServTBParamRate is derivable from diffServTBParamBurstSize and
diffServTBParamInterval; a superior implementation will allow the

configuration of any two of diffServTBParamRate,
diffServTBParamBurstSize, and diffServTBParamInterval, and respond
with the appropriate error code if all three are specified but are
not mathematically related.

When the MIB is used for configuration, diffServTBParamNextFree
always contains a legal value for diffServTBParamId that is not
currently used in the system's configuration.

3.4. Actions applied to packets

"Actions" are the things a differentiated services interface PHB may
do to a packet in transit. At a minimum, such a policy might
calculate statistics on traffic in various configured classes, mark
it with a DSCP, drop it, or enqueue it before passing it on for other
processing.

Actions are composed of a structural element, the
diffServActionTable, and various component action entries that may be
applied. In the case of the Algorithmic Dropper, an additional
parameter table may be specified to control Active Queue Management,
as defined in [RED93] and other AQM specifications.

3.4.1. diffServActionTable - The Action Table

The action table identifies sequences of actions to be applied to a
packet. Successive actions are chained through diffServActionNext,
ultimately resulting in zeroDotZero (indicating that the policy is
complete), a pointer to a queue, or a pointer to some other
functional data path element.

When the MIB is used for configuration, diffServActionNextFree always
contains a legal value for diffServActionId that is not currently
used in the system's configuration.

3.4.2. diffServCountActTable - The Count Action Table

The count action accumulates statistics pertaining to traffic passing
through a given path through the policy. It is intended to be useful
for usage-based billing, for statistical studies, or for analysis of
the behavior of a policy in a given network. The objects in the
Count Action are various counters and a discontinuity time. The
counters display the number of packets and bytes encountered on the
path since the discontinuity time. They share the same discontinuity
time, which is the discontinuity time of the interface or agent.

The designers of this MIB expect that every path through a policy
should have a corresponding counter. In early versions, it was
impossible to configure an action without implementing a counter,
although the current design makes them in effect the network
manager's option, as a result of making actions consistent in
structure and extensibility. The assurance of proper debugging and
accounting is therefore left with the policy designer.

When the MIB is used for configuration, diffServCountActNextFree
always contains a legal value for diffServCountActId that is not
currently used in the system's configuration.

3.4.3. diffServDscpMarkActTable - The Mark Action Table

The Mark Action table is an unusual table, both in SNMP and in this
MIB. It might be viewed not so much as an array of single-object
entries as an array of OBJECT-IDENTIFIER conventions, as the OID for
a diffServDscpMarkActDscp instance conveys all of the necessary
information: packets are to be marked with the requisite DSCP.

As such, contrary to common practice, the index for the table is
read- only, and is both the Entry's index and its only value.

3.4.4. diffServAlgDropTable - The Algorithmic Drop Table

The Algorithmic Drop Table identifies a dropping algorithm, drops
packets, and counts the drops. Classified as an action, it is in
effect a method which applies a packet to a queue, and may modify
either. When the algorithm is "always drop", this is simple; when
the algorithm calls for head-drop, tail-drop, or a variety of Active
Queue Management, the queue is inspected, and in the case of Active
Queue Management, additional parameters are REQUIRED.

What may not be clear from the name is that an Algorithmic Drop
action often does not drop traffic. Algorithms other than "always
drop" normally drop a few percent of packets at most. The action
inspects the diffServQEntry that diffServAlgDropQMeasure points to in
order to determine whether the packet should be dropped.

When the MIB is used for configuration, diffServAlgDropNextFree
always contains a legal value for diffServAlgDropId that is not
currently used in the system's configuration.

3.4.5. diffServRandomDropTable - The Random Drop Parameters Table

   The Random Drop Table is an extension of the Algorithmic Drop Table
   intended for use on queues whose depth is actively managed. Active
   Queue Management algorithms are typified by [RED93], but the
   parameters they use vary. It was deemed for the purposes of this MIB
   that the proper values to represent include:

      o Target case mean queue depth, expressed in bytes or packets

      o Worst case mean queue depth, expressed in bytes or packets

      o Maximum drop rate expressed as drops per thousand

      o Coefficient of an exponentially weighted moving average,
         expressed as the numerator of a fraction whose denominator is
         65536.

      o Sampling rate

   An example of the representation chosen in this MIB for this element
   is shown in Figure 1.

   Random droppers often have their drop probability function described
   as a plot of drop probability (P) against averaged queue length (Q).
   (Qmin,Pmin) then defines the start of the characteristic plot.
   Normally Pmin=0, meaning with average queue length below Qmin, there
   will be no drops. (Qmax,Pmax) defines a "knee" on the plot, after
   which point the drop probability becomes more progressive (greater
   slope). (Qclip,1) defines the queue length at which all packets will
   be dropped. Notice this is different from Tail Drop because this
   uses an averaged queue length, although it is possible for Qclip to
   equal Qmax.

   In the MIB module, diffServRandomDropMinThreshBytes and
   diffServRandomDropMinThreshPkts represent Qmin.
   diffServRandomDropMaxThreshBytes and diffServRandomDropMaxThreshPkts
   represent Qmax. diffServAlgDropQThreshold represents Qclip.
   diffServRandomDropInvProbMax represents Pmax (inverse). This MIB
   does not represent Pmin (assumed to be zero unless otherwise
   represented). In addition, since message memory is finite, queues
   generally have some upper bound above which they are incapable of
   storing additional traffic. Normally this number is equal to Qclip,
   specified by diffServAlgDropQThreshold.

```
        AlgDrop                                        Queue
        +-----------------+                           +-------+
  --->| Next     ---------+--+------------------->| Next -+--> ...
      | QMeasure -------+--+                       | ...   |
      | QThreshold      |       RandomDrop         +-------+
      | Type=randomDrop |       +----------------+
      | Specific -------+---->| MinThreshBytes |
      +-----------------+       | MaxThreshBytes |
                                | ProbMax        |
                                | Weight         |
                                | SamplingRate   |
                                +----------------+
```
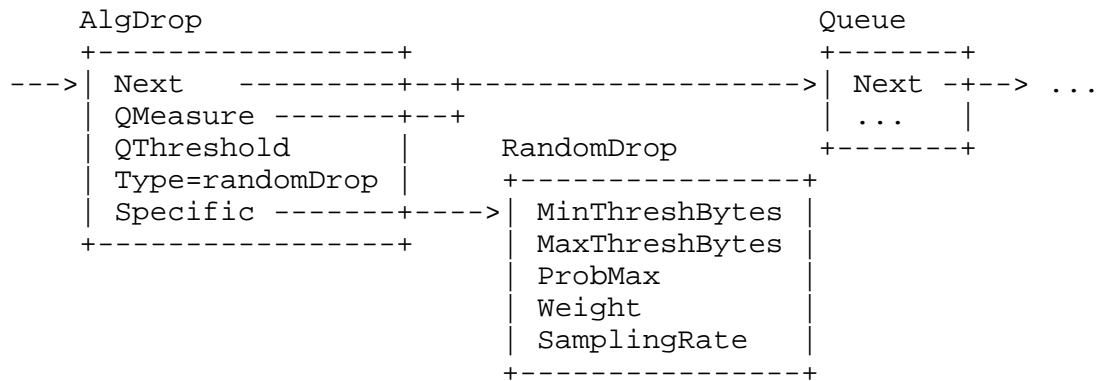
   Figure 1: Example Use of the RandomDropTable for Random Droppers

   Each random dropper specification is associated with a queue. This
   allows multiple drop processes (of same or different types) to be
   associated with the same queue, as different PHB implementations may
   require. This also allows for sequences of multiple droppers if
   necessary.

   The calculation of a smoothed queue length may also have an important
   bearing on the behavior of the dropper: parameters may include the
   sampling interval or rate, and the weight of each sample. The
   performance may be very sensitive to the values of these parameters
   and a wide range of possible values may be required due to a wide
   range of link speeds. Most algorithms include a sample weight,
   represented here by diffServRandomDropWeight. The availability of
   diffServRandomDropSamplingRate as readable is important, the
   information provided by Sampling Rate is essential to the
   configuration of diffServRandomDropWeight. Having Sampling Rate be
   configurable is also helpful, as line speed increases, the ability to
   have queue sampling be less frequent than packet arrival is needed.
   Note, however, that there is ongoing research on this topic, see e.g.
   [ACTQMGMT] and [AQMROUTER].

   Additional parameters may be added in an enterprise MIB module, e.g.
   by using AUGMENTS on this table, to handle aspects of random drop
   algorithms that are not standardized here.

   When the MIB is used for configuration, diffServRandomDropNextFree
   always contains a legal value for diffServRandomDropId that is not
   currently used in the system's configuration.

3.5. Queuing and Scheduling of Packets

   These include Queues and Schedulers, which are inter-related in their
   use of queuing techniques. By doing so, it is possible to build
   multi-level schedulers, such as those which treat a set of queues as
   having priority among them, and at a specific priority find a
   secondary WFQ scheduler with some number of queues.

3.5.1. diffServQTable - The Class or Queue Table

   The Queue Table models simple FIFO queues. The Scheduler Table
   allows flexibility in constructing both simple and somewhat more
   complex queuing hierarchies from those queues.

   Queue Table entries are pointed at by the "next" attributes of the
   upstream elements, such as diffServMeterSucceedNext or
   diffServActionNext. Note that multiple upstream elements may direct
   their traffic to the same Queue Table entry. For example, the
   Assured Forwarding PHB suggests that all traffic marked AF11, AF12 or
   AF13 be placed in the same queue, after metering, without reordering.
   To accomplish that, the upstream diffServAlgDropNext pointers each
   point to the same diffServQEntry.

   A common requirement of a queue is that its traffic enjoy a certain
   minimum or maximum rate, or that it be given a certain priority.
   Functionally, the selection of such is a function of a scheduler.
   The parameter is associated with the queue, however, using the
   Minimum or Maximum Rate Parameters Table.

   When the MIB is used for configuration, diffServQNextFree always
   contains a legal value for diffServQId that is not currently used in
   the system's configuration.

3.5.2. diffServSchedulerTable - The Scheduler Table

   The scheduler, and therefore the Scheduler Table, accepts inputs from
   either queues or a preceding scheduler. The Scheduler Table allows
   flexibility in constructing both simple and somewhat more complex
   queuing hierarchies from those queues.

   When the MIB is used for configuration, diffServSchedulerNextFree
   always contains a legal value for diffServSchedulerId that is not
   currently used in the system's configuration.

3.5.3. diffServMinRateTable - The Minimum Rate Table

   When the output rate of a queue or scheduler must be given a minimum
   rate or a priority, this is done using the diffServMinRateTable.

Rates may be expressed as absolute rates, or as a fraction of
ifSpeed, and imply the use of a rate-based scheduler such as WFQ or
WRR. The use of a priority implies the use of a Priority Scheduler.
Only one of the Absolute or Relative rates needs to be set; the other
takes the relevant value as a result. Excess capacity is distributed
proportionally among the inputs to a scheduler using the assured
rate. More complex functionality may be described by augmenting this
MIB.

When a priority scheduler is used, its effect is to give the queue
the entire capacity of the subject interface less the capacity used
by higher priorities, if there is traffic present to use it. This is
true regardless of the rate specifications applied to that queue or
other queues on the interface. Policing excess traffic will mitigate
this behavior.

When the MIB is used for configuration, diffServMinRateNextFree
always contains a legal value for diffServMinRateId that is not
currently used in the system's configuration.

3.5.4. diffServMaxRateTable - The Maximum Rate Table

When the output rate of a queue or scheduler must be limited to at
most a specified maximum rate, this is done using the
diffServMaxRateTable. Rates may be expressed as absolute rates, or
as a fraction of ifSpeed. Only one of the Absolute or Relative rate
needs to be set; the other takes the relevant value as a result.

The definition of a multirate shaper requires multiple
diffServMaxRateEntries. In this case, an algorithm such as [SHAPER]
is used. In that algorithm, more than one rate is specified, and at
any given time traffic is shaped to the lowest specified rate which
exceeds the arrival rate of traffic.

When the MIB is used for configuration, diffServMaxRateNextFree
always contains a legal value for diffServMaxRateId that is not
currently used in the system's configuration.

3.5.5. Using queues and schedulers together

For representing a Strict Priority scheduler, each scheduler input is
assigned a priority with respect to all the other inputs feeding the
same scheduler, with default values for the other parameters.
Higher-priority traffic that is not being delayed for shaping will be
serviced before a lower-priority input. An example is found in
Figure 2.

For weighted scheduling methods, such as WFQ or WRR, the "weight" of
a given scheduler input is represented with a Minimum Service Rate
leaky-bucket profile which provides a guaranteed minimum bandwidth to
that input, if required. This is represented by a rate
diffServMinRateAbsolute; the classical weight is the ratio between
that rate and the interface speed, or perhaps the ratio between that
rate and the sum of the configured rates for classes. The rate may
be represented by a relative value, as a fraction of the interface's
current line rate, diffServMinRateRelative, to assist in cases where
line rates are variable or where a higher-level policy might be
expressed in terms of fractions of network resources. The two rate
parameters are inter-related and changes in one may be reflected in
the other. An example is found in figure 3.

```
                                  +-----+
            +-------+             | P S |
            | Queue +------------>+ r c |
            +-------+-+--------+   | i h |
                      |Priority|  | o e |
                      +--------+  | r d +----------->
            +-------+             | i u |
            | Queue +------------>+ t l |
            +-------+-+--------+   | y e |
                      |Priority|  |   r |
                      +--------+  +-----+
```
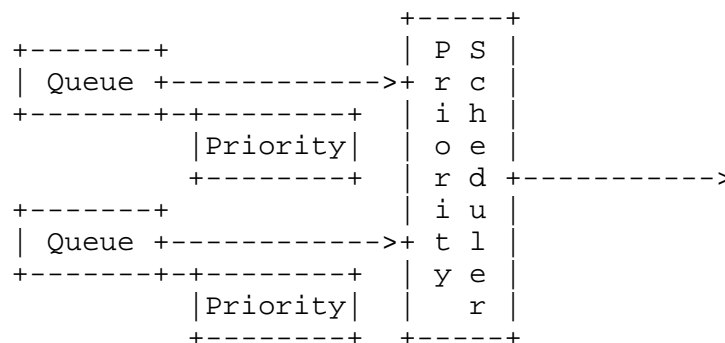
Figure 2: Priority Scheduler with two queues

For weighted scheduling methods, one can say loosely, that WRR
focuses on meeting bandwidth sharing, without concern for relative
delay amongst the queues; where WFQ controls both queue the service
order and the amount of traffic serviced, providing bandwidth sharing
and relative delay ordering amongst the queues.

A queue or scheduled set of queues (which is an input to a scheduler)
may also be capable of acting as a non-work-conserving [MODEL]
traffic shaper: this is done by defining a Maximum Service Rate
leaky-bucket profile in order to limit the scheduler bandwidth
available to that input. This is represented by a rate, in
diffServMaxRateAbsolute; the classical weight is the ratio between
that rate and the interface speed, or perhaps the ratio between that
rate and the sum of the configured rates for classes. The rate may
be represented by a relative value, as a fraction of the interface's
current line rate, diffServMaxRateRelative. This MIB presumes that
shaping is something a scheduler does to its inputs, which it models
as a queue with a maximum rate or a scheduler whose output has a
maximum rate.

```
                                   +-----+
         +-------+                 | W S |
         | Queue +------------>+ R c |
         +-------+-+--------+   | R h |
               |   Rate  |   |   e |
               +--------+   | o d +----------->
         +-------+           | r u |
         | Queue +------------>+   l |
         +-------+-+--------+   | W e |
               |   Rate  |   | F r |
               +--------+   | Q   |
                                   +-----+
```
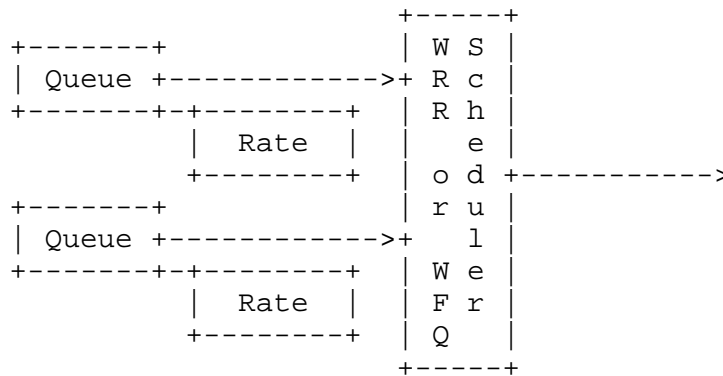
         Figure 3: WRR or WFQ rate-based scheduler with two inputs

   The same may be done on a queue, if a given class is to be shaped to
   a maximum rate without shaping other classes, as in Figure 5.

   Other types of priority and weighted scheduling methods can be
   defined using existing parameters in diffServMinRateEntry. NOTE:
   diffServSchedulerMethod uses OBJECT IDENTIFIER syntax, with the
   different types of scheduling methods defined as OBJECT-IDENTITY.

```
                                   +---+
         +-------+                 | S |
         | Queue +------------>+ c |
         +-------+-+--------+   | h |
               |       |   | e +----------->
               +--------+   | d +-+-------+
                             | u | |Shaping|
         +-------+           | l | | Rate  |
         | Queue +------------>+ e | +-------+
         +-------+-+--------+   | r |
               |       |   +---+
               +--------+
```
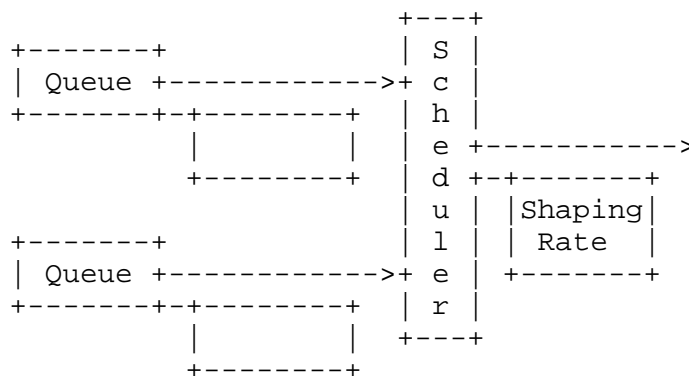
         Figure 4: Shaping scheduled traffic to a known rate

```
                                     +---+
           +-------+                 | S |
           | Queue +------------>+ c |
           +-------+-+--------+   | h |
                     |Min Rate|   | e +----------->
                     +--------+   | d |
                                  | u |
           +-------+              | l |
           | Queue +------------>+ e |
           +-------+-+--------+   | r |
                     |Min Rate|   |   |
                     +--------+   |   |
                     |Max Rate|   |   |
                     +--------+  +---+
```
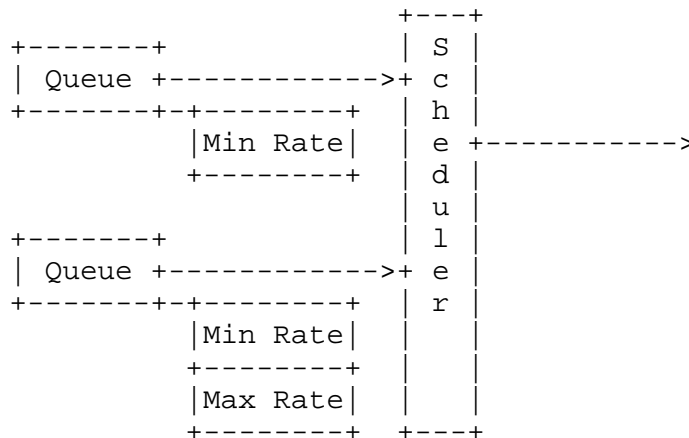
            Figure 5: Shaping one input to a work-conserving scheduler

   Future scheduling methods may be defined in other MIBs. This
   requires an OBJECT-IDENTITY definition, a description of how the
   existing objects are reused, if they are, and any new objects they
   require.

   To implement an EF and two AF classes, one must use a combination of
   priority and WRR/WFQ scheduling. This requires us to cascade two
   schedulers. If one were to additionally shape the output of the
   system to a rate lower than the interface rate, one must place an
   upper bound rate on the output of the priority scheduler. See figure
   6.

3.6. Example configuration for AF and EF

   For the sake of argument, let us build an example with one EF class
   and four AF classes using the constructs in this MIB.

3.6.1. AF and EF Ingress Interface Configuration

   The ingress edge interface identifies traffic into classes, meters
   it, and ensures that any excess is appropriately dealt with according
   to the PHB. For AF, this means marking excess; for EF, it means
   dropping excess or shaping it to a maximum rate.

```
                                               +-----+
          +-------+                            | P S |
          | Queue +--------------------------->+ r c |
          +-------+--------------------+-------+ | i h |
                                       |Priority| | o e +---------->
                                       +--------+ | r d +-+-------+
                                +------+           | i u | |Shaping|
          +-------+             | W S +----------->+ t l | | Rate  |
          | Queue +------------>+ R c +-+--------+ | y e | +-------+
          +-------+-+--------+   | R h | |Priority| |   r |
                    |Min Rate|   |   e | +--------+ +-----+
                    +--------+   | o d |
          +-------+             | r u |
          | Queue +------------>+   l |
          +-------+-+--------+   | W e |
                    |Min Rate|   | F r |
                    +--------+   | Q   |
                                 +------+
```
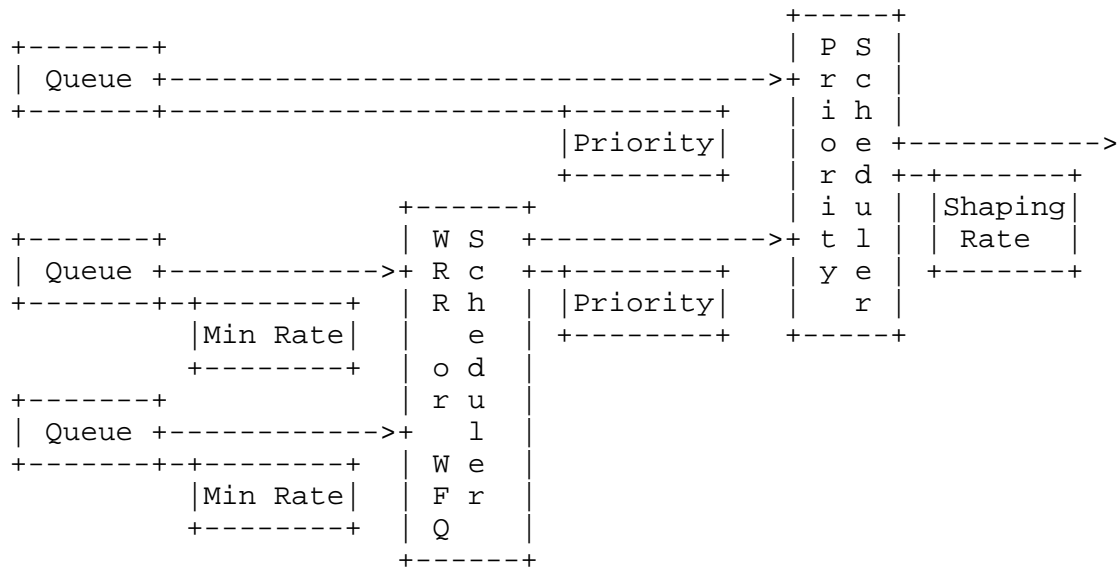
Figure 6: Combined EF and AF services using cascaded schedulers.

```
        +-----------------------+
        | diffServDataPathStart |
        +-----------+-----------+
                    |
       +----------+
       |
  +--+--+    +-----+    +-----+    +-----+    +-----+
  | AF1 +-----+ AF2 +-----+ AF3 +-----+ AF4 +-----+ EF  |
  +--+--+    +--+--+    +--+--+    +--+--+    +--+--+
     |          |          |          |          |
  +--+--+    +--+--+    +--+--+    +--+--+    +--+--+
  |trTCM|    |trTCM|    |trTCM|    |trTCM|    |srTCM|
  |Meter|    |Meter|    |Meter|    |Meter|    |Meter|
  +-+++-+    +-+++-+    +-+++-+    +-+++-+    +-+-+-+
   |||        |||        |||        |||        | |
  +-+||---+  +-+||---+  +-+||---+  +-+||---+  +-+-|---+
  |+-+|----+ |+-+|----+ |+-+|----+ |+-+|----+ |+--+----+
  ||+-+-----+||+-+-----+||+-+-----+||+-+-----+||Actions|
  +||Actions|+||Actions|+||Actions|+||Actions|+|       |
   +|       | +|       | +|       | +|       | +-+-----+
    +-+-----+  +-+-----+  +-+-----+  +-+-----+   |
    |||        |||        |||        |||         |
    VVV        VVV        VVV        VVV         V
```
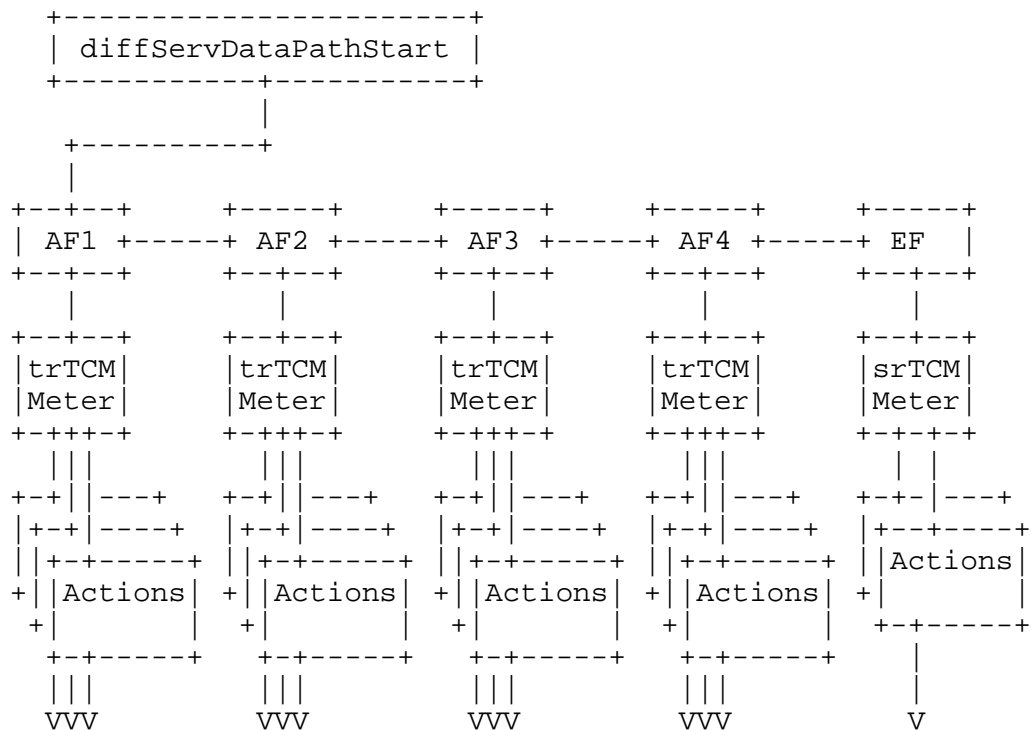
         Accepted traffic is sent to IP forwarding

   Figure 7: combined EF and AF implementation, ingress side

3.6.1.1. Classification In The Example

   A packet arriving at an ingress interface picks up its policy from
   the diffServDataPathTable. This points to a classifier, which will
   select traffic according to some specification for each traffic
   class.

   An example of a classifier for an AFm class would be a set of three
   classifier elements, each pointing to a Multi-field classification
   parameter block identifying one of the AFmn DSCPs. Alternatively,
   the filters might contain selectors for HTTP traffic or some other
   application.

   An example of a classifier for EF traffic might be a classifier
   element pointing to a filter specifying the EF code point, a
   collection of classifiers with parameter blocks specifying individual
   telephone calls, or a variety of other approaches.

   Typically, of course, a classifier identifies a variety of traffic
   and breaks it up into separate classes. It might very well contain
   fourteen classifier elements indicating the twelve AFmn DSCP values,
   EF, and "everything else". These would presumably direct traffic
   down six functional data paths: one for each AF or EF class, and one
   for all other traffic.

3.6.1.2. AF Implementation On an Ingress Edge Interface

   Each AFm class applies a Two Rate Three Color Meter, dividing traffic
   into three groups. These groups of traffic conform to both specified
   rates, only the higher one, or none. The intent, on the ingress
   interface at the edge of the network, is to measure and appropriately
   mark traffic.

3.6.1.2.1. AF Metering On an Ingress Edge Interface

   Each AFm class applies a Two Rate Three Color Meter, dividing traffic
   into three groups. If two rates R and S, where R < S, are specified
   and traffic arrives at rate T, traffic comprising up to R bits per
   second is considered to conform to the "confirmed" rate, R. If
   R < T, traffic comprising up to S-R bits per second is considered to
   conform to the "excess" rate, S. Any further excess is non-
   conformant.

   Two meter entries are used to configure this, one for the conforming
   rate and one for the excess rate. The rate parameters are stored in
   associated Token Bucket Parameter Entries. The "FailNext" pointer of
   the lower rate Meter Entry points to the other Meter Entry; both
   "SucceedNext" pointers and the "FailNext" pointer of the higher Meter

Entry point to lists of actions. In the color-blind mode, all three
classifier "next" entries point to the lower rate meter entry. In
the color-aware mode, the AFm1 classifier points to the lower rate
entry, the AFm2 classifier points to the higher rate entry (as it is
only compared against that rate), and the AFm3 classifier points
directly to the actions taken when both rates fail.

3.6.1.2.2. AF Actions On an Ingress Edge Interface

   For network planning and perhaps for billing purposes, arriving
   traffic is normally counted. Therefore, a "count" action, consisting
   of an action table entry pointing to a count table entry, is
   configured.

   Also, traffic is marked with the appropriate DSCP. The first R bits
   per second are marked AFm1, the next S-R bits per second are marked
   AFm2, and the rest is marked AFm3. It may be that traffic is
   arriving marked with the same DSCP, but in general, the additional
   complexity of deciding that it is being remarked to the same value is
   not useful. Therefore, a "mark" action, consisting of an action
   table entry pointing to a mark table entry, is configured.

   At this point, the usual case is that traffic is now forwarded in the
   usual manner. To indicate this, the "SucceedNext" pointer of the
   Mark Action is set to zeroDotZero.

3.6.1.3. EF Implementation On an Ingress Edge Interface

   The EF class applies a Single Rate Two Color Meter, dividing traffic
   into "conforming" and "excess" groups. The intent, on the ingress
   interface at the edge of the network, is to measure and appropriately
   mark conforming traffic and drop the excess.

3.6.1.3.1. EF Metering On an Ingress Edge Interface

   A single rate two color (srTCM) meter requires one token bucket. It
   is therefore configured using a single meter entry with a
   corresponding Token Bucket Parameter Entry. Arriving traffic either
   "succeeds" or "fails".

3.6.1.3.2. EF Actions On an Ingress Edge Interface

   For network planning and perhaps for billing purposes, arriving
   traffic that conforms to the meter is normally counted. Therefore, a
   "count" action, consisting of an action table entry pointing to a
   count table entry, is configured.

Also, traffic is (re)marked with the EF DSCP. Therefore, a "mark"
action, consisting of an action table entry pointing to a mark table
entry, is configured.

At this point, the successful traffic is now forwarded in the usual
manner. To indicate this, the "SucceedNext" pointer of the Mark
Action is set to zeroDotZero.

Traffic that exceeded the arrival policy, however, is to be dropped.
One can use a count action on this traffic if the several counters
are interesting. However, since the drop counter in the Algorithmic
Drop Entry will count packets dropped, this is not clearly necessary.
An Algorithmic Drop Entry of the type "alwaysDrop" with no successor
is sufficient.

3.7. AF and EF Egress Edge Interface Configuration

3.7.1. Classification On an Egress Edge Interface

A packet arriving at an egress interface may have been classified on
an ingress interface, and the egress interface may have access to
that information. If it is relevant, there is no reason not to use
that information. If it is not available, however, there may be a
need to (re)classify on the egress interface. In any event, it picks
up its "program" from the diffServDataPathTable. This points to a
classifier, which will select traffic according to some specification
for each traffic class.

```
              +-----------------------+
              | diffServDataPathStart |
              +-----------+-----------+
                          |
                 +----------+
                 |
     +--+--+    +-----+    +-----+    +-----+    +-----+
     | AF1 +----+ AF2 +----+ AF3 +----+ AF4 +----+ EF  |
     +-+++-+    +-+++-+    +-+++-+    +-+++-+    +-+-+-+
      |||        |||        |||        |||        | |
     +-+++-+    +-+++-+    +-+++-+    +-+++-+    +-+-+-+
     |trTCM|    |trTCM|    |trTCM|    |trTCM|    |srTCM|
     |Meter|    |Meter|    |Meter|    |Meter|    |Meter|
     +-+++-+    +-+++-+    +-+++-+    +-+++-+    +-+-+-+
      |||        |||        |||        |||        | |
     +-+||---+  +-+||---+  +-+||---+  +-+||---+  +-+-|---+
     |+-+|----+ |+-+|----+ |+-+|----+ |+-+|----+ |+--+---+
     ||+-+-----+||+-+-----+||+-+-----+||+-+-----+||Actions|
     +||Actions|+||Actions|+||Actions|+||Actions|+|      |
      +|       | +|       | +|       | +|       | +-+-----+
       +-+-----+  +-+-----+  +-+-----+  +-+-----+   |
        |||        |||        |||        |||        |
     +-+++--+    +-+++--+    +-+++--+    +-+++--+   +--+---+
     | Queue|    | Queue|    | Queue|    | Queue|   | Queue|
     +--+---+    +--+---+    +--+---+    +--+---+   +--+---+
        |          |          |          |            |
     +--+----------+----------+----------+---+        |
     |      WFQ/WRR Scheduler               |         |
     +--------------------------------------+---+     |
                                   |            |     |
                                   |            |     |
                          +-----+------------+----+
                          | Priority Scheduler    |
                          +---------+-----------+
                                    |
                                    V
```
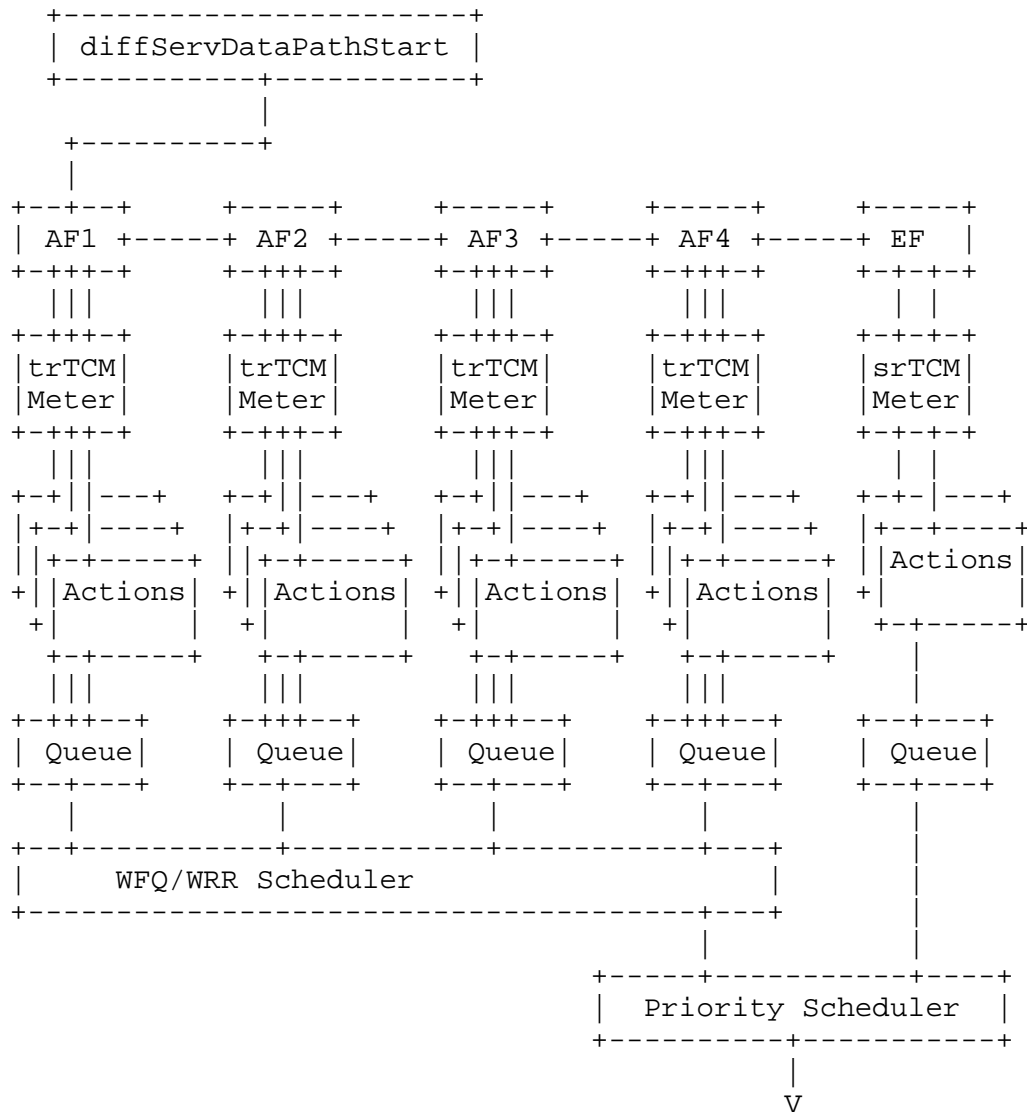
                 Figure 8: combined EF and AF implementation

   An example of a classifier for an AFm class would be a succession of
   three classifier elements, each pointing to a Multi-field
   classification parameter block identifying one of the AFmn DSCPs.
   Alternatively, the filter might contain selectors for HTTP traffic or
   some other application.

An example of a classifier for EF traffic might be either a
classifier element pointing to a Multi-field parameter specifying the
EF code point, or a collection of classifiers with parameter blocks
specifying individual telephone calls, or a variety of other
approaches.

Each classifier delivers traffic to appropriate functional data path
elements.

3.7.2. AF Implementation On an Egress Edge Interface

Each AFm class applies a Two Rate Three Color Meter, dividing traffic
into three groups. These groups of traffic conform to both specified
rates, only the higher one, or none. The intent, on the ingress
interface at the edge of the network, is to measure and appropriately
mark traffic.

3.7.2.1. AF Metering On an Egress Edge Interface

Each AFm class applies a Two Rate Three Color Meter, dividing traffic
into three groups. If two rates R and S, where R < S, are specified
and traffic arrives at rate T, traffic comprising up to R bits per
second is considered to conform to the "confirmed" rate, R. If
R < T, traffic comprising up to S-R bits per second is considered to
conform to the "excess" rate, S. Any further excess is non-
conformant.

Two meter entries are used to configure this, one for the conforming
rate and one for the excess rate. The rate parameters are stored in
associated Token Bucket Parameter Entries. The "FailNext" pointer of
the lower rate Meter Entry points to the other Meter Entry; both
"SucceedNext" pointers and the "FailNext" pointer of the higher Meter
Entry point to lists of actions. In the color-blind mode, all three
classifier "next" entries point to the lower rate meter entry. In
the color-aware mode, the AFm1 classifier points to the lower rate
entry, the AFm2 classifier points to the higher rate entry (as it is
only compared against that rate), and the AFm3 classifier points
directly to the actions taken when both rates fail.

```
          +-------------------------------------------------------+
          |                      Classifier                       |
          +--------+----------------------------------------------+
               |Green| Yellow| Red
               |     |       |
          +--+-----+-------+--+ Fail +-------------------+
          |        Meter          +------+    Meter          |
          +--+---------------+     +---+-------+--------+
             | Succeed (Green)         |      |Fail (Red)
             |                   +---------+   |
             |                   | Succeed (Yellow)|
          +----+----+       +----+----+      +----+----+
          | Count   |       | Count   |      | Count   |
          | Action  |       | Action  |      | Action  |
          +----+----+       +----+----+      +----+----+
               |                 |                |
          +----+----+       +----+----+      +----+----+
          |Mark AFx1|       |Mark AFx2|      |Mark AFx3|
          | Action  |       | Action  |      | Action  |
          +----+----+       +----+----+      +----+----+
               |                 |                |
          +----+----+       +----+----+      +----+----+
          | Random  |       | Random  |      | Random  |
          | Drop    |       | Drop    |      | Drop    |
          | Action  |       | Action  |      | Action  |
          +----+----+       +----+----+      +----+----+
               |                 |                |
          +--------+----------------+----------------+--------+
          |                      Queue                        |
          +------------------------+--------------------------+
                                   |
                              +----+----+
                              | Rate    |
                              |Scheduler|
                              +----+----+
                                   |
```
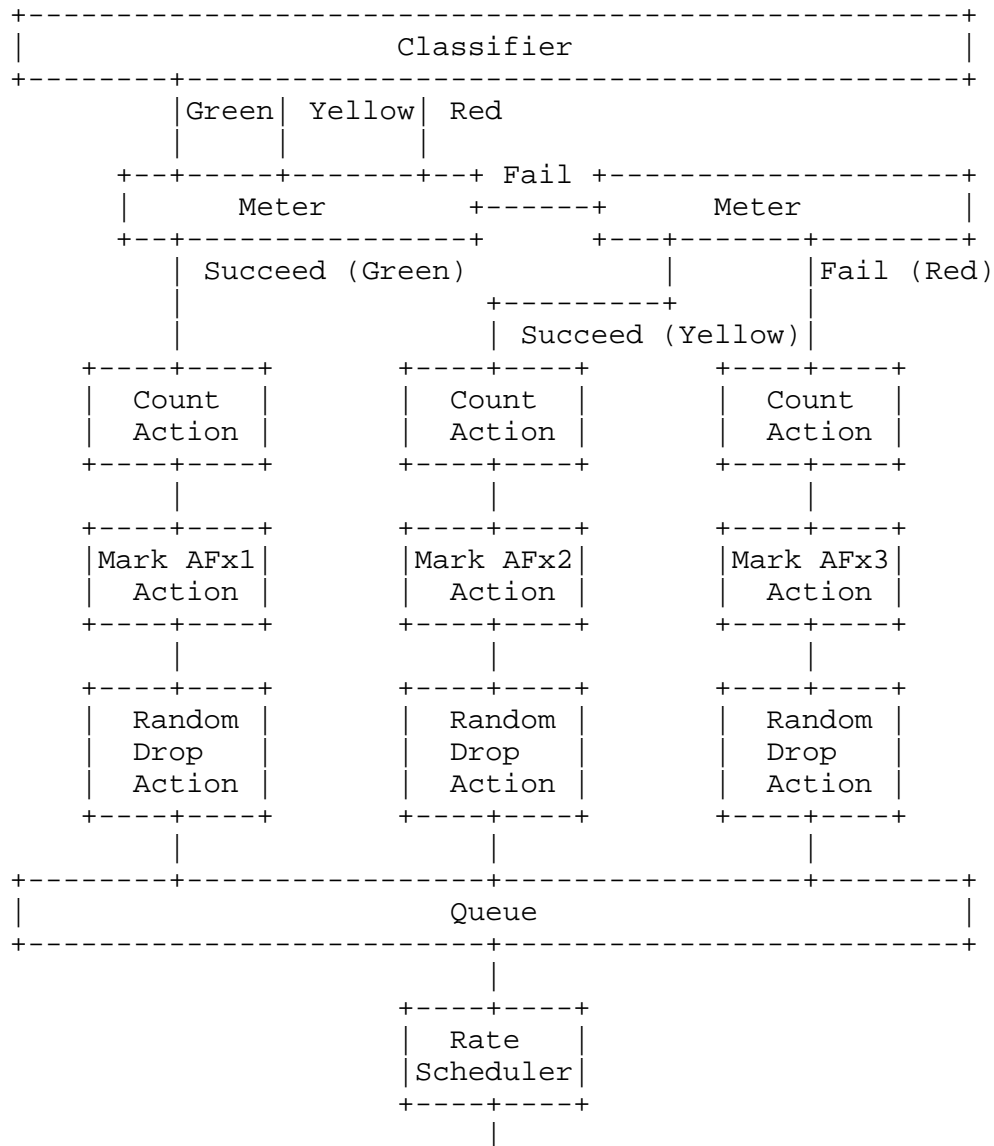
          Figure 9a: Typical AF Edge egress interface configuration,
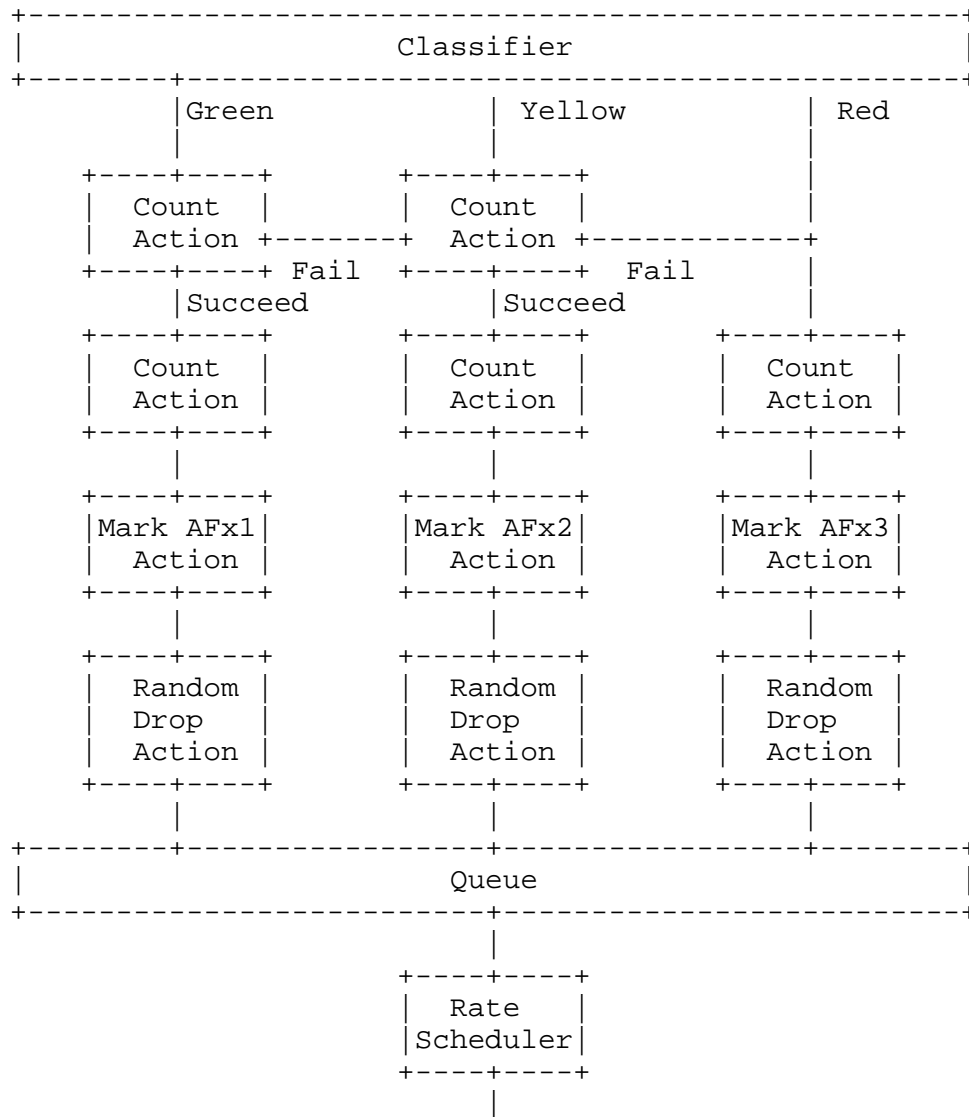   using color-blind meters

```
    +---------------------------------------------------------+
    |                      Classifier                         |
    +---------+-----------------------------------------------+
              |Green               | Yellow            | Red
              |                    |                   |
        +----+----+          +----+----+               |
        | Count   |          | Count   |               |
        | Action +-------+   Action +------------+     |
        +----+----+ Fail  +----+----+   Fail     |
              |Succeed          |Succeed          |
        +----+----+          +----+----+    +----+----+
        | Count   |          | Count   |    | Count   |
        | Action  |          | Action  |    | Action  |
        +----+----+          +----+----+    +----+----+
              |                    |              |
        +----+----+          +----+----+    +----+----+
        |Mark AFx1|          |Mark AFx2|    |Mark AFx3|
        | Action  |          | Action  |    | Action  |
        +----+----+          +----+----+    +----+----+
              |                    |              |
        +----+----+          +----+----+    +----+----+
        | Random  |          | Random  |    | Random  |
        | Drop    |          | Drop    |    | Drop    |
        | Action  |          | Action  |    | Action  |
        +----+----+          +----+----+    +----+----+
              |                    |              |
    +---------+--------------------+--------------+--------+
    |                       Queue                          |
    +---------------------------+--------------------------+
                                |
                        +----+----+
                        | Rate    |
                        |Scheduler|
                        +----+----+
                                |
```

Figure 9b: Typical AF Edge egress interface configuration,
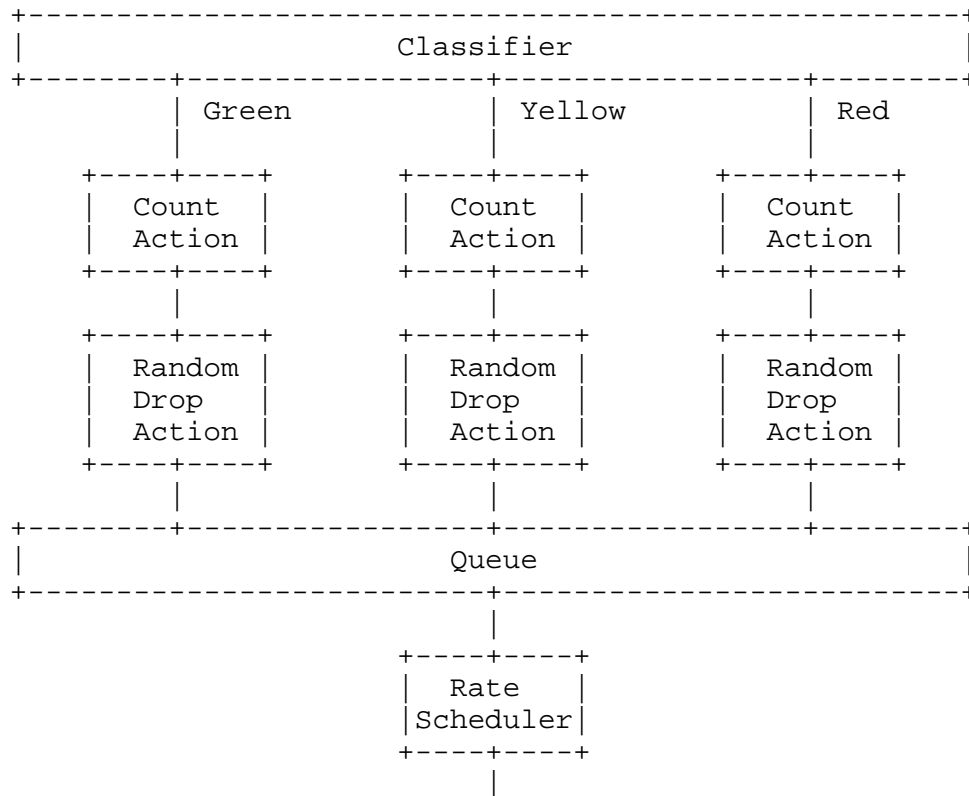   using color-aware meters

```
+-------------------------------------------------------+
|                      Classifier                       |
+---------+----------------+----------------+--------+
          | Green          | Yellow         | Red
          |                |                |
   +----+----+      +----+----+      +----+----+
   | Count   |      | Count   |      | Count   |
   | Action  |      | Action  |      | Action  |
   +----+----+      +----+----+      +----+----+
        |                |                |
   +----+----+      +----+----+      +----+----+
   | Random  |      | Random  |      | Random  |
   | Drop    |      | Drop    |      | Drop    |
   | Action  |      | Action  |      | Action  |
   +----+----+      +----+----+      +----+----+
        |                |                |
+--------+---------------+----------------+--------+
|                        Queue                      |
+------------------------+--------------------------+
                         |
                  +----+----+
                  | Rate    |
                  |Scheduler|
                  +----+----+
                         |
```

             Figure 10: Typical AF Edge core interface configuration

3.7.2.2. AF Actions On an Egress Edge Interface

   For network planning and perhaps for billing purposes, departing
   traffic is normally counted. Therefore, a "count" action, consisting
   of an action table entry pointing to a count table entry, is
   configured.

   Also, traffic may be marked with an appropriate DSCP. The first R
   bits per second are marked AFm1, the next S-R bits per second are
   marked AFm2, and the rest is marked AFm3. It may be that traffic is
   arriving marked with the same DSCP, but in general, the additional
   complexity of deciding that it is being remarked to the same value is
   not useful. Therefore, a "mark" action, consisting of an action
   table entry pointing to a mark table entry, is configured.

   At this point, the usual case is that traffic is now queued for
   transmission. The queue uses Active Queue Management, using an
   algorithm such as RED. Therefore, an Algorithmic Dropper is

configured for each AFmn traffic stream, with a slightly lower min-
threshold (and possibly lower max-threshold) for the excess traffic
than for the committed traffic.

3.7.2.3. AF Rate-based Queuing On an Egress Edge Interface

The queue expected by AF is normally a work-conserving queue. It
usually has a specified minimum rate, and may have a maximum rate
below the bandwidth of the interface. In concept, it will use as
much bandwidth as is available to it, but assure the lower bound.

Common ways to implement this include various forms of Weighted Fair
Queuing (WFQ) or Weighted Round Robin (WRR). Integrated over a
longer interval, these give each class a predictable throughput rate.
They differ in that over short intervals they will order traffic
differently. In general, traffic classes that keep traffic in queue
will tend to absorb latency from queues with lower mean occupancy, in
exchange for which they make use of any available capacity.

3.7.3. EF Implementation On an Egress Edge Interface

The EF class applies a Single Rate Two Color Meter, dividing traffic
into "conforming" and "excess" groups. The intent, on the egress
interface at the edge of the network, is to measure and appropriately
mark conforming traffic and drop the excess.

3.7.3.1. EF Metering On an Egress Edge Interface

A single rate two color (srTCM) meter requires one token bucket. It
is therefore configured using a single meter entry with a
corresponding Token Bucket Parameter Entry. Arriving traffic either
"succeeds" or "fails".

3.7.3.2. EF Actions On an Egress Edge Interface

For network planning and perhaps for billing purposes, departing
traffic that conforms to the meter is normally counted. Therefore, a
"count" action, consisting of an action table entry pointing to a
count table entry, is configured.

Also, traffic is (re)marked with the EF DSCP. Therefore, a "mark"
action, consisting of an action table entry pointing to a mark table
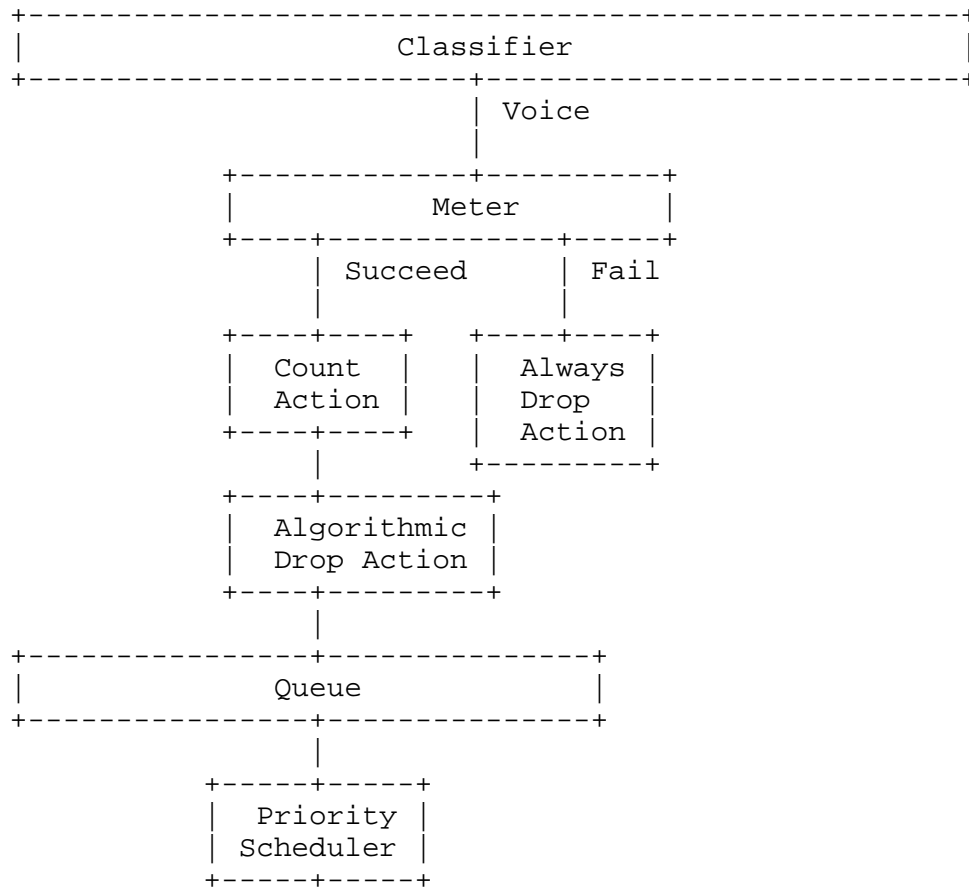entry, is configured.

```
      +----------------------------------------------------+
      |                    Classifier                      |
      +-----------------------+----------------------------+
                              | Voice
                              |
             +------------+---------+
             |          Meter       |
             +----+------------+----+
                  | Succeed    | Fail
                  |            |
             +----+----+   +----+----+
             | Count   |   | Always  |
             | Action  |   | Drop    |
             +----+----+   | Action  |
                  |        +---------+
             +----+--------+
             | Algorithmic |
             | Drop Action |
             +----+--------+
                  |
      +-----------+---------------+
      |          Queue            |
      +-----------+---------------+
                  |
             +-----+-----+
             | Priority  |
             | Scheduler |
             +-----+-----+
```

       Figure 11: Typical EF Edge (Policing) Configuration
```

```
            +--------------------------------+
            |            Classifier          |
            +----------------+---------------+
                             | Voice
                             |
                     +----+----+
                     |  Count  |
                     |  Action |
                     +----+----+
                          |
                  +------+-------+
                  |  Algorithmic |
                  |  Drop Action |
                  +------+-------+
                         |
            +---------------+---------------+
            |              Queue            |
            +---------------+---------------+
                            |
                    +-----+-----+
                    |  Priority |
                    |  Scheduler|
                    +-----+-----+
```

        Figure 12: Typical EF Core interface Configuration

   At this point, the successful traffic is now queued for transmission,
   using a priority queue or perhaps a rate-based queue with significant
   over-provision. Since the amount of traffic present is known, one
   might not drop from this queue at all.

   Traffic that exceeded the policy, however, is dropped. A count
   action can be used on this traffic if the several counters are
   interesting. However, since the drop counter in the Algorithmic Drop
   Entry will count packets dropped, this is not clearly necessary. An
   Algorithmic Drop Entry of the type "alwaysDrop" with no successor is
   sufficient.

3.7.3.3. EF Priority Queuing On an Egress Edge Interface

   The normal implementation is a priority queue, to minimize induced
   jitter. A separate queue is used for each EF class, with a strict
   ordering.

4. Conventions used in this MIB

4.1. The use of RowPointer to indicate data path linkage

   RowPointer is a textual convention used to identify a conceptual row
   in a MIB Table by pointing to one of its objects. One of the ways
   this MIB uses it is to indicate succession, pointing to data path
   linkage table entries.

   For succession, it answers the question "what happens next?". Rather
   than presume that the next table must be as specified in the
   conceptual model [MODEL] and providing its index, the RowPointer
   takes you to the MIB row representing that thing. In the
   diffServMeterTable, for example, the diffServMeterFailNext RowPointer
   might take you to another meter, while the diffServMeterSucceedNext
   RowPointer would take you to an action.

   Since a RowPointer is not tied to any specific object except by the
   value it contains, it is possible and acceptable to use RowPointers
   to merge data paths. An obvious example of such a use is in the
   classifier: traffic matching the DSCPs AF11, AF12, and AF13 might be
   presented to the same meter in order to perform the processing
   described in the Assured Forwarding PHB. Another use would be to
   merge data paths from several interfaces; if they represent a single
   service contract, having them share a common set of counters and
   common policy may be a desirable configuration. Note well, however,
   that such configurations may have related implementation issues - if
   Differentiated Services processing for the interfaces is implemented
   in multiple forwarding engines, the engines will need to communicate
   if they are to implement such a feature. An implementation that
   fails to provide this capability is not considered to have failed the
   intention of this MIB or of the [MODEL]; an implementation that does
   provide it is not considered superior from a standards perspective.

      NOTE -- the RowPointer construct is used to connect the functional
      data paths. The [MODEL] describes these as TCBs, as an aid to
      understanding. This MIB, however, does not model TCBs directly.
      It operates at a lower level of abstraction using only individual
      elements, connected in succession by RowPointers. Therefore, the
      concept of TCBs enclosing individual Functional Data Path elements
      is not directly applicable to this MIB, although management tools
      that use this MIB may employ such a concept.

   It is possible that a path through a device following a set of
   RowPointers is indeterminate i.e. it ends in a dangling RowPointer.
   Guidance is provided in the MIB module's DESCRIPTION-clause for each
   of the linkage attribute. In general, for both zeroDotZero and
   dangling RowPointer, it is assumed the data path ends and the traffic

should be given to the next logical part of the device, usually a
forwarding process or a transmission engine, or the proverbial bit-
bucket. Any variation from this usage is indicated by the attribute
affected.

4.2. The use of RowPointer to indicate parameters

   RowPointer is also used in this MIB to indicate parameterization, for
   pointing to parameterization table entries.

   For indirection (as in the diffServClfrElementTable), the idea is to
   allow other MIBs, including proprietary ones, to define new and
   arcane filters - MAC headers, IPv4 and IPv6 headers, BGP Communities
   and all sorts of other things - while still utilizing the structures
   of this MIB. This is a form of class inheritance (in "object
   oriented" language): it allows base object definitions ("classes") to
   be extended in proprietary or standard ways, in the future, by other
   documents.

   RowPointer also clearly indicates the identified conceptual row's
   content does not change, hence they can be simultaneously used and
   pointed to, by more than one data path linkage table entries. The
   identification of RowPointer allows higher level policy mechanisms to
   take advantage of this characteristic.

4.3. Conceptual row creation and deletion

   A number of conceptual tables defined in this MIB use as an index an
   arbitrary integer value, unique across the scope of the agent. In
   order to help with multi-manager row-creation problems, a mechanism
   must be provided to allow a manager to obtain unique values for such
   an index and to ensure that, when used, the manager knows whether it
   got what it wanted or not.

   Typically, such a table has an associated NextFree variable e.g.
   diffServClfrNextFree which provides a suitable value for the index of
   the next row to be created e.g. diffServClfrId. The value zero is
   used to indicate that the agent can configure no more entries. The
   table also has a columnar Status attribute with RowStatus syntax [RFC
   2579].

   Generally, if a manager attempts to create a row, the agent will
   create the row and return success. If the agent has insufficient
   resources or such a row already exists, then it returns an error. A
   manager must be prepared to try again in such circumstances, probably
   by re-reading the NextFree to obtain a new index value in case a
   second manager had got in between the first manager's read of the
   NextFree value and the first manager's row-creation attempt.

To simplify management creation and deletion of rows in this MIB, the
agent is expected to assist in maintaining its consistency. It may
accomplish this by maintaining internal usage counters for any row
that might be pointed to by a RowPointer, or by any equivalent means.
When a RowPointer is created or written, and the row it points to
does not exist, the SET returns an inconsistentValue error. When a
RowStatus variable is set to 'destroy' but the usage counter is non-
zero, the SET returns no error but the indicated row is left intact.
The agent should later remove the row in the event that the usage
counter becomes zero.

The use of RowStatus is covered in more detail in [RFC 2579].

5. Extending this MIB

With the structures of this MIB divided into data path linkage tables
and parameterization tables, and with the use of RowPointer, new data
path linkage and parameterization tables can be defined in other MIB
modules, and used with tables defined in this MIB. This MIB does not
limit the type of entries its RowPointer attributes can point to,
hence new functional data path elements can be defined in other MIBs
and integrated with functional data path elements of this MIB. For
example, new Action functional data path element can be defined for
Traffic Engineering and be integrated with Differentiated Services
functional data path elements, possibly used within the same data
path sharing the same classifiers and meters.

It is more likely that new parameterization tables will be created in
other MIBs as new methods or proprietary methods get deployed for
existing Differentiated Services Functional Data Path Elements. For
example, different kinds of filters can be defined by using new
filter parameterization tables. New scheduling methods can be
deployed by defining new scheduling method OIDs and new scheduling
parameter tables.

Notice both new data path linkage tables and parameterization tables
can be added without needing to change this MIB document or affect
existing tables and their usage.

6. MIB Definition

DIFFSERV-DSCP-TC DEFINITIONS ::= BEGIN

```
   IMPORTS
   Integer32, MODULE-IDENTITY, mib-2
        FROM SNMPv2-SMI
   TEXTUAL-CONVENTION
        FROM SNMPv2-TC;
```

```
diffServDSCPTC MODULE-IDENTITY
    LAST-UPDATED "200205090000Z"
    ORGANIZATION "IETF Differentiated Services WG"
    CONTACT-INFO
        "         Fred Baker
                  Cisco Systems
                  1121 Via Del Rey
                  Santa Barbara, CA 93117, USA
                  E-mail: fred@cisco.com

                  Kwok Ho Chan
                  Nortel Networks
                  600 Technology Park Drive
                  Billerica, MA 01821, USA
                  E-mail: khchan@nortelnetworks.com

                  Andrew Smith
                  Harbour Networks
                  Jiuling Building
                  21 North Xisanhuan Ave.
                  Beijing, 100089, PRC
                  E-mail: ah_smith@acm.org

                    Differentiated Services Working Group:
                  diffserv@ietf.org"
    DESCRIPTION
       "The Textual Conventions defined in this module should be used
       whenever a Differentiated Services Code Point is used in a MIB."
    REVISION "200205090000Z"
    DESCRIPTION
       "Initial version, published as RFC 3289."
    ::= { mib-2 96 }

Dscp ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS    current
    DESCRIPTION
       "A Differentiated Services Code-Point that may be used for
       marking a traffic stream."
    REFERENCE
        "RFC 2474, RFC 2780"
    SYNTAX    Integer32 (0..63)

DscpOrAny ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS    current
    DESCRIPTION
       "The IP header Differentiated Services Code-Point that may be
```

```
        used for discriminating among traffic streams. The value -1 is
        used to indicate a wild card i.e. any value."
    REFERENCE
        "RFC 2474, RFC 2780"
    SYNTAX    Integer32 (-1 | 0..63)


END

DIFFSERV-MIB DEFINITIONS ::= BEGIN

    IMPORTS
    Unsigned32, Counter64, MODULE-IDENTITY, OBJECT-TYPE,
    OBJECT-IDENTITY, zeroDotZero, mib-2
        FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, RowStatus, RowPointer,
    StorageType, AutonomousType
        FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP
        FROM SNMPv2-CONF
    ifIndex, InterfaceIndexOrZero
        FROM IF-MIB
    InetAddressType, InetAddress, InetAddressPrefixLength,
    InetPortNumber
        FROM INET-ADDRESS-MIB
    BurstSize
        FROM INTEGRATED-SERVICES-MIB
    Dscp, DscpOrAny
        FROM DIFFSERV-DSCP-TC;


diffServMib MODULE-IDENTITY
    LAST-UPDATED "200202070000Z"
    ORGANIZATION "IETF Differentiated Services WG"
    CONTACT-INFO
        "        Fred Baker
                 Cisco Systems
                 1121 Via Del Rey
                 Santa Barbara, CA 93117, USA
                 E-mail: fred@cisco.com

                 Kwok Ho Chan
                 Nortel Networks
                 600 Technology Park Drive
                 Billerica, MA 01821, USA
                 E-mail: khchan@nortelnetworks.com

                 Andrew Smith
                 Harbour Networks
                 Jiuling Building
```

```
                 21 North Xisanhuan Ave.
                 Beijing, 100089, PRC
                 E-mail: ah_smith@acm.org

                 Differentiated Services Working Group:
                 diffserv@ietf.org"
      DESCRIPTION
         "This MIB defines the objects necessary to manage a device that
         uses the Differentiated Services Architecture described in RFC
         2475. The Conceptual Model of a Differentiated Services Router
         provides supporting information on how such a router is modeled."
      REVISION "200202070000Z"
      DESCRIPTION
         "Initial version, published as RFC 3289."
      ::= { mib-2 97 }

diffServMIBObjects     OBJECT IDENTIFIER ::= { diffServMib 1 }
diffServMIBConformance OBJECT IDENTIFIER ::= { diffServMib 2 }
diffServMIBAdmin       OBJECT IDENTIFIER ::= { diffServMib 3 }

IndexInteger ::= TEXTUAL-CONVENTION
      DISPLAY-HINT "d"
      STATUS    current
      DESCRIPTION
         "An integer which may be used as a table index."
      SYNTAX    Unsigned32 (1..4294967295)

IndexIntegerNextFree ::= TEXTUAL-CONVENTION
      DISPLAY-HINT "d"
      STATUS    current
      DESCRIPTION
         "An integer which may be used as a new Index in a table.

         The special value of 0 indicates that no more new entries can be
         created in the relevant table.

         When a MIB is used for configuration, an object with this SYNTAX
         always contains a legal value (if non-zero) for an index that is
         not currently used in the relevant table. The Command Generator
         (Network Management Application) reads this variable and uses the
         (non-zero) value read when creating a new row with an SNMP SET.
         When the SET is performed, the Command Responder (agent) must
         determine whether the value is indeed still unused; Two Network
         Management Applications may attempt to create a row
         (configuration entry) simultaneously and use the same value. If
         it is currently unused, the SET succeeds and the Command
         Responder (agent) changes the value of this object, according to
         an implementation-specific algorithm.  If the value is in use,
```

        however, the SET fails. The Network Management Application must
        then re-read this variable to obtain a new usable value.

        An OBJECT-TYPE definition using this SYNTAX MUST specify the
        relevant table for which the object is providing this
        functionality."
     SYNTAX   Unsigned32 (0..4294967295)

IfDirection ::= TEXTUAL-CONVENTION
     STATUS current
     DESCRIPTION
        "IfDirection specifies a direction of data travel on an
        interface. 'inbound' traffic is operated on during reception from
        the interface, while 'outbound' traffic is operated on prior to
        transmission on the interface."
     SYNTAX   INTEGER {
                    inbound(1),   -- ingress interface
                    outbound(2)   -- egress interface
}

--
-- Data Path
--

diffServDataPath   OBJECT IDENTIFIER ::= { diffServMIBObjects 1 }

--
-- Data Path Table
--
-- The Data Path Table enumerates the Differentiated Services
-- Functional Data Paths within this device. Each entry in this table
-- is indexed by ifIndex and ifDirection. Each entry provides the
-- first Differentiated Services Functional Data Path Element to
-- process data flowing along specific data path. This table should
-- have at most two entries for each interface capable of
-- Differentiated Services processing on this device: ingress and
-- egress.

-- Note that Differentiated Services Functional Data Path Elements
-- linked together using their individual next pointers and anchored by
-- an entry of the diffServDataPathTable constitute a functional data
-- path.
--

diffServDataPathTable OBJECT-TYPE
     SYNTAX   SEQUENCE OF DiffServDataPathEntry
     MAX-ACCESS   not-accessible
     STATUS   current

        DESCRIPTION
           "The data path table contains RowPointers indicating the start of
           the functional data path for each interface and traffic direction
           in this device. These may merge, or be separated into parallel
           data paths."
        ::= { diffServDataPath 1 }

diffServDataPathEntry OBJECT-TYPE
        SYNTAX   DiffServDataPathEntry
        MAX-ACCESS   not-accessible
        STATUS   current
        DESCRIPTION
           "An entry in the data path table indicates the start of a single
           Differentiated Services Functional Data Path in this device.

           These are associated with individual interfaces, logical or
           physical, and therefore are instantiated by ifIndex. Therefore,
           the interface index must have been assigned, according to the
           procedures applicable to that, before it can be meaningfully
           used. Generally, this means that the interface must exist.

           When diffServDataPathStorage is of type nonVolatile, however,
           this may reflect the configuration for an interface whose ifIndex
           has been assigned but for which the supporting implementation is
           not currently present."
        INDEX { ifIndex, diffServDataPathIfDirection }
        ::= { diffServDataPathTable 1 }

DiffServDataPathEntry ::= SEQUENCE {
    diffServDataPathIfDirection   IfDirection,
    diffServDataPathStart   RowPointer,
    diffServDataPathStorage   StorageType,
    diffServDataPathStatus   RowStatus
}

diffServDataPathIfDirection OBJECT-TYPE
        SYNTAX   IfDirection
        MAX-ACCESS   not-accessible
        STATUS   current
        DESCRIPTION
           "IfDirection specifies whether the reception or transmission path
           for this interface is in view."
        ::= { diffServDataPathEntry 1 }

diffServDataPathStart OBJECT-TYPE
        SYNTAX   RowPointer
        MAX-ACCESS   read-create
        STATUS   current

```
    DESCRIPTION
        "This selects the first Differentiated Services Functional Data
        Path Element to handle traffic for this data path. This
        RowPointer should point to an instance of one of:
          diffServClfrEntry
          diffServMeterEntry
          diffServActionEntry
          diffServAlgDropEntry
          diffServQEntry

        A value of zeroDotZero in this attribute indicates that no
        Differentiated Services treatment is performed on traffic of this
        data path. A pointer with the value zeroDotZero normally
        terminates a functional data path.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    ::= { diffServDataPathEntry 2 }

diffServDataPathStorage OBJECT-TYPE
    SYNTAX         StorageType
    MAX-ACCESS     read-create
    STATUS         current
    DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServDataPathEntry 3 }

diffServDataPathStatus OBJECT-TYPE
    SYNTAX         RowStatus
    MAX-ACCESS     read-create
    STATUS         current
    DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time."
    ::= { diffServDataPathEntry 4 }

--
-- Classifiers
--

diffServClassifier     OBJECT IDENTIFIER ::= { diffServMIBObjects 2 }

--
```

-- Classifier Table
--
-- The Classifier Table allows multiple classifier elements, of same or
-- different types, to be used together. A classifier must completely
-- classify all packets presented to it. This means that all traffic
-- presented to a classifier must match at least one classifier element
-- within the classifier, with the classifier element parameters
-- specified by a filter.

-- If there is ambiguity between classifier elements of different
-- classifier, classifier linkage order indicates their precedence; the
-- first classifier in the link is applied to the traffic first.

-- Entries in the classifier element table serves as the anchor for
-- each classification pattern, defined in filter table entries. Each
-- classifier element table entry also specifies the subsequent
-- downstream Differentiated Services Functional Data Path Element when
-- the classification pattern is satisfied. Each entry in the
-- classifier element table describes one branch of the fan-out
-- characteristic of a classifier indicated in the Informal
-- Differentiated Services Model section 4.1. A classifier is composed
-- of one or more classifier elements.

diffServClfrNextFree OBJECT-TYPE
    SYNTAX   IndexIntegerNextFree
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
       "This object contains an unused value for diffServClfrId, or a
       zero to indicate that none exist."
    ::= { diffServClassifier 1 }

diffServClfrTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF DiffServClfrEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "This table enumerates all the diffserv classifier functional
       data path elements of this device. The actual classification
       definitions are defined in diffServClfrElementTable entries
       belonging to each classifier.

       An entry in this table, pointed to by a RowPointer specifying an
       instance of diffServClfrStatus, is frequently used as the name
       for a set of classifier elements, which all use the index
       diffServClfrId. Per the semantics of the classifier element
       table, these entries constitute one or more unordered sets of
       tests which may be simultaneously applied to a message to

      classify it.

      The primary function of this table is to ensure that the value of
      diffServClfrId is unique before attempting to use it in creating
      a diffServClfrElementEntry. Therefore, the diffServClfrEntry must
      be created on the same SET as the diffServClfrElementEntry, or
      before the diffServClfrElementEntry is created."
   ::= { diffServClassifier 2 }

diffServClfrEntry OBJECT-TYPE
    SYNTAX   DiffServClfrEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "An entry in the classifier table describes a single classifier.
       All classifier elements belonging to the same classifier use the
       classifier's diffServClfrId as part of their index."
    INDEX { diffServClfrId }
    ::= { diffServClfrTable 1 }

DiffServClfrEntry ::= SEQUENCE {
    diffServClfrId   IndexInteger,
    diffServClfrStorage   StorageType,
    diffServClfrStatus   RowStatus
}

diffServClfrId OBJECT-TYPE
    SYNTAX   IndexInteger
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "An index that enumerates the classifier entries. Managers
       should obtain new values for row creation in this table by
       reading diffServClfrNextFree."
    ::= { diffServClfrEntry 1 }

diffServClfrStorage OBJECT-TYPE
    SYNTAX   StorageType
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The storage type for this conceptual row. Conceptual rows
       having the value 'permanent' need not allow write-access to any
       columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServClfrEntry 2 }

diffServClfrStatus OBJECT-TYPE

```
     SYNTAX         RowStatus
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
         "The status of this conceptual row. All writable objects in this
         row may be modified at any time. Setting this variable to
         'destroy' when the MIB contains one or more RowPointers pointing
         to it results in destruction being delayed until the row is no
         longer used."
     ::= { diffServClfrEntry 3 }

--
-- Classifier Element Table
--
diffServClfrElementNextFree OBJECT-TYPE
     SYNTAX         IndexIntegerNextFree
     MAX-ACCESS     read-only
     STATUS         current
     DESCRIPTION
         "This object contains an unused value for diffServClfrElementId,
         or a zero to indicate that none exist."
     ::= { diffServClassifier 3 }

diffServClfrElementTable OBJECT-TYPE
     SYNTAX         SEQUENCE OF DiffServClfrElementEntry
     MAX-ACCESS     not-accessible
     STATUS         current
     DESCRIPTION
         "The classifier element table enumerates the relationship between
         classification patterns and subsequent downstream Differentiated
         Services Functional Data Path elements.
         diffServClfrElementSpecific points to a filter that specifies the
         classification parameters. A classifier may use filter tables of
         different types together.

         One example of a filter table defined in this MIB is
         diffServMultiFieldClfrTable, for IP Multi-Field Classifiers
         (MFCs). Such an entry might identify anything from a single
         micro-flow (an identifiable sub-session packet stream directed
         from one sending transport to the receiving transport or
         transports), or aggregates of those such as the traffic from a
         host, traffic for an application, or traffic between two hosts
         using an application and a given DSCP. The standard Behavior
         Aggregate used in the Differentiated Services Architecture is
         encoded as a degenerate case of such an aggregate - the traffic
         using a particular DSCP value.

         Filter tables for other filter types may be defined elsewhere."
```

```
    ::= { diffServClassifier 4 }


diffServClfrElementEntry OBJECT-TYPE
    SYNTAX        DiffServClfrElementEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An entry in the classifier element table describes a single
       element of the classifier."
    INDEX { diffServClfrId, diffServClfrElementId }
    ::= { diffServClfrElementTable 1 }


DiffServClfrElementEntry ::= SEQUENCE  {
    diffServClfrElementId         IndexInteger,
    diffServClfrElementPrecedence Unsigned32,
    diffServClfrElementNext        RowPointer,
    diffServClfrElementSpecific    RowPointer,
    diffServClfrElementStorage     StorageType,
    diffServClfrElementStatus      RowStatus
}


diffServClfrElementId OBJECT-TYPE
    SYNTAX        IndexInteger
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An index that enumerates the Classifier Element entries.
       Managers obtain new values for row creation in this table by
       reading diffServClfrElementNextFree."
    ::= { diffServClfrElementEntry 1 }


diffServClfrElementPrecedence OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
       "The relative order in which classifier elements are applied:
       higher numbers represent classifier element with higher
       precedence.  Classifier elements with the same order must be
       unambiguous i.e. they must define non-overlapping patterns, and
       are considered to be applied simultaneously to the traffic
       stream. Classifier elements with different order may overlap in
       their filters:  the classifier element with the highest order
       that matches is taken.

       On a given interface, there must be a complete classifier in
       place at all times in the ingress direction.  This means one or
       more filters must match any possible pattern. There is no such
```

            requirement in the egress direction."
        ::= { diffServClfrElementEntry 2 }

diffServClfrElementNext OBJECT-TYPE
        SYNTAX   RowPointer
        MAX-ACCESS   read-create
        STATUS   current
        DESCRIPTION
            "This attribute provides one branch of the fan-out functionality
            of a classifier described in the Informal Differentiated Services
            Model section 4.1.

            This selects the next Differentiated Services Functional Data
            Path Element to handle traffic for this data path. This
            RowPointer should point to an instance of one of:
              diffServClfrEntry
              diffServMeterEntry
              diffServActionEntry
              diffServAlgDropEntry
              diffServQEntry

            A value of zeroDotZero in this attribute indicates no further
            Differentiated Services treatment is performed on traffic of this
            data path. The use of zeroDotZero is the normal usage for the
            last functional data path element of the current data path.

            Setting this to point to a target that does not exist results in
            an inconsistentValue error. If the row pointed to is removed or
            becomes inactive by other means, the treatment is as if this
            attribute contains a value of zeroDotZero."

        ::= { diffServClfrElementEntry 3 }

diffServClfrElementSpecific OBJECT-TYPE
        SYNTAX   RowPointer
        MAX-ACCESS   read-create
        STATUS   current
        DESCRIPTION
            "A pointer to a valid entry in another table, filter table, that
            describes the applicable classification parameters, e.g. an entry
            in diffServMultiFieldClfrTable.

            The value zeroDotZero is interpreted to match anything not
            matched by another classifier element - only one such entry may
            exist for each classifier.

            Setting this to point to a target that does not exist results in
            an inconsistentValue error. If the row pointed to is removed or

        becomes inactive by other means, the element is ignored."
    ::= { diffServClfrElementEntry 4 }

diffServClfrElementStorage OBJECT-TYPE
    SYNTAX   StorageType
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The storage type for this conceptual row. Conceptual rows
       having the value 'permanent' need not allow write-access to any
       columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServClfrElementEntry 5 }

diffServClfrElementStatus OBJECT-TYPE
    SYNTAX   RowStatus
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The status of this conceptual row. All writable objects in this
       row may be modified at any time. Setting this variable to
       'destroy' when the MIB contains one or more RowPointers pointing
       to it results in destruction being delayed until the row is no
       longer used."
    ::= { diffServClfrElementEntry 6 }

--
-- IP Multi-field Classification Table
--
-- Classification based on six different fields in the IP header.
-- Functional Data Paths may share definitions by using the same entry.
--

diffServMultiFieldClfrNextFree OBJECT-TYPE
    SYNTAX   IndexIntegerNextFree
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
       "This object contains an unused value for
       diffServMultiFieldClfrId, or a zero to indicate that none exist."
    ::= { diffServClassifier 5 }

diffServMultiFieldClfrTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF DiffServMultiFieldClfrEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "A table of IP Multi-field Classifier filter entries that a

         system may use to identify IP traffic."
    ::= { diffServClassifier 6 }

diffServMultiFieldClfrEntry OBJECT-TYPE
    SYNTAX   DiffServMultiFieldClfrEntry
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "An IP Multi-field Classifier entry describes a single filter."
    INDEX { diffServMultiFieldClfrId }
    ::= { diffServMultiFieldClfrTable 1 }

DiffServMultiFieldClfrEntry ::= SEQUENCE {
    diffServMultiFieldClfrId   IndexInteger,
    diffServMultiFieldClfrAddrType   InetAddressType,
    diffServMultiFieldClfrDstAddr   InetAddress,
    diffServMultiFieldClfrDstPrefixLength InetAddressPrefixLength,
    diffServMultiFieldClfrSrcAddr   InetAddress,
    diffServMultiFieldClfrSrcPrefixLength InetAddressPrefixLength,
    diffServMultiFieldClfrDscp   DscpOrAny,
    diffServMultiFieldClfrFlowId   Unsigned32,
    diffServMultiFieldClfrProtocol   Unsigned32,
    diffServMultiFieldClfrDstL4PortMin InetPortNumber,
    diffServMultiFieldClfrDstL4PortMax InetPortNumber,
    diffServMultiFieldClfrSrcL4PortMin InetPortNumber,
    diffServMultiFieldClfrSrcL4PortMax InetPortNumber,
    diffServMultiFieldClfrStorage   StorageType,
    diffServMultiFieldClfrStatus   RowStatus
}

diffServMultiFieldClfrId OBJECT-TYPE
    SYNTAX   IndexInteger
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "An index that enumerates the MultiField Classifier filter
       entries. Managers obtain new values for row creation in this
       table by reading diffServMultiFieldClfrNextFree."

    ::= { diffServMultiFieldClfrEntry 1 }

diffServMultiFieldClfrAddrType OBJECT-TYPE
    SYNTAX   InetAddressType
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The type of IP address used by this classifier entry. While
       other types of addresses are defined in the InetAddressType

```
      textual convention, and DNS names, a classifier can only look at
      packets on the wire. Therefore, this object is limited to IPv4
      and IPv6 addresses."
    ::= { diffServMultiFieldClfrEntry 2 }

diffServMultiFieldClfrDstAddr OBJECT-TYPE
    SYNTAX          InetAddress
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
      "The IP address to match against the packet's destination IP
      address. This may not be a DNS name, but may be an IPv4 or IPv6
      prefix.  diffServMultiFieldClfrDstPrefixLength indicates the
      number of bits that are relevant."
    ::= { diffServMultiFieldClfrEntry 3 }

diffServMultiFieldClfrDstPrefixLength OBJECT-TYPE
    SYNTAX          InetAddressPrefixLength
    UNITS           "bits"
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
      "The length of the CIDR Prefix carried in
      diffServMultiFieldClfrDstAddr. In IPv4 addresses, a length of 0
      indicates a match of any address; a length of 32 indicates a
      match of a single host address, and a length between 0 and 32
      indicates the use of a CIDR Prefix. IPv6 is similar, except that
      prefix lengths range from 0..128."
    DEFVAL          { 0 }
    ::= { diffServMultiFieldClfrEntry 4 }

diffServMultiFieldClfrSrcAddr OBJECT-TYPE
    SYNTAX          InetAddress
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
      "The IP address to match against the packet's source IP address.
      This may not be a DNS name, but may be an IPv4 or IPv6 prefix.
      diffServMultiFieldClfrSrcPrefixLength indicates the number of
      bits that are relevant."
    ::= { diffServMultiFieldClfrEntry 5 }

diffServMultiFieldClfrSrcPrefixLength OBJECT-TYPE
    SYNTAX          InetAddressPrefixLength
    UNITS           "bits"
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
```

```
          "The length of the CIDR Prefix carried in
          diffServMultiFieldClfrSrcAddr. In IPv4 addresses, a length of 0
          indicates a match of any address; a length of 32 indicates a
          match of a single host address, and a length between 0 and 32
          indicates the use of a CIDR Prefix. IPv6 is similar, except that
          prefix lengths range from 0..128."
      DEFVAL          { 0 }
      ::= { diffServMultiFieldClfrEntry 6 }

  diffServMultiFieldClfrDscp OBJECT-TYPE
      SYNTAX          DscpOrAny
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The value that the DSCP in the packet must have to match this
          entry. A value of -1 indicates that a specific DSCP value has not
          been defined and thus all DSCP values are considered a match."
      DEFVAL          { -1 }
      ::= { diffServMultiFieldClfrEntry 7 }

  diffServMultiFieldClfrFlowId OBJECT-TYPE
      SYNTAX          Unsigned32 (0..1048575)
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The flow identifier in an IPv6 header."
      ::= { diffServMultiFieldClfrEntry 8 }

  diffServMultiFieldClfrProtocol OBJECT-TYPE
      SYNTAX          Unsigned32 (0..255)
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The IP protocol to match against the IPv4 protocol number or the
          IPv6 Next- Header number in the packet. A value of 255 means
          match all.  Note the protocol number of 255 is reserved by IANA,
          and Next-Header number of 0 is used in IPv6."
      DEFVAL          { 255 }
      ::= { diffServMultiFieldClfrEntry 9 }

  diffServMultiFieldClfrDstL4PortMin OBJECT-TYPE
      SYNTAX          InetPortNumber
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The minimum value that the layer-4 destination port number in
          the packet must have in order to match this classifier entry."
      DEFVAL          { 0 }
```

```
    ::= { diffServMultiFieldClfrEntry 10 }

diffServMultiFieldClfrDstL4PortMax OBJECT-TYPE
    SYNTAX          InetPortNumber
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
       "The maximum value that the layer-4 destination port number in
       the packet must have in order to match this classifier entry.
       This value must be equal to or greater than the value specified
       for this entry in diffServMultiFieldClfrDstL4PortMin."
    DEFVAL        { 65535 }
    ::= { diffServMultiFieldClfrEntry 11 }

diffServMultiFieldClfrSrcL4PortMin OBJECT-TYPE
    SYNTAX          InetPortNumber
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
       "The minimum value that the layer-4 source port number in the
       packet must have in order to match this classifier entry."
    DEFVAL        { 0 }
    ::= { diffServMultiFieldClfrEntry 12 }

diffServMultiFieldClfrSrcL4PortMax OBJECT-TYPE
    SYNTAX          InetPortNumber
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
       "The maximum value that the layer-4 source port number in the
       packet must have in order to match this classifier entry. This
       value must be equal to or greater than the value specified for
       this entry in diffServMultiFieldClfrSrcL4PortMin."
    DEFVAL        { 65535 }
    ::= { diffServMultiFieldClfrEntry 13 }

diffServMultiFieldClfrStorage OBJECT-TYPE
    SYNTAX       StorageType
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
       "The storage type for this conceptual row.  Conceptual rows
       having the value 'permanent' need not allow write-access to any
       columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServMultiFieldClfrEntry 14 }

diffServMultiFieldClfrStatus OBJECT-TYPE
```

```
     SYNTAX       RowStatus
     MAX-ACCESS   read-create
     STATUS       current
     DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
      ::= { diffServMultiFieldClfrEntry 15 }

--
-- Meters
--

diffServMeter            OBJECT IDENTIFIER ::= { diffServMIBObjects 3 }

--
-- This MIB supports a variety of Meters.  It includes a specific
-- definition for Token Bucket Meter, which are but one type of
-- specification. Other metering parameter sets can be defined in other
-- MIBs.

-- Multiple meter elements may be logically cascaded using their
-- diffServMeterSucceedNext and diffServMeterFailNext pointers if
-- required. One example of this might be for an AF PHB implementation
-- that uses multiple level conformance meters.

-- Cascading of individual meter elements in the MIB is intended to be
-- functionally equivalent to multiple level conformance determination
-- of a packet.  The sequential nature of the representation is merely
-- a notational convenience for this MIB.

-- srTCM meters (RFC 2697) can be specified using two sets of
-- diffServMeterEntry and diffServTBParamEntry. The first set specifies
-- the Committed Information Rate and Committed Burst Size
-- token-bucket.  The second set specifies the Excess Burst Size
-- token-bucket.

-- trTCM meters (RFC 2698) can be specified using two sets of
-- diffServMeterEntry and diffServTBParamEntry. The first set specifies
-- the Committed Information Rate and Committed Burst Size
-- token-bucket.  The second set specifies the Peak Information Rate
-- and Peak Burst Size token-bucket.

-- tswTCM meters (RFC 2859) can be specified using two sets of
-- diffServMeterEntry and diffServTBParamEntry. The first set specifies
-- the Committed Target Rate token-bucket.  The second set specifies
```

```
-- the Peak Target Rate token-bucket. diffServTBParamInterval in each
-- token bucket reflects the Average Interval.
--

diffServMeterNextFree OBJECT-TYPE
    SYNTAX          IndexIntegerNextFree
    MAX-ACCESS   read-only
    STATUS          current
    DESCRIPTION
       "This object contains an unused value for diffServMeterId, or a
       zero to indicate that none exist."
    ::= { diffServMeter 1 }

diffServMeterTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DiffServMeterEntry
    MAX-ACCESS   not-accessible
    STATUS          current
    DESCRIPTION
       "This table enumerates specific meters that a system may use to
       police a stream of traffic. The traffic stream to be metered is
       determined by the Differentiated Services Functional Data Path
       Element(s) upstream of the meter i.e. by the object(s) that point
       to each entry in this table.  This may include all traffic on an
       interface.

       Specific meter details are to be found in table entry referenced
       by diffServMeterSpecific."
    ::= { diffServMeter 2 }

diffServMeterEntry OBJECT-TYPE
    SYNTAX          DiffServMeterEntry
    MAX-ACCESS   not-accessible
    STATUS          current
    DESCRIPTION
       "An entry in the meter table describes a single conformance level
       of a meter."
    INDEX { diffServMeterId }
    ::= { diffServMeterTable 1 }

DiffServMeterEntry ::= SEQUENCE  {
    diffServMeterId                 IndexInteger,
    diffServMeterSucceedNext        RowPointer,
    diffServMeterFailNext           RowPointer,
    diffServMeterSpecific           RowPointer,
    diffServMeterStorage            StorageType,
    diffServMeterStatus             RowStatus
}
```

diffServMeterId OBJECT-TYPE
    SYNTAX   IndexInteger
    MAX-ACCESS   not-accessible
    STATUS   current
    DESCRIPTION
       "An index that enumerates the Meter entries. Managers obtain new
       values for row creation in this table by reading
       diffServMeterNextFree."
    ::= { diffServMeterEntry 1 }

diffServMeterSucceedNext OBJECT-TYPE
    SYNTAX   RowPointer
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
        "If the traffic does conform, this selects the next
        Differentiated Services Functional Data Path element to handle
        traffic for this data path. This RowPointer should point to an
        instance of one of:
          diffServClfrEntry
          diffServMeterEntry
          diffServActionEntry
          diffServAlgDropEntry
          diffServQEntry

        A value of zeroDotZero in this attribute indicates that no
        further Differentiated Services treatment is performed on traffic
        of this data path. The use of zeroDotZero is the normal usage for
        the last functional data path element of the current data path.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error. If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    DEFVAL   { zeroDotZero }
    ::= { diffServMeterEntry 2 }

diffServMeterFailNext OBJECT-TYPE
    SYNTAX   RowPointer
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "If the traffic does not conform, this selects the next
       Differentiated Services Functional Data Path element to handle
       traffic for this data path. This RowPointer should point to an
       instance of one of:
         diffServClfrEntry
         diffServMeterEntry

```
        diffServActionEntry
        diffServAlgDropEntry
        diffServQEntry

    A value of zeroDotZero in this attribute indicates no further
    Differentiated Services treatment is performed on traffic of this
    data path. The use of zeroDotZero is the normal usage for the
    last functional data path element of the current data path.

    Setting this to point to a target that does not exist results in
    an inconsistentValue error.  If the row pointed to is removed or
    becomes inactive by other means, the treatment is as if this
    attribute contains a value of zeroDotZero."
    DEFVAL        { zeroDotZero }
    ::= { diffServMeterEntry 3 }

diffServMeterSpecific OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This indicates the behavior of the meter by pointing to an entry
        containing detailed parameters. Note that entries in that
        specific table must be managed explicitly.

        For example, diffServMeterSpecific may point to an entry in
        diffServTBParamTable, which contains an instance of a single set
        of Token Bucket parameters.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the meter always succeeds."
    ::= { diffServMeterEntry 4 }

diffServMeterStorage OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServMeterEntry 5 }

diffServMeterStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
```

```
    STATUS          current
    DESCRIPTION
       "The status of this conceptual row. All writable objects in this
       row may be modified at any time. Setting this variable to
       'destroy' when the MIB contains one or more RowPointers pointing
       to it results in destruction being delayed until the row is no
       longer used."
    ::= { diffServMeterEntry 6 }

--
-- Token Bucket Parameter Table
--

diffServTBParam         OBJECT IDENTIFIER ::= { diffServMIBObjects 4 }

-- Each entry in the Token Bucket Parameter Table parameterize a single
-- token bucket.  Multiple token buckets can be used together to
-- parameterize multiple levels of conformance.

-- Note that an entry in the Token Bucket Parameter Table can be shared
-- by multiple diffServMeterTable entries.
--

diffServTBParamNextFree OBJECT-TYPE
    SYNTAX          IndexIntegerNextFree
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
       "This object contains an unused value for diffServTBParamId, or a
       zero to indicate that none exist."
    ::= { diffServTBParam 1 }

diffServTBParamTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DiffServTBParamEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
       "This table enumerates a single set of token bucket meter
       parameters that a system may use to police a stream of traffic.
       Such meters are modeled here as having a single rate and a single
       burst size. Multiple entries are used when multiple rates/burst
       sizes are needed."
    ::= { diffServTBParam 2 }

diffServTBParamEntry OBJECT-TYPE
    SYNTAX          DiffServTBParamEntry
    MAX-ACCESS      not-accessible
    STATUS          current
```

```
        DESCRIPTION
            "An entry that describes a single set of token bucket
            parameters."
        INDEX { diffServTBParamId }
        ::= { diffServTBParamTable 1 }

    DiffServTBParamEntry ::= SEQUENCE  {
        diffServTBParamId              IndexInteger,
        diffServTBParamType            AutonomousType,
        diffServTBParamRate            Unsigned32,
        diffServTBParamBurstSize       BurstSize,
        diffServTBParamInterval        Unsigned32,
        diffServTBParamStorage         StorageType,
        diffServTBParamStatus          RowStatus
    }

    diffServTBParamId OBJECT-TYPE
        SYNTAX        IndexInteger
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "An index that enumerates the Token Bucket Parameter entries.
            Managers obtain new values for row creation in this table by
            reading diffServTBParamNextFree."
        ::= { diffServTBParamEntry 1 }

    diffServTBParamType OBJECT-TYPE
        SYNTAX        AutonomousType
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "The Metering algorithm associated with the Token Bucket
            parameters.  zeroDotZero indicates this is unknown.

            Standard values for generic algorithms:
            diffServTBParamSimpleTokenBucket, diffServTBParamAvgRate,
            diffServTBParamSrTCMBlind, diffServTBParamSrTCMAware,
            diffServTBParamTrTCMBlind, diffServTBParamTrTCMAware, and
            diffServTBParamTswTCM are specified in this MIB as OBJECT-
            IDENTITYs; additional values may be further specified in other
            MIBs."
        ::= { diffServTBParamEntry 2 }

    diffServTBParamRate OBJECT-TYPE
        SYNTAX        Unsigned32 (1..4294967295)
        UNITS         "kilobits per second"
        MAX-ACCESS    read-create
        STATUS        current
```

```
     DESCRIPTION
        "The token-bucket rate, in kilobits per second (kbps). This
        attribute is used for:
        1. CIR in RFC 2697 for srTCM
        2. CIR and PIR in RFC 2698 for trTCM
        3. CTR and PTR in RFC 2859 for TSWTCM
        4. AverageRate in RFC 3290."
     ::= { diffServTBParamEntry 3 }

diffServTBParamBurstSize OBJECT-TYPE
     SYNTAX         BurstSize
     UNITS          "Bytes"
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The maximum number of bytes in a single transmission burst. This
        attribute is used for:
        1. CBS and EBS in RFC 2697 for srTCM
        2. CBS and PBS in RFC 2698 for trTCM
        3. Burst Size in RFC 3290."
     ::= { diffServTBParamEntry 4 }

diffServTBParamInterval OBJECT-TYPE
     SYNTAX         Unsigned32 (1..4294967295)
     UNITS          "microseconds"
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The time interval used with the token bucket.  For:
        1. Average Rate Meter, the Informal Differentiated Services Model
           section 5.2.1, - Delta.
        2. Simple Token Bucket Meter, the Informal Differentiated
           Services Model section 5.1, - time interval t.
        3. RFC 2859 TSWTCM, - AVG_INTERVAL.
        4. RFC 2697 srTCM, RFC 2698 trTCM, - token bucket update time
           interval."
     ::= { diffServTBParamEntry 5 }

diffServTBParamStorage OBJECT-TYPE
     SYNTAX         StorageType
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
     DEFVAL { nonVolatile }
     ::= { diffServTBParamEntry 6 }
```

```
diffServTBParamStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
    ::= { diffServTBParamEntry 7 }

--
-- OIDs for diffServTBParamType definitions.
--

diffServTBMeters  OBJECT IDENTIFIER ::= { diffServMIBAdmin 1 }

diffServTBParamSimpleTokenBucket OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
        "Two Parameter Token Bucket Meter as described in the Informal
        Differentiated Services Model section 5.2.3."
    ::= { diffServTBMeters 1 }

diffServTBParamAvgRate OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
        "Average Rate Meter as described in the Informal Differentiated
        Services Model section 5.2.1."
    ::= { diffServTBMeters 2 }

diffServTBParamSrTCMBlind OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
        "Single Rate Three Color Marker Metering as defined by RFC 2697,
        in the 'Color Blind' mode as described by the RFC."
    REFERENCE
        "RFC 2697"
    ::= { diffServTBMeters 3 }

diffServTBParamSrTCMAware OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
        "Single Rate Three Color Marker Metering as defined by RFC 2697,
        in the 'Color Aware' mode as described by the RFC."
    REFERENCE
        "RFC 2697"
```

```
    ::= { diffServTBMeters 4 }


diffServTBParamTrTCMBlind OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
       "Two Rate Three Color Marker Metering as defined by RFC 2698, in
       the 'Color Blind' mode as described by the RFC."
    REFERENCE
        "RFC 2698"
    ::= { diffServTBMeters 5 }


diffServTBParamTrTCMAware OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
       "Two Rate Three Color Marker Metering as defined by RFC 2698, in
       the 'Color Aware' mode as described by the RFC."
    REFERENCE
        "RFC 2698"
    ::= { diffServTBMeters 6 }


diffServTBParamTswTCM OBJECT-IDENTITY
    STATUS        current
    DESCRIPTION
       "Time Sliding Window Three Color Marker Metering as defined by
       RFC 2859."
    REFERENCE
        "RFC 2859"
    ::= { diffServTBMeters 7 }

--
-- Actions
--

diffServAction          OBJECT IDENTIFIER ::= { diffServMIBObjects 5 }


--
-- The Action Table allows enumeration of the different types of
-- actions to be applied to a traffic flow.
--

diffServActionNextFree OBJECT-TYPE
    SYNTAX        IndexIntegerNextFree
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
       "This object contains an unused value for diffServActionId, or a
       zero to indicate that none exist."
    ::= { diffServAction 1 }
```

```
diffServActionTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF DiffServActionEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "The Action Table enumerates actions that can be performed to a
       stream of traffic. Multiple actions can be concatenated. For
       example, traffic exiting from a meter may be counted, marked, and
       potentially dropped before entering a queue.

       Specific actions are indicated by diffServActionSpecific which
       points to an entry of a specific action type parameterizing the
       action in detail."
    ::= { diffServAction 2 }

diffServActionEntry OBJECT-TYPE
    SYNTAX        DiffServActionEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "Each entry in the action table allows description of one
       specific action to be applied to traffic."
    INDEX { diffServActionId }
    ::= { diffServActionTable 1 }

DiffServActionEntry ::= SEQUENCE  {
    diffServActionId               IndexInteger,
    diffServActionInterface        InterfaceIndexOrZero,
    diffServActionNext             RowPointer,
    diffServActionSpecific         RowPointer,
    diffServActionStorage          StorageType,
    diffServActionStatus           RowStatus
}

diffServActionId OBJECT-TYPE
    SYNTAX        IndexInteger
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An index that enumerates the Action entries.  Managers obtain
       new values for row creation in this table by reading
       diffServActionNextFree."
    ::= { diffServActionEntry 1 }

diffServActionInterface  OBJECT-TYPE
     SYNTAX        InterfaceIndexOrZero
     MAX-ACCESS    read-create
     STATUS        current
```

          DESCRIPTION
             "The interface index (value of ifIndex) that this action occurs
             on. This may be derived from the diffServDataPathStartEntry's
             index by extension through the various RowPointers. However, as
             this may be difficult for a network management station, it is
             placed here as well. If this is indeterminate, the value is
             zero.

             This is of especial relevance when reporting the counters which
             may apply to traffic crossing an interface:
                 diffServCountActOctets,
                 diffServCountActPkts,
                 diffServAlgDropOctets,
                 diffServAlgDropPkts,
                 diffServAlgRandomDropOctets, and
                 diffServAlgRandomDropPkts.

             It is also especially relevant to the queue and scheduler which
             may be subsequently applied."
          ::= { diffServActionEntry 2 }

diffServActionNext OBJECT-TYPE
     SYNTAX   RowPointer
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
          "This selects the next Differentiated Services Functional Data
          Path Element to handle traffic for this data path. This
          RowPointer should point to an instance of one of:
             diffServClfrEntry
             diffServMeterEntry
             diffServActionEntry
             diffServAlgDropEntry
             diffServQEntry

          A value of zeroDotZero in this attribute indicates no further
          Differentiated Services treatment is performed on traffic of this
          data path. The use of zeroDotZero is the normal usage for the
          last functional data path element of the current data path.

          Setting this to point to a target that does not exist results in
          an inconsistentValue error. If the row pointed to is removed or
          becomes inactive by other means, the treatment is as if this
          attribute contains a value of zeroDotZero."
     DEFVAL   { zeroDotZero }
     ::= { diffServActionEntry 3 }

diffServActionSpecific OBJECT-TYPE

```
      SYNTAX          RowPointer
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "A pointer to an object instance providing additional information
          for the type of action indicated by this action table entry.

          For the standard actions defined by this MIB module, this should
          point to either a diffServDscpMarkActEntry or a
          diffServCountActEntry. For other actions, it may point to an
          object instance defined in some other MIB.

          Setting this to point to a target that does not exist results in
          an inconsistentValue error.  If the row pointed to is removed or
          becomes inactive by other means, the Meter should be treated as
          if it were not present.  This may lead to incorrect policy
          behavior."
      ::= { diffServActionEntry 4 }

diffServActionStorage OBJECT-TYPE
      SYNTAX          StorageType
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The storage type for this conceptual row.  Conceptual rows
          having the value 'permanent' need not allow write-access to any
          columnar objects in the row."
      DEFVAL { nonVolatile }
      ::= { diffServActionEntry 5 }

diffServActionStatus OBJECT-TYPE
      SYNTAX          RowStatus
      MAX-ACCESS      read-create
      STATUS          current
      DESCRIPTION
          "The status of this conceptual row. All writable objects in this
          row may be modified at any time. Setting this variable to
          'destroy' when the MIB contains one or more RowPointers pointing
          to it results in destruction being delayed until the row is no
          longer used."
       ::= { diffServActionEntry 6 }

-- DSCP Mark Action Table
--
-- Rows of this table are pointed to by diffServActionSpecific to
-- provide detailed parameters specific to the DSCP Mark action.
--
-- A single entry in this table can be shared by multiple
```

```
-- diffServActionTable entries.
--

diffServDscpMarkActTable OBJECT-TYPE
    SYNTAX         SEQUENCE OF DiffServDscpMarkActEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
       "This table enumerates specific DSCPs used for marking or
        remarking the DSCP field of IP packets. The entries of this table
        may be referenced by a diffServActionSpecific attribute."
    ::= { diffServAction 3 }

diffServDscpMarkActEntry OBJECT-TYPE
    SYNTAX         DiffServDscpMarkActEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
       "An entry in the DSCP mark action table that describes a single
        DSCP used for marking."
    INDEX { diffServDscpMarkActDscp }
    ::= { diffServDscpMarkActTable 1 }

DiffServDscpMarkActEntry ::= SEQUENCE  {
    diffServDscpMarkActDscp          Dscp
}

diffServDscpMarkActDscp OBJECT-TYPE
    SYNTAX         Dscp
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
       "The DSCP that this Action will store into the DSCP field of the
        subject. It is quite possible that the only packets subject to
        this Action are already marked with this DSCP. Note also that
        Differentiated Services processing may result in packet being
        marked on both ingress to a network and on egress from it, and
        that ingress and egress can occur in the same router."
     ::= { diffServDscpMarkActEntry 1 }

--
-- Count Action Table
--
-- Because the MIB structure allows multiple cascading
-- diffServActionEntry be used to describe multiple actions for a data
-- path, the counter became an optional action type.  In normal
-- implementation, either a data path has counters or it does not, as
-- opposed to being configurable. The management entity may choose to
```

```
-- read the counter or not.  Hence it is recommended for implementation
-- that have counters to always configure the count action as the first
-- of multiple actions.
--

diffServCountActNextFree OBJECT-TYPE
    SYNTAX          IndexIntegerNextFree
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
       "This object contains an unused value for
       diffServCountActId, or a zero to indicate that none exist."
    ::= { diffServAction 4 }

diffServCountActTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DiffServCountActEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
       "This table contains counters for all the traffic passing through
       an action element."
    ::= { diffServAction 5 }

diffServCountActEntry OBJECT-TYPE
    SYNTAX          DiffServCountActEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
       "An entry in the count action table describes a single set of
       traffic counters."
    INDEX { diffServCountActId }
    ::= { diffServCountActTable 1 }

DiffServCountActEntry ::= SEQUENCE  {
    diffServCountActId          IndexInteger,
    diffServCountActOctets      Counter64,
    diffServCountActPkts        Counter64,
    diffServCountActStorage     StorageType,
    diffServCountActStatus      RowStatus
}

diffServCountActId OBJECT-TYPE
    SYNTAX          IndexInteger
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
       "An index that enumerates the Count Action entries.  Managers
       obtain new values for row creation in this table by reading
```

```
        diffServCountActNextFree."
    ::= { diffServCountActEntry 1 }


diffServCountActOctets OBJECT-TYPE
    SYNTAX          Counter64
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of octets at the Action data path element.

        Discontinuities in the value of this counter can occur at re-
        initialization of the management system and at other times as
        indicated by the value of ifCounterDiscontinuityTime on the
        relevant interface."
    ::= { diffServCountActEntry 2 }


diffServCountActPkts OBJECT-TYPE
    SYNTAX          Counter64
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of packets at the Action data path element.

        Discontinuities in the value of this counter can occur at re-
        initialization of the management system and at other times as
        indicated by the value of ifCounterDiscontinuityTime on the
        relevant interface."
    ::= { diffServCountActEntry 3 }


diffServCountActStorage OBJECT-TYPE
    SYNTAX          StorageType
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServCountActEntry 4 }


diffServCountActStatus OBJECT-TYPE
    SYNTAX          RowStatus
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
```

```
         to it results in destruction being delayed until the row is no
         longer used."
      ::= { diffServCountActEntry 5 }


--
-- Algorithmic Drop Table
--

diffServAlgDrop          OBJECT IDENTIFIER ::= { diffServMIBObjects 6 }

diffServAlgDropNextFree OBJECT-TYPE
    SYNTAX        IndexIntegerNextFree
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
       "This object contains an unused value for diffServAlgDropId, or a
       zero to indicate that none exist."
    ::= { diffServAlgDrop 1 }

diffServAlgDropTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF DiffServAlgDropEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "The algorithmic drop table contains entries describing an
       element that drops packets according to some algorithm."
    ::= { diffServAlgDrop 2 }

diffServAlgDropEntry OBJECT-TYPE
    SYNTAX        DiffServAlgDropEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An entry describes a process that drops packets according to
       some algorithm. Further details of the algorithm type are to be
       found in diffServAlgDropType and with more detail parameter entry
       pointed to by diffServAlgDropSpecific when necessary."
    INDEX { diffServAlgDropId }
    ::= { diffServAlgDropTable 1 }

DiffServAlgDropEntry ::= SEQUENCE  {
    diffServAlgDropId                 IndexInteger,
    diffServAlgDropType               INTEGER,
    diffServAlgDropNext               RowPointer,
    diffServAlgDropQMeasure           RowPointer,
    diffServAlgDropQThreshold         Unsigned32,
    diffServAlgDropSpecific           RowPointer,
    diffServAlgDropOctets             Counter64,
```

```
    diffServAlgDropPkts               Counter64,
    diffServAlgRandomDropOctets       Counter64,
    diffServAlgRandomDropPkts         Counter64,
    diffServAlgDropStorage            StorageType,
    diffServAlgDropStatus             RowStatus
}


diffServAlgDropId OBJECT-TYPE
    SYNTAX          IndexInteger
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "An index that enumerates the Algorithmic Dropper entries.
        Managers obtain new values for row creation in this table by
        reading diffServAlgDropNextFree."
    ::= { diffServAlgDropEntry 1 }


diffServAlgDropType OBJECT-TYPE
    SYNTAX          INTEGER {
                        other(1),
                        tailDrop(2),
                        headDrop(3),
                        randomDrop(4),
                        alwaysDrop(5)
}
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The type of algorithm used by this dropper. The value other(1)
        requires further specification in some other MIB module.

        In the tailDrop(2) algorithm, diffServAlgDropQThreshold
        represents the maximum depth of the queue, pointed to by
        diffServAlgDropQMeasure, beyond which all newly arriving packets
        will be dropped.

        In the headDrop(3) algorithm, if a packet arrives when the
        current depth of the queue, pointed to by
        diffServAlgDropQMeasure, is at diffServAlgDropQThreshold, packets
        currently at the head of the queue are dropped to make room for
        the new packet to be enqueued at the tail of the queue.

        In the randomDrop(4) algorithm, on packet arrival, an Active
        Queue Management algorithm is executed which may randomly drop a
        packet. This algorithm may be proprietary, and it may drop either
        the arriving packet or another packet in the queue.
        diffServAlgDropSpecific points to a diffServRandomDropEntry that
        describes the algorithm. For this algorithm,
```

        diffServAlgDropQThreshold is understood to be the absolute
        maximum size of the queue and additional parameters are described
        in diffServRandomDropTable.

        The alwaysDrop(5) algorithm is as its name specifies; always
        drop. In this case, the other configuration values in this Entry
        are not meaningful; There is no useful 'next' processing step,
        there is no queue, and parameters describing the queue are not
        useful. Therefore, diffServAlgDropNext, diffServAlgDropMeasure,
        and diffServAlgDropSpecific are all zeroDotZero."
    ::= { diffServAlgDropEntry 2 }

diffServAlgDropNext OBJECT-TYPE
    SYNTAX   RowPointer
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
        "This selects the next Differentiated Services Functional Data
        Path Element to handle traffic for this data path. This
        RowPointer should point to an instance of one of:
          diffServClfrEntry
          diffServMeterEntry
          diffServActionEntry
          diffServQEntry

        A value of zeroDotZero in this attribute indicates no further
        Differentiated Services treatment is performed on traffic of this
        data path. The use of zeroDotZero is the normal usage for the
        last functional data path element of the current data path.

        When diffServAlgDropType is alwaysDrop(5), this object is
        ignored.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error. If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    ::= { diffServAlgDropEntry 3 }

diffServAlgDropQMeasure OBJECT-TYPE
    SYNTAX   RowPointer
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
        "Points to an entry in the diffServQTable to indicate the queue
        that a drop algorithm is to monitor when deciding whether to drop
        a packet. If the row pointed to does not exist, the algorithmic
        dropper element is considered inactive.

      Setting this to point to a target that does not exist results in
      an inconsistentValue error. If the row pointed to is removed or
      becomes inactive by other means, the treatment is as if this
      attribute contains a value of zeroDotZero."
    ::= { diffServAlgDropEntry 4 }

diffServAlgDropQThreshold OBJECT-TYPE
    SYNTAX   Unsigned32 (1..4294967295)
    UNITS   "Bytes"
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
      "A threshold on the depth in bytes of the queue being measured at
      which a trigger is generated to the dropping algorithm, unless
      diffServAlgDropType is alwaysDrop(5) where this object is
      ignored.

      For the tailDrop(2) or headDrop(3) algorithms, this represents
      the depth of the queue, pointed to by diffServAlgDropQMeasure, at
      which the drop action will take place. Other algorithms will need
      to define their own semantics for this threshold."
    ::= { diffServAlgDropEntry 5 }

diffServAlgDropSpecific OBJECT-TYPE
    SYNTAX   RowPointer
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
      "Points to a table entry that provides further detail regarding a
      drop algorithm.

      Entries with diffServAlgDropType equal to other(1) may have this
      point to a table defined in another MIB module.

      Entries with diffServAlgDropType equal to randomDrop(4) must have
      this point to an entry in diffServRandomDropTable.

      For all other algorithms specified in this MIB, this should take
      the value zeroDotZero.

      The diffServAlgDropType is authoritative for the type of the drop
      algorithm and the specific parameters for the drop algorithm
      needs to be evaluated based on the diffServAlgDropType.

      Setting this to point to a target that does not exist results in
      an inconsistentValue error. If the row pointed to is removed or
      becomes inactive by other means, the treatment is as if this
      attribute contains a value of zeroDotZero."

         ::= { diffServAlgDropEntry 6 }

diffServAlgDropOctets OBJECT-TYPE
     SYNTAX   Counter64
     MAX-ACCESS   read-only
     STATUS   current
     DESCRIPTION
        "The number of octets that have been deterministically dropped by
        this drop process.

        Discontinuities in the value of this counter can occur at re-
        initialization of the management system and at other times as
        indicated by the value of ifCounterDiscontinuityTime on the
        relevant interface."
     ::= { diffServAlgDropEntry 7 }

diffServAlgDropPkts OBJECT-TYPE
     SYNTAX   Counter64
     MAX-ACCESS   read-only
     STATUS   current
     DESCRIPTION
        "The number of packets that have been deterministically dropped
        by this drop process.

        Discontinuities in the value of this counter can occur at re-
        initialization of the management system and at other times as
        indicated by the value of ifCounterDiscontinuityTime on the
        relevant interface."
     ::= { diffServAlgDropEntry 8 }

diffServAlgRandomDropOctets OBJECT-TYPE
     SYNTAX   Counter64
     MAX-ACCESS   read-only
     STATUS   current
     DESCRIPTION
        "The number of octets that have been randomly dropped by this
        drop process. This counter applies, therefore, only to random
        droppers.

        Discontinuities in the value of this counter can occur at re-
        initialization of the management system and at other times as
        indicated by the value of ifCounterDiscontinuityTime on the
        relevant interface."
     ::= { diffServAlgDropEntry 9 }

diffServAlgRandomDropPkts OBJECT-TYPE
     SYNTAX   Counter64
     MAX-ACCESS   read-only

```
        STATUS          current
        DESCRIPTION
            "The number of packets that have been randomly dropped by this
            drop process. This counter applies, therefore, only to random
            droppers.

            Discontinuities in the value of this counter can occur at re-
            initialization of the management system and at other times as
            indicated by the value of ifCounterDiscontinuityTime on the
            relevant interface."
        ::= { diffServAlgDropEntry 10 }

diffServAlgDropStorage OBJECT-TYPE
        SYNTAX          StorageType
        MAX-ACCESS      read-create
        STATUS          current
        DESCRIPTION
            "The storage type for this conceptual row.  Conceptual rows
            having the value 'permanent' need not allow write-access to any
            columnar objects in the row."
        DEFVAL { nonVolatile }
        ::= { diffServAlgDropEntry 11 }

diffServAlgDropStatus OBJECT-TYPE
        SYNTAX          RowStatus
        MAX-ACCESS      read-create
        STATUS          current
        DESCRIPTION
            "The status of this conceptual row. All writable objects in this
            row may be modified at any time. Setting this variable to
            'destroy' when the MIB contains one or more RowPointers pointing
            to it results in destruction being delayed until the row is no
            longer used."
        ::= { diffServAlgDropEntry 12 }

--
-- Random Drop Table
--

diffServRandomDropNextFree OBJECT-TYPE
        SYNTAX          IndexIntegerNextFree
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
            "This object contains an unused value for diffServRandomDropId,
            or a zero to indicate that none exist."
        ::= { diffServAlgDrop 3 }
```

```
diffServRandomDropTable OBJECT-TYPE
    SYNTAX         SEQUENCE OF DiffServRandomDropEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "The random drop table contains entries describing a process that
       drops packets randomly. Entries in this table are pointed to by
       diffServAlgDropSpecific."
    ::= { diffServAlgDrop 4 }

diffServRandomDropEntry OBJECT-TYPE
    SYNTAX         DiffServRandomDropEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An entry describes a process that drops packets according to a
       random algorithm."
    INDEX { diffServRandomDropId }
    ::= { diffServRandomDropTable 1 }

DiffServRandomDropEntry ::= SEQUENCE  {
    diffServRandomDropId               IndexInteger,
    diffServRandomDropMinThreshBytes   Unsigned32,
    diffServRandomDropMinThreshPkts    Unsigned32,
    diffServRandomDropMaxThreshBytes   Unsigned32,
    diffServRandomDropMaxThreshPkts    Unsigned32,
    diffServRandomDropProbMax          Unsigned32,
    diffServRandomDropWeight           Unsigned32,
    diffServRandomDropSamplingRate     Unsigned32,
    diffServRandomDropStorage          StorageType,
    diffServRandomDropStatus           RowStatus
}

diffServRandomDropId OBJECT-TYPE
    SYNTAX         IndexInteger
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An index that enumerates the Random Drop entries.  Managers
       obtain new values for row creation in this table by reading
       diffServRandomDropNextFree."
    ::= { diffServRandomDropEntry 1 }

diffServRandomDropMinThreshBytes OBJECT-TYPE
    SYNTAX         Unsigned32 (1..4294967295)
    UNITS         "bytes"
    MAX-ACCESS    read-create
    STATUS        current
```

       DESCRIPTION
          "The average queue depth in bytes, beyond which traffic has a
          non-zero probability of being dropped. Changes in this variable
          may or may not be reflected in the reported value of
          diffServRandomDropMinThreshPkts."
       ::= { diffServRandomDropEntry 2 }

   diffServRandomDropMinThreshPkts OBJECT-TYPE
       SYNTAX   Unsigned32 (1..4294967295)
       UNITS   "packets"
       MAX-ACCESS   read-create
       STATUS   current
       DESCRIPTION
          "The average queue depth in packets, beyond which traffic has a
          non-zero probability of being dropped. Changes in this variable
          may or may not be reflected in the reported value of
          diffServRandomDropMinThreshBytes."
       ::= { diffServRandomDropEntry 3 }

   diffServRandomDropMaxThreshBytes OBJECT-TYPE
       SYNTAX   Unsigned32 (1..4294967295)
       UNITS   "bytes"
       MAX-ACCESS   read-create
       STATUS   current
       DESCRIPTION
          "The average queue depth beyond which traffic has a probability
          indicated by diffServRandomDropProbMax of being dropped or
          marked. Note that this differs from the physical queue limit,
          which is stored in diffServAlgDropQThreshold. Changes in this
          variable may or may not be reflected in the reported value of
          diffServRandomDropMaxThreshPkts."
       ::= { diffServRandomDropEntry 4 }

   diffServRandomDropMaxThreshPkts OBJECT-TYPE
       SYNTAX   Unsigned32 (1..4294967295)
       UNITS   "packets"
       MAX-ACCESS   read-create
       STATUS   current
       DESCRIPTION
          "The average queue depth beyond which traffic has a probability
          indicated by diffServRandomDropProbMax of being dropped or
          marked. Note that this differs from the physical queue limit,
          which is stored in diffServAlgDropQThreshold. Changes in this
          variable may or may not be reflected in the reported value of
          diffServRandomDropMaxThreshBytes."
       ::= { diffServRandomDropEntry 5 }

   diffServRandomDropProbMax OBJECT-TYPE

```
     SYNTAX         Unsigned32 (0..1000)
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The worst case random drop probability, expressed in drops per
        thousand packets.

        For example, if in the worst case every arriving packet may be
        dropped (100%) for a period, this has the value 1000.
        Alternatively, if in the worst case only one percent (1%) of
        traffic may be dropped, it has the value 10."
     ::= { diffServRandomDropEntry 6 }

diffServRandomDropWeight OBJECT-TYPE
     SYNTAX         Unsigned32 (0..65536)
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The weighting of past history in affecting the Exponentially
        Weighted Moving Average function that calculates the current
        average queue depth.  The equation uses
        diffServRandomDropWeight/65536 as the coefficient for the new
        sample in the equation, and (65536 -
        diffServRandomDropWeight)/65536 as the coefficient of the old
        value.

        Implementations may limit the values of diffServRandomDropWeight
        to a subset of the possible range of values, such as powers of
        two. Doing this would facilitate implementation of the
        Exponentially Weighted Moving Average using shift instructions or
        registers."
     ::= { diffServRandomDropEntry 7 }

diffServRandomDropSamplingRate OBJECT-TYPE
     SYNTAX         Unsigned32 (0..1000000)
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The number of times per second the queue is sampled for queue
        average calculation.  A value of zero is used to mean that the
        queue is sampled approximately each time a packet is enqueued (or
        dequeued)."
     ::= { diffServRandomDropEntry 8 }

diffServRandomDropStorage OBJECT-TYPE
     SYNTAX         StorageType
     MAX-ACCESS     read-create
     STATUS         current
```

```
        DESCRIPTION
            "The storage type for this conceptual row.  Conceptual rows
            having the value 'permanent' need not allow write-access to any
            columnar objects in the row."
        DEFVAL { nonVolatile }
        ::= { diffServRandomDropEntry 9 }

diffServRandomDropStatus OBJECT-TYPE
    SYNTAX          RowStatus
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
    ::= { diffServRandomDropEntry 10 }

--
-- Queue Table
--

diffServQueue           OBJECT IDENTIFIER ::= { diffServMIBObjects 7 }

--
-- An entry of diffServQTable represents a FIFO queue Differentiated
-- Services Functional Data Path element as described in the Informal
-- Differentiated Services Model section 7.1.1. Note that the
-- specification of scheduling parameters for a queue as part of the
-- input to a scheduler functional data path element as described in
-- the Informal Differentiated Services Model section 7.1.2. This
-- allows building of hierarchical queuing/scheduling. A queue
-- therefore has these attributes:
--
-- 1. Which scheduler will service this queue, diffServQNext.
-- 2. How the scheduler will service this queue, with respect
--     to all the other queues the same scheduler needs to service,
--     diffServQMinRate.
--
-- Note that upstream Differentiated Services Functional Data Path
-- elements may point to a shared diffServQTable entry as described
-- in the Informal Differentiated Services Model section 7.1.1.
--

diffServQNextFree OBJECT-TYPE
    SYNTAX          IndexIntegerNextFree
    MAX-ACCESS      read-only
```

```
    STATUS         current
    DESCRIPTION
       "This object contains an unused value for diffServQId, or a zero
       to indicate that none exist."
    ::= { diffServQueue 1 }

diffServQTable OBJECT-TYPE
    SYNTAX         SEQUENCE OF DiffServQEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
       "The Queue Table enumerates the individual queues.  Note that the
       MIB models queuing systems as composed of individual queues, one
       per class of traffic, even though they may in fact be structured
       as classes of traffic scheduled using a common calendar queue, or
       in other ways."
    ::= { diffServQueue 2 }

diffServQEntry OBJECT-TYPE
    SYNTAX         DiffServQEntry
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
       "An entry in the Queue Table describes a single queue or class of
       traffic."
    INDEX { diffServQId }
    ::= { diffServQTable 1 }

DiffServQEntry ::= SEQUENCE  {
    diffServQId                    IndexInteger,
    diffServQNext                  RowPointer,
    diffServQMinRate               RowPointer,
    diffServQMaxRate               RowPointer,
    diffServQStorage               StorageType,
    diffServQStatus                RowStatus
}

diffServQId OBJECT-TYPE
    SYNTAX         IndexInteger
    MAX-ACCESS     not-accessible
    STATUS         current
    DESCRIPTION
       "An index that enumerates the Queue entries.  Managers obtain new
       values for row creation in this table by reading
       diffServQNextFree."
    ::= { diffServQEntry 1 }

diffServQNext OBJECT-TYPE
```

```
    SYNTAX         RowPointer
    MAX-ACCESS     read-create
    STATUS         current
    DESCRIPTION
        "This selects the next Differentiated Services Scheduler.  The
        RowPointer must point to a diffServSchedulerEntry.

        A value of zeroDotZero in this attribute indicates an incomplete
        diffServQEntry instance. In such a case, the entry has no
        operational effect, since it has no parameters to give it
        meaning.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    ::= { diffServQEntry 2 }

diffServQMinRate OBJECT-TYPE
    SYNTAX         RowPointer
    MAX-ACCESS     read-create
    STATUS         current
    DESCRIPTION
        "This RowPointer indicates the diffServMinRateEntry that the
        scheduler, pointed to by diffServQNext, should use to service
        this queue.

        If the row pointed to is zeroDotZero, the minimum rate and
        priority is unspecified.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    ::= { diffServQEntry 3 }

diffServQMaxRate OBJECT-TYPE
    SYNTAX         RowPointer
    MAX-ACCESS     read-create
    STATUS         current
    DESCRIPTION
        "This RowPointer indicates the diffServMaxRateEntry that the
        scheduler, pointed to by diffServQNext, should use to service
        this queue.

        If the row pointed to is zeroDotZero, the maximum rate is the
        line speed of the interface.
```

          Setting this to point to a target that does not exist results in
          an inconsistentValue error. If the row pointed to is removed or
          becomes inactive by other means, the treatment is as if this
          attribute contains a value of zeroDotZero."
     ::= { diffServQEntry 4 }

diffServQStorage OBJECT-TYPE
     SYNTAX   StorageType
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
        "The storage type for this conceptual row. Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
     DEFVAL { nonVolatile }
     ::= { diffServQEntry 5 }

diffServQStatus OBJECT-TYPE
     SYNTAX   RowStatus
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
     ::= { diffServQEntry 6 }

--
-- Scheduler Table
--

diffServScheduler   OBJECT IDENTIFIER ::= { diffServMIBObjects 8 }

--
-- A Scheduler Entry represents a packet scheduler, such as a priority
-- scheduler or a WFQ scheduler. It provides flexibility for multiple
-- scheduling algorithms, each servicing multiple queues, to be used on
-- the same logical/physical interface.
--
-- Note that upstream queues or schedulers specify several of the
-- scheduler's parameters. These must be properly specified if the
-- scheduler is to behave as expected.
--
-- The diffServSchedulerMaxRate attribute specifies the parameters when
-- a scheduler's output is sent to another scheduler. This is used in
-- building hierarchical queues or schedulers.

```
--
-- More discussion of the scheduler functional data path element is in
-- the Informal Differentiated Services Model section 7.1.2.
--

diffServSchedulerNextFree OBJECT-TYPE
    SYNTAX          IndexIntegerNextFree
    MAX-ACCESS   read-only
    STATUS          current
    DESCRIPTION
        "This object contains an unused value for diffServSchedulerId, or
        a zero to indicate that none exist."
    ::= { diffServScheduler 1 }

diffServSchedulerTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF DiffServSchedulerEntry
    MAX-ACCESS   not-accessible
    STATUS          current
    DESCRIPTION
        "The Scheduler Table enumerates packet schedulers. Multiple
        scheduling algorithms can be used on a given data path, with each
        algorithm described by one diffServSchedulerEntry."
    ::= { diffServScheduler 2 }

diffServSchedulerEntry OBJECT-TYPE
    SYNTAX          DiffServSchedulerEntry
    MAX-ACCESS   not-accessible
    STATUS          current
    DESCRIPTION
        "An entry in the Scheduler Table describing a single instance of
        a scheduling algorithm."
    INDEX { diffServSchedulerId }
    ::= { diffServSchedulerTable 1 }

DiffServSchedulerEntry ::= SEQUENCE  {
    diffServSchedulerId                 IndexInteger,
    diffServSchedulerNext               RowPointer,
    diffServSchedulerMethod             AutonomousType,
    diffServSchedulerMinRate            RowPointer,
    diffServSchedulerMaxRate            RowPointer,
    diffServSchedulerStorage            StorageType,
    diffServSchedulerStatus             RowStatus
}

diffServSchedulerId OBJECT-TYPE
    SYNTAX          IndexInteger
    MAX-ACCESS   not-accessible
    STATUS          current
```

         DESCRIPTION
            "An index that enumerates the Scheduler entries. Managers obtain
            new values for row creation in this table by reading
            diffServSchedulerNextFree."
         ::= { diffServSchedulerEntry 1 }

diffServSchedulerNext OBJECT-TYPE
     SYNTAX   RowPointer
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
         "This selects the next Differentiated Services Functional Data
         Path Element to handle traffic for this data path. This normally
         is null (zeroDotZero), or points to a diffServSchedulerEntry or a
         diffServQEntry.

         However, this RowPointer may also point to an instance of:
            diffServClfrEntry,
            diffServMeterEntry,
            diffServActionEntry,
            diffServAlgDropEntry.

         It would point another diffServSchedulerEntry when implementing
         multiple scheduler methods for the same data path, such as having
         one set of queues scheduled by WRR and that group participating
         in a priority scheduling system in which other queues compete
         with it in that way. It might also point to a second scheduler
         in a hierarchical scheduling system.

         If the row pointed to is zeroDotZero, no further Differentiated
         Services treatment is performed on traffic of this data path.

         Setting this to point to a target that does not exist results in
         an inconsistentValue error. If the row pointed to is removed or
         becomes inactive by other means, the treatment is as if this
         attribute contains a value of zeroDotZero."
     DEFVAL   { zeroDotZero }
     ::= { diffServSchedulerEntry 2 }

diffServSchedulerMethod OBJECT-TYPE
     SYNTAX   AutonomousType
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
         "The scheduling algorithm used by this Scheduler. zeroDotZero
         indicates that this is unknown. Standard values for generic
         algorithms: diffServSchedulerPriority, diffServSchedulerWRR, and
         diffServSchedulerWFQ are specified in this MIB; additional values

```
      may be further specified in other MIBs."
    ::= { diffServSchedulerEntry 3 }

diffServSchedulerMinRate OBJECT-TYPE
    SYNTAX          RowPointer
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "This RowPointer indicates the entry in diffServMinRateTable
        which indicates the priority or minimum output rate from this
        scheduler. This attribute is used only when there is more than
        one level of scheduler.

        When it has the value zeroDotZero, it indicates that no minimum
        rate or priority is imposed.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    DEFVAL       { zeroDotZero }
    ::= { diffServSchedulerEntry 4 }

diffServSchedulerMaxRate OBJECT-TYPE
    SYNTAX          RowPointer
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "This RowPointer indicates the entry in diffServMaxRateTable
        which indicates the maximum output rate from this scheduler.
        When more than one maximum rate applies (eg, when a multi-rate
        shaper is in view), it points to the first of those rate entries.
        This attribute is used only when there is more than one level of
        scheduler.

        When it has the value zeroDotZero, it indicates that no maximum
        rate is imposed.

        Setting this to point to a target that does not exist results in
        an inconsistentValue error.  If the row pointed to is removed or
        becomes inactive by other means, the treatment is as if this
        attribute contains a value of zeroDotZero."
    DEFVAL       { zeroDotZero }
    ::= { diffServSchedulerEntry 5 }

diffServSchedulerStorage OBJECT-TYPE
    SYNTAX          StorageType
    MAX-ACCESS      read-create
```

```
     STATUS         current
     DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
     DEFVAL { nonVolatile }
     ::= { diffServSchedulerEntry 6 }

diffServSchedulerStatus OBJECT-TYPE
     SYNTAX         RowStatus
     MAX-ACCESS     read-create
     STATUS         current
     DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
     ::= { diffServSchedulerEntry 7 }

--
-- OIDs for diffServTBParamType definitions.
--

diffServSchedulers  OBJECT IDENTIFIER ::= { diffServMIBAdmin 2 }

diffServSchedulerPriority OBJECT-IDENTITY
     STATUS         current
     DESCRIPTION
        "For use with diffServSchedulerMethod to indicate the Priority
        scheduling method.  This is defined as an algorithm in which the
        presence of data in a queue or set of queues absolutely precludes
        dequeue from another queue or set of queues of lower priority.
        Note that attributes from diffServMinRateEntry of the
        queues/schedulers feeding this scheduler are used when
        determining the next packet to schedule."
     ::= { diffServSchedulers 1 }

diffServSchedulerWRR OBJECT-IDENTITY
     STATUS         current
     DESCRIPTION
        "For use with diffServSchedulerMethod to indicate the Weighted
        Round Robin scheduling method, defined as any algorithm in which
        a set of queues are visited in a fixed order, and varying amounts
        of traffic are removed from each queue in turn to implement an
        average output rate by class. Notice attributes from
        diffServMinRateEntry of the queues/schedulers feeding this
        scheduler are used when determining the next packet to schedule."
```

```
     ::= { diffServSchedulers 2 }

diffServSchedulerWFQ OBJECT-IDENTITY
     STATUS        current
     DESCRIPTION
        "For use with diffServSchedulerMethod to indicate the Weighted
        Fair Queuing scheduling method, defined as any algorithm in which
        a set of queues are conceptually visited in some order, to
        implement an average output rate by class. Notice attributes from
        diffServMinRateEntry of the queues/schedulers feeding this
        scheduler are used when determining the next packet to schedule."
     ::= { diffServSchedulers 3 }


--
-- Minimum Rate Parameters Table
--
-- The parameters used by a scheduler for its inputs or outputs are
-- maintained separately from the Queue or Scheduler table entries for
-- reusability reasons and so that they may be used by both queues and
-- schedulers.  This follows the approach for separation of data path
-- elements from parameterization that is used throughout this MIB.
-- Use of these Minimum Rate Parameter Table entries by Queues and
-- Schedulers allows the modeling of hierarchical scheduling systems.
--
-- Specifically, a Scheduler has one or more inputs and one output.
-- Any queue feeding a scheduler, or any scheduler which feeds a second
-- scheduler, might specify a minimum transfer rate by pointing to an
-- Minimum Rate Parameter Table entry.
--
-- The diffServMinRatePriority/Abs/Rel attributes are used as
-- parameters to the work-conserving portion of a scheduler:
-- "work-conserving" implies that the scheduler can continue to emit
-- data as long as there is data available at its input(s).  This has
-- the effect of guaranteeing a certain priority relative to other
-- scheduler inputs and/or a certain minimum proportion of the
-- available output bandwidth. Properly configured, this means a
-- certain minimum rate, which may be exceeded should traffic be
-- available should there be spare bandwidth after all other classes
-- have had opportunities to consume their own minimum rates.
--


diffServMinRateNextFree OBJECT-TYPE
     SYNTAX        IndexIntegerNextFree
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
        "This object contains an unused value for diffServMinRateId, or a
        zero to indicate that none exist."
```

```
          ::= { diffServScheduler 3 }


diffServMinRateTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF DiffServMinRateEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "The Minimum Rate Parameters Table enumerates individual sets of
       scheduling parameter that can be used/reused by Queues and
       Schedulers."
       ::= { diffServScheduler 4 }


diffServMinRateEntry OBJECT-TYPE
    SYNTAX        DiffServMinRateEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An entry in the Minimum Rate Parameters Table describes a single
       set of scheduling parameters for use by one or more queues or
       schedulers."
    INDEX { diffServMinRateId }
    ::= { diffServMinRateTable 1 }


DiffServMinRateEntry ::= SEQUENCE  {
    diffServMinRateId               IndexInteger,
    diffServMinRatePriority         Unsigned32,
    diffServMinRateAbsolute         Unsigned32,
    diffServMinRateRelative         Unsigned32,
    diffServMinRateStorage          StorageType,
    diffServMinRateStatus           RowStatus
}


diffServMinRateId OBJECT-TYPE
    SYNTAX        IndexInteger
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An index that enumerates the Scheduler Parameter entries.
       Managers obtain new values for row creation in this table by
       reading diffServMinRateNextFree."
    ::= { diffServMinRateEntry 1 }


diffServMinRatePriority OBJECT-TYPE
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
       "The priority of this input to the associated scheduler, relative
```

```
             to the scheduler's other inputs. A queue or scheduler with a
             larger numeric value will be served before another with a smaller
             numeric value."
        ::= { diffServMinRateEntry 2 }

   diffServMinRateAbsolute OBJECT-TYPE
        SYNTAX          Unsigned32 (1..4294967295)
        UNITS           "kilobits per second"
        MAX-ACCESS      read-create
        STATUS          current
        DESCRIPTION
             "The minimum absolute rate, in kilobits/sec, that a downstream
             scheduler element should allocate to this queue. If the value is
             zero, then there is effectively no minimum rate guarantee. If the
             value is non-zero, the scheduler will assure the servicing of
             this queue to at least this rate.

             Note that this attribute value and that of
             diffServMinRateRelative are coupled: changes to one will affect
             the value of the other. They are linked by the following
             equation, in that setting one will change the other:

               diffServMinRateRelative =
                        (diffServMinRateAbsolute*1000000)/ifSpeed

             or, if appropriate:

               diffServMinRateRelative = diffServMinRateAbsolute/ifHighSpeed"
        REFERENCE
             "ifSpeed, ifHighSpeed, Interface MIB, RFC 2863"
        ::= { diffServMinRateEntry 3 }

   diffServMinRateRelative OBJECT-TYPE
        SYNTAX          Unsigned32 (1..4294967295)
        MAX-ACCESS      read-create
        STATUS          current
        DESCRIPTION
             "The minimum rate that a downstream scheduler element should
             allocate to this queue, relative to the maximum rate of the
             interface as reported by ifSpeed or ifHighSpeed, in units of
             1/1000 of 1. If the value is zero, then there is effectively no
             minimum rate guarantee. If the value is non-zero, the scheduler
             will assure the servicing of this queue to at least this rate.

             Note that this attribute value and that of
             diffServMinRateAbsolute are coupled: changes to one will affect
             the value of the other. They are linked by the following
             equation, in that setting one will change the other:
```

```
        diffServMinRateRelative =
                (diffServMinRateAbsolute*1000000)/ifSpeed

    or, if appropriate:

        diffServMinRateRelative = diffServMinRateAbsolute/ifHighSpeed"
    REFERENCE
        "ifSpeed, ifHighSpeed, Interface MIB, RFC 2863"
    ::= { diffServMinRateEntry 4 }

diffServMinRateStorage OBJECT-TYPE
    SYNTAX        StorageType
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The storage type for this conceptual row.  Conceptual rows
        having the value 'permanent' need not allow write-access to any
        columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServMinRateEntry 5 }

diffServMinRateStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The status of this conceptual row. All writable objects in this
        row may be modified at any time. Setting this variable to
        'destroy' when the MIB contains one or more RowPointers pointing
        to it results in destruction being delayed until the row is no
        longer used."
    ::= { diffServMinRateEntry 6 }

--
-- Maximum Rate Parameter Table
--
-- The parameters used by a scheduler for its inputs or outputs are
-- maintained separately from the Queue or Scheduler table entries for
-- reusability reasons and so that they may be used by both queues and
-- schedulers.  This follows the approach for separation of data path
-- elements from parameterization that is used throughout this MIB.
-- Use of these Maximum Rate Parameter Table entries by Queues and
-- Schedulers allows the modeling of hierarchical scheduling systems.
--
-- Specifically, a Scheduler has one or more inputs and one output.
-- Any queue feeding a scheduler, or any scheduler which feeds a second
-- scheduler, might specify a maximum transfer rate by pointing to a
-- Maximum Rate Parameter Table entry. Multi-rate shapers, such as a
```

```
-- Dual Leaky Bucket algorithm, specify their rates using multiple
-- Maximum Rate Parameter Entries with the same diffServMaxRateId but
-- different diffServMaxRateLevels.
--
-- The diffServMaxRateLevel/Abs/Rel attributes are used as
-- parameters to the non-work-conserving portion of a scheduler:
-- non-work-conserving implies that the scheduler may sometimes not
-- emit a packet, even if there is data available at its input(s).
-- This has the effect of limiting the servicing of the queue/scheduler
-- input or output, in effect performing shaping of the packet stream
-- passing through the queue/scheduler, as described in the Informal
-- Differentiated Services Model section 7.2.
--

diffServMaxRateNextFree OBJECT-TYPE
    SYNTAX         IndexIntegerNextFree
    MAX-ACCESS   read-only
    STATUS         current
    DESCRIPTION
      "This object contains an unused value for diffServMaxRateId, or a
      zero to indicate that none exist."
    ::= { diffServScheduler 5 }

diffServMaxRateTable OBJECT-TYPE
    SYNTAX         SEQUENCE OF DiffServMaxRateEntry
    MAX-ACCESS   not-accessible
    STATUS         current
    DESCRIPTION
      "The Maximum Rate Parameter Table enumerates individual sets of
      scheduling parameter that can be used/reused by Queues and
      Schedulers."
    ::= { diffServScheduler 6 }

diffServMaxRateEntry OBJECT-TYPE
    SYNTAX         DiffServMaxRateEntry
    MAX-ACCESS   not-accessible
    STATUS         current
    DESCRIPTION
      "An entry in the Maximum Rate Parameter Table describes a single
      set of scheduling parameters for use by one or more queues or
      schedulers."
    INDEX { diffServMaxRateId, diffServMaxRateLevel }
    ::= { diffServMaxRateTable 1 }

DiffServMaxRateEntry ::= SEQUENCE  {
    diffServMaxRateId                  IndexInteger,
    diffServMaxRateLevel               Unsigned32,
    diffServMaxRateAbsolute            Unsigned32,
```

```
    diffServMaxRateRelative          Unsigned32,
    diffServMaxRateThreshold         BurstSize,
    diffServMaxRateStorage           StorageType,
    diffServMaxRateStatus            RowStatus
}


diffServMaxRateId OBJECT-TYPE
    SYNTAX          IndexInteger
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "An index that enumerates the Maximum Rate Parameter entries.
        Managers obtain new values for row creation in this table by
        reading diffServMaxRateNextFree."
    ::= { diffServMaxRateEntry 1 }

diffServMaxRateLevel OBJECT-TYPE
    SYNTAX          Unsigned32 (1..32)
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "An index that indicates which level of a multi-rate shaper is
        being given its parameters. A multi-rate shaper has some number
        of rate levels. Frame Relay's dual rate specification refers to a
        'committed' and an 'excess' rate; ATM's dual rate specification
        refers to a 'mean' and a 'peak' rate. This table is generalized
        to support an arbitrary number of rates. The committed or mean
        rate is level 1, the peak rate (if any) is the highest level rate
        configured, and if there are other rates they are distributed in
        monotonically increasing order between them."
    ::= { diffServMaxRateEntry 2 }

diffServMaxRateAbsolute OBJECT-TYPE
    SYNTAX          Unsigned32 (1..4294967295)
    UNITS           "kilobits per second"
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The maximum rate in kilobits/sec that a downstream scheduler
        element should allocate to this queue. If the value is zero, then
        there is effectively no maximum rate limit and that the scheduler
        should attempt to be work conserving for this queue. If the value
        is non-zero, the scheduler will limit the servicing of this queue
        to, at most, this rate in a non-work-conserving manner.

        Note that this attribute value and that of
        diffServMaxRateRelative are coupled: changes to one will affect
        the value of the other. They are linked by the following
```

       equation, in that setting one will change the other:

         diffServMaxRateRelative =
                 (diffServMaxRateAbsolute*1000000)/ifSpeed

       or, if appropriate:

         diffServMaxRateRelative = diffServMaxRateAbsolute/ifHighSpeed"
     REFERENCE
         "ifSpeed, ifHighSpeed, Interface MIB, RFC 2863"
     ::= { diffServMaxRateEntry 3 }

diffServMaxRateRelative OBJECT-TYPE
     SYNTAX   Unsigned32 (1..4294967295)
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
        "The maximum rate that a downstream scheduler element should
        allocate to this queue, relative to the maximum rate of the
        interface as reported by ifSpeed or ifHighSpeed, in units of
        1/1000 of 1. If the value is zero, then there is effectively no
        maximum rate limit and the scheduler should attempt to be work
        conserving for this queue. If the value is non-zero, the
        scheduler will limit the servicing of this queue to, at most,
        this rate in a non-work-conserving manner.

        Note that this attribute value and that of
        diffServMaxRateAbsolute are coupled: changes to one will affect
        the value of the other. They are linked by the following
        equation, in that setting one will change the other:

         diffServMaxRateRelative =
                 (diffServMaxRateAbsolute*1000000)/ifSpeed

       or, if appropriate:

         diffServMaxRateRelative = diffServMaxRateAbsolute/ifHighSpeed"
     REFERENCE
         "ifSpeed, ifHighSpeed, Interface MIB, RFC 2863"
     ::= { diffServMaxRateEntry 4 }

diffServMaxRateThreshold OBJECT-TYPE
     SYNTAX   BurstSize
     UNITS   "Bytes"
     MAX-ACCESS   read-create
     STATUS   current
     DESCRIPTION
        "The number of bytes of queue depth at which the rate of a

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        multi-rate scheduler will increase to the next output rate. In
        the last conceptual row for such a shaper, this threshold is
        ignored and by convention is zero."
    REFERENCE
         "Adaptive rate Shaper, RFC 2963"
    ::= { diffServMaxRateEntry 5 }

diffServMaxRateStorage OBJECT-TYPE
    SYNTAX   StorageType
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The storage type for this conceptual row. Conceptual rows
       having the value 'permanent' need not allow write-access to any
       columnar objects in the row."
    DEFVAL { nonVolatile }
    ::= { diffServMaxRateEntry 6 }

diffServMaxRateStatus OBJECT-TYPE
    SYNTAX   RowStatus
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The status of this conceptual row. All writable objects in this
       row may be modified at any time. Setting this variable to
       'destroy' when the MIB contains one or more RowPointers pointing
       to it results in destruction being delayed until the row is no
       longer used."
    ::= { diffServMaxRateEntry 7 }

--
-- MIB Compliance statements.
--

diffServMIBCompliances OBJECT IDENTIFIER ::=
                                    { diffServMIBConformance 1 }
diffServMIBGroups   OBJECT IDENTIFIER ::=
                                    { diffServMIBConformance 2 }

diffServMIBFullCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
       "When this MIB is implemented with support for read-create, then
       such an implementation can claim full compliance. Such devices
       can then be both monitored and configured with this MIB."

    MODULE IF-MIB -- The interfaces MIB, RFC2863
    MANDATORY-GROUPS {

```
        ifCounterDiscontinuityGroup
    }

    MODULE -- This Module
    MANDATORY-GROUPS {
        diffServMIBDataPathGroup, diffServMIBClfrGroup,
        diffServMIBClfrElementGroup, diffServMIBMultiFieldClfrGroup,
        diffServMIBActionGroup, diffServMIBAlgDropGroup,
        diffServMIBQGroup, diffServMIBSchedulerGroup,
        diffServMIBMaxRateGroup, diffServMIBMinRateGroup,
        diffServMIBCounterGroup
    }

    GROUP diffServMIBMeterGroup
    DESCRIPTION
        "This group is mandatory for devices that implement metering
        functions."

    GROUP diffServMIBTBParamGroup
    DESCRIPTION
        "This group is mandatory for devices that implement token-bucket
        metering functions."

    GROUP diffServMIBDscpMarkActGroup
    DESCRIPTION
        "This group is mandatory for devices that implement DSCP-Marking
        functions."

    GROUP diffServMIBRandomDropGroup
    DESCRIPTION
        "This group is mandatory for devices that implement Random Drop
        functions."

    OBJECT diffServDataPathStatus
    SYNTAX RowStatus { active(1) }
    WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
    DESCRIPTION
        "Support for createAndWait and notInService is not required."

    OBJECT diffServClfrStatus
    SYNTAX RowStatus { active(1) }
    WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
    DESCRIPTION
        "Support for createAndWait and notInService is not required."

    OBJECT diffServClfrElementStatus
    SYNTAX RowStatus { active(1) }
    WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
```

```
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServMultiFieldClfrAddrType
     SYNTAX  InetAddressType { unknown(0), ipv4(1), ipv6(2) }
     DESCRIPTION
        "An implementation is only required to support IPv4 and IPv6
        addresses."

     OBJECT diffServMultiFieldClfrDstAddr
     SYNTAX  InetAddress (SIZE(0|4|16))
     DESCRIPTION
        "An implementation is only required to support IPv4 and globally
        unique IPv6 addresses."

     OBJECT diffServAlgDropStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServRandomDropStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServQStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServSchedulerStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServMinRateStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
     DESCRIPTION
        "Support for createAndWait and notInService is not required."

     OBJECT diffServMaxRateStatus
     SYNTAX RowStatus { active(1) }
     WRITE-SYNTAX RowStatus { createAndGo(4), destroy(6) }
```

```
    DESCRIPTION
        "Support for createAndWait and notInService is not required."

    ::= { diffServMIBCompliances 1 }

--
-- Read-Only Compliance
--

diffServMIBReadOnlyCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "When this MIB is implemented without support for read-create
        (i.e. in read-only mode), then such an implementation can claim
        read-only compliance. Such a device can then be monitored but can
        not be configured with this MIB."

    MODULE IF-MIB -- The interfaces MIB, RFC2863
    MANDATORY-GROUPS {
        ifCounterDiscontinuityGroup
    }

    MODULE -- This Module
    MANDATORY-GROUPS {
        diffServMIBDataPathGroup, diffServMIBClfrGroup,
        diffServMIBClfrElementGroup, diffServMIBMultiFieldClfrGroup,
        diffServMIBActionGroup, diffServMIBAlgDropGroup,
        diffServMIBQGroup, diffServMIBSchedulerGroup,
        diffServMIBMaxRateGroup, diffServMIBMinRateGroup,
        diffServMIBCounterGroup
    }

    GROUP diffServMIBMeterGroup
    DESCRIPTION
        "This group is mandatory for devices that implement metering
        functions."

    GROUP diffServMIBTBParamGroup
    DESCRIPTION
        "This group is mandatory for devices that implement token-bucket
        metering functions."

    GROUP       diffServMIBDscpMarkActGroup
    DESCRIPTION
        "This group is mandatory for devices that implement DSCP-Marking
        functions."

    GROUP       diffServMIBRandomDropGroup
```

```
      DESCRIPTION
         "This group is mandatory for devices that implement Random Drop
         functions."

      OBJECT          diffServDataPathStart
      MIN-ACCESS      read-only
      DESCRIPTION
         "Write access is not required."

      OBJECT          diffServDataPathStorage
      MIN-ACCESS      read-only
      DESCRIPTION
         "Write access is not required."

      OBJECT          diffServDataPathStatus
      SYNTAX          RowStatus { active(1) }
      MIN-ACCESS      read-only
      DESCRIPTION
         "Write access is not required, and active is the only status that
         needs to be supported."

      OBJECT          diffServClfrNextFree
      MIN-ACCESS      not-accessible
      DESCRIPTION
         "Object not needed when diffServClfrTable is implemented read-
         only"

      OBJECT          diffServClfrStorage
      MIN-ACCESS      read-only
      DESCRIPTION
         "Write access is not required."

      OBJECT          diffServClfrStatus
      SYNTAX          RowStatus { active(1) }
      MIN-ACCESS      read-only
      DESCRIPTION
         "Write access is not required, and active is the only status that
         needs to be supported."

      OBJECT          diffServClfrElementNextFree
      MIN-ACCESS      not-accessible
      DESCRIPTION
         "Object not needed when diffServClfrelementTable is implemented
         read-only"

      OBJECT          diffServClfrElementPrecedence
      MIN-ACCESS      read-only
      DESCRIPTION
```

```
   "Write access is not required."


OBJECT        diffServClfrElementNext
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required."


OBJECT        diffServClfrElementSpecific
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required."


OBJECT        diffServClfrElementStorage
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required."


OBJECT        diffServClfrElementStatus
SYNTAX        RowStatus { active(1) }
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required, and active is the only status that
   needs to be supported."


OBJECT        diffServMultiFieldClfrNextFree
MIN-ACCESS    not-accessible
DESCRIPTION
   "Object is not needed when diffServMultiFieldClfrTable is
   implemented in read-only mode."


OBJECT        diffServMultiFieldClfrAddrType
SYNTAX        InetAddressType { unknown(0), ipv4(1), ipv6(2) }
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required. An implementation is only required
   to support IPv4 and IPv6 addresses."


OBJECT        diffServMultiFieldClfrDstAddr
SYNTAX        InetAddress (SIZE(0|4|16))
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required. An implementation is only required
   to support IPv4 and globally unique IPv6 addresses."


OBJECT        diffServMultiFieldClfrDstPrefixLength
MIN-ACCESS    read-only
DESCRIPTION
   "Write access is not required."
```

```
    OBJECT          diffServMultiFieldClfrSrcAddr
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required. An implementation is only required
        to support IPv4 and globally unique IPv6 addresses."

    OBJECT          diffServMultiFieldClfrSrcPrefixLength
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrDscp
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrFlowId
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrProtocol
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrDstL4PortMin
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrDstL4PortMax
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrSrcL4PortMin
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrSrcL4PortMax
    MIN-ACCESS      read-only
    DESCRIPTION
        "Write access is not required."

    OBJECT          diffServMultiFieldClfrStorage
    MIN-ACCESS      read-only
```

```
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServMultiFieldClfrStatus
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required, createAndWait and notInService
        support is not required."

     OBJECT        diffServMeterNextFree
     MIN-ACCESS    not-accessible
     DESCRIPTION
        "Object is not needed when diffServMultiFieldClfrTable is
        implemented in read-only mode."

     OBJECT        diffServMeterSucceedNext
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServMeterFailNext
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServMeterSpecific
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServMeterStorage
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServMeterStatus
     SYNTAX        RowStatus { active(1) }
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required, and active is the only status that
        needs to be supported."

     OBJECT        diffServTBParamNextFree
     MIN-ACCESS    not-accessible
     DESCRIPTION
        "Object is not needed when diffServTBParamTable is implemented in
        read-only mode."
```

```
OBJECT         diffServTBParamType
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServTBParamRate
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServTBParamBurstSize
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServTBParamInterval
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServTBParamStorage
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServTBParamStatus
SYNTAX         RowStatus { active(1) }
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required, and active is the only status that
   needs to be supported."

OBJECT         diffServActionNextFree
MIN-ACCESS     not-accessible
DESCRIPTION
   "Object is not needed when diffServActionTable is implemented in
   read-only mode."

OBJECT         diffServActionInterface
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."

OBJECT         diffServActionNext
MIN-ACCESS     read-only
DESCRIPTION
   "Write access is not required."
```

```
    OBJECT        diffServActionSpecific
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT        diffServActionStorage
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT        diffServActionStatus
    SYNTAX        RowStatus { active(1) }
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required, and active is the only status that
       needs to be supported."

    OBJECT        diffServCountActNextFree
    MIN-ACCESS    not-accessible
    DESCRIPTION
       "Object is not needed when diffServCountActTable is implemented
       in read-only mode."

    OBJECT        diffServCountActStorage
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT        diffServCountActStatus
    SYNTAX        RowStatus { active(1) }
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required, and active is the only status that
       needs to be supported."

    OBJECT        diffServAlgDropNextFree
    MIN-ACCESS    not-accessible
    DESCRIPTION
       "Object is not needed when diffServAlgDropTable is implemented in
       read-only mode."

    OBJECT        diffServAlgDropType
    MIN-ACCESS    read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT        diffServAlgDropNext
    MIN-ACCESS    read-only
```

```
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServAlgDropQMeasure
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServAlgDropQThreshold
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServAlgDropSpecific
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServAlgDropStorage
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServAlgDropStatus
     SYNTAX        RowStatus { active(1) }
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required, and active is the only status that
        needs to be supported."

     OBJECT        diffServRandomDropNextFree
     MIN-ACCESS    not-accessible
     DESCRIPTION
        "Object is not needed when diffServRandomDropTable is implemented
        in read-only mode."

     OBJECT        diffServRandomDropMinThreshBytes
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServRandomDropMinThreshPkts
     MIN-ACCESS    read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT        diffServRandomDropMaxThreshBytes
     MIN-ACCESS    read-only
```

```
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropMaxThreshPkts
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropProbMax
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropWeight
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropSamplingRate
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropStorage
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServRandomDropStatus
       SYNTAX          RowStatus { active(1) }
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required, and active is the only status that
          needs to be supported."

       OBJECT          diffServQNextFree
       MIN-ACCESS      not-accessible
       DESCRIPTION
          "Object is not needed when diffServQTable is implemented in
          read-only mode."

       OBJECT          diffServQNext
       MIN-ACCESS      read-only
       DESCRIPTION
          "Write access is not required."

       OBJECT          diffServQMinRate
       MIN-ACCESS      read-only
```

```
DESCRIPTION
    "Write access is not required."

OBJECT      diffServQMaxRate
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServQStorage
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServQStatus
SYNTAX      RowStatus { active(1) }
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required, and active is the only status that
    needs to be supported."

OBJECT      diffServSchedulerNextFree
MIN-ACCESS  not-accessible
DESCRIPTION
    "Object is not needed when diffServSchedulerTable is implemented
    in read-only mode."

OBJECT      diffServSchedulerNext
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServSchedulerMethod
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServSchedulerMinRate
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServSchedulerMaxRate
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      diffServSchedulerStorage
MIN-ACCESS  read-only
```

```
     DESCRIPTION
        "Write access is not required."

     OBJECT       diffServSchedulerStatus
     SYNTAX       RowStatus { active(1) }
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required, and active is the only status that
        needs to be supported."

     OBJECT       diffServMinRateNextFree
     MIN-ACCESS   not-accessible
     DESCRIPTION
        "Object is not needed when diffServMinRateTable is implemented in
        read-only mode."

     OBJECT       diffServMinRatePriority
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT       diffServMinRateAbsolute
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT       diffServMinRateRelative
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT       diffServMinRateStorage
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required."

     OBJECT       diffServMinRateStatus
     SYNTAX       RowStatus { active(1) }
     MIN-ACCESS   read-only
     DESCRIPTION
        "Write access is not required, and active is the only status that
        needs to be supported."

     OBJECT       diffServMaxRateNextFree
     MIN-ACCESS   not-accessible
     DESCRIPTION
        "Object is not needed when diffServMaxrateTable is implemented in
        read-only mode."
```

```
        OBJECT         diffServMaxRateAbsolute
        MIN-ACCESS     read-only
        DESCRIPTION
           "Write access is not required."

        OBJECT         diffServMaxRateRelative
        MIN-ACCESS     read-only
        DESCRIPTION
           "Write access is not required."

        OBJECT         diffServMaxRateThreshold
        MIN-ACCESS     read-only
        DESCRIPTION
           "Write access is not required."

        OBJECT         diffServMaxRateStorage
        MIN-ACCESS     read-only
        DESCRIPTION
           "Write access is not required."

        OBJECT         diffServMaxRateStatus
        SYNTAX         RowStatus { active(1) }
        MIN-ACCESS     read-only
        DESCRIPTION
           "Write access is not required, and active is the only status that
           needs to be supported."

        ::= { diffServMIBCompliances 2 }

    diffServMIBDataPathGroup OBJECT-GROUP
        OBJECTS {
                   diffServDataPathStart, diffServDataPathStorage,
                   diffServDataPathStatus
        }
        STATUS         current
        DESCRIPTION
           "The Data Path Group defines the MIB Objects that describe a
           functional data path."
        ::= { diffServMIBGroups 1 }

    diffServMIBClfrGroup OBJECT-GROUP
        OBJECTS {
                   diffServClfrNextFree, diffServClfrStorage,
                   diffServClfrStatus
        }
        STATUS         current
        DESCRIPTION
           "The Classifier Group defines the MIB Objects that describe the
```

          list the starts of individual classifiers."
     ::= { diffServMIBGroups 2 }

diffServMIBClfrElementGroup OBJECT-GROUP
     OBJECTS {
               diffServClfrElementNextFree,
               diffServClfrElementPrecedence, diffServClfrElementNext,
               diffServClfrElementSpecific, diffServClfrElementStorage,
               diffServClfrElementStatus
     }
     STATUS   current
     DESCRIPTION
        "The Classifier Element Group defines the MIB Objects that
        describe the classifier elements that make up a generic
        classifier."
     ::= { diffServMIBGroups 3 }

diffServMIBMultiFieldClfrGroup OBJECT-GROUP
     OBJECTS {
               diffServMultiFieldClfrNextFree,
               diffServMultiFieldClfrAddrType,
               diffServMultiFieldClfrDstAddr,
               diffServMultiFieldClfrDstPrefixLength,
               diffServMultiFieldClfrFlowId,
               diffServMultiFieldClfrSrcAddr,
               diffServMultiFieldClfrSrcPrefixLength,
               diffServMultiFieldClfrDscp,
               diffServMultiFieldClfrProtocol,
               diffServMultiFieldClfrDstL4PortMin,
               diffServMultiFieldClfrDstL4PortMax,
               diffServMultiFieldClfrSrcL4PortMin,
               diffServMultiFieldClfrSrcL4PortMax,
               diffServMultiFieldClfrStorage,
               diffServMultiFieldClfrStatus
     }
     STATUS   current
     DESCRIPTION
        "The Multi-field Classifier Group defines the MIB Objects that
        describe a classifier element for matching on various fields of
        an IP and upper-layer protocol header."
     ::= { diffServMIBGroups 4 }

diffServMIBMeterGroup OBJECT-GROUP
     OBJECTS {
               diffServMeterNextFree, diffServMeterSucceedNext,
               diffServMeterFailNext, diffServMeterSpecific,
               diffServMeterStorage, diffServMeterStatus
     }

```
     STATUS         current
     DESCRIPTION
        "The Meter Group defines the objects used in describing a generic
         meter element."
     ::= { diffServMIBGroups 5 }

diffServMIBTBParamGroup OBJECT-GROUP
     OBJECTS {
                 diffServTBParamNextFree, diffServTBParamType,
                 diffServTBParamRate, diffServTBParamBurstSize,
                 diffServTBParamInterval, diffServTBParamStorage,
                 diffServTBParamStatus
     }
     STATUS         current
     DESCRIPTION
        "The Token-Bucket Meter Group defines the objects used in
         describing a token bucket meter element."
     ::= { diffServMIBGroups 6 }

diffServMIBActionGroup OBJECT-GROUP
     OBJECTS {
                 diffServActionNextFree, diffServActionNext,
                 diffServActionSpecific, diffServActionStorage,
                 diffServActionInterface, diffServActionStatus
     }
     STATUS         current
     DESCRIPTION
        "The Action Group defines the objects used in describing a
         generic action element."
     ::= { diffServMIBGroups 7 }

diffServMIBDscpMarkActGroup OBJECT-GROUP
     OBJECTS {
                 diffServDscpMarkActDscp
     }
     STATUS         current
     DESCRIPTION
        "The DSCP Mark Action Group defines the objects used in
         describing a DSCP Marking Action element."
     ::= { diffServMIBGroups 8 }

diffServMIBCounterGroup OBJECT-GROUP
     OBJECTS {
                 diffServCountActOctets, diffServCountActPkts,
                 diffServAlgDropOctets, diffServAlgDropPkts,
                 diffServAlgRandomDropOctets, diffServAlgRandomDropPkts,
                 diffServCountActStorage, diffServCountActStatus,
                 diffServCountActNextFree
```

```
        }
    STATUS          current
    DESCRIPTION
        "A collection of objects providing information specific to
        packet-oriented network interfaces."
    ::= { diffServMIBGroups 9 }

diffServMIBAlgDropGroup OBJECT-GROUP
    OBJECTS {
                diffServAlgDropNextFree, diffServAlgDropType,
                diffServAlgDropNext, diffServAlgDropQMeasure,
                diffServAlgDropQThreshold, diffServAlgDropSpecific,
                diffServAlgDropStorage, diffServAlgDropStatus
    }
    STATUS          current
    DESCRIPTION
        "The Algorithmic Drop Group contains the objects that describe
        algorithmic dropper operation and configuration."
    ::= { diffServMIBGroups 10 }

diffServMIBRandomDropGroup OBJECT-GROUP
    OBJECTS {
                diffServRandomDropNextFree,
                diffServRandomDropMinThreshBytes,
                diffServRandomDropMinThreshPkts,
                diffServRandomDropMaxThreshBytes,
                diffServRandomDropMaxThreshPkts,
                diffServRandomDropProbMax,
                diffServRandomDropWeight,
                diffServRandomDropSamplingRate,
                diffServRandomDropStorage,
                diffServRandomDropStatus
    }
    STATUS          current
    DESCRIPTION
        "The Random Drop Group augments the Algorithmic Drop Group for
        random dropper operation and configuration."
    ::= { diffServMIBGroups 11 }

diffServMIBQGroup OBJECT-GROUP

    OBJECTS {
                diffServQNextFree, diffServQNext, diffServQMinRate,
                diffServQMaxRate, diffServQStorage, diffServQStatus
    }
    STATUS          current
    DESCRIPTION
        "The Queue Group contains the objects that describe an
```

```
         interface's queues."
      ::= { diffServMIBGroups 12 }


diffServMIBSchedulerGroup OBJECT-GROUP
      OBJECTS {
                diffServSchedulerNextFree, diffServSchedulerNext,
                diffServSchedulerMethod, diffServSchedulerMinRate,
                diffServSchedulerMaxRate, diffServSchedulerStorage,
                diffServSchedulerStatus
      }
      STATUS        current
      DESCRIPTION
         "The Scheduler Group contains the objects that describe packet
         schedulers on interfaces."
      ::= { diffServMIBGroups 13 }


diffServMIBMinRateGroup OBJECT-GROUP
      OBJECTS {
                diffServMinRateNextFree, diffServMinRatePriority,
                diffServMinRateAbsolute, diffServMinRateRelative,
                diffServMinRateStorage, diffServMinRateStatus
      }
      STATUS        current
      DESCRIPTION
         "The Minimum Rate Parameter Group contains the objects that
         describe packet schedulers' minimum rate or priority guarantees."
      ::= { diffServMIBGroups 14 }


diffServMIBMaxRateGroup OBJECT-GROUP
      OBJECTS {
                diffServMaxRateNextFree, diffServMaxRateAbsolute,
                diffServMaxRateRelative, diffServMaxRateThreshold,
                diffServMaxRateStorage, diffServMaxRateStatus
      }
      STATUS        current
      DESCRIPTION
         "The Maximum Rate Parameter Group contains the objects that
         describe packet schedulers' maximum rate guarantees."
      ::= { diffServMIBGroups 15 }


END
```

7. Acknowledgments

   This MIB builds on all the work that has gone into the Informal
   Management Model for Differentiated Services Routers, Differentiated
   Services PIB, and Differentiated Services Policy MIB (SNMPCONF WG).

   It has been developed with the active involvement of many people, but
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   Moore, Kathleen Nichols, Ping Pan, Nabil Seddigh, John Seligson, and
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   Hazewinkel, and Bert Wijnen are especially to be noted for review
   comments on the structure and usage of the MIB for network management
   purposes, and its compliance with SMIv2.

8. Security Considerations

   It is clear that this MIB is potentially useful for configuration.
   Anything that can be configured can be misconfigured, with
   potentially disastrous effects.

   At this writing, no security holes have been identified beyond those
   that SNMP Security is itself intended to address. These relate
   primarily to controlled access to sensitive information and the
   ability to configure a device - or which might result from operator
   error, which is beyond the scope of any security architecture.

   There are many read-write and read-create management objects defined
   in this MIB. Such objects are often 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. The use of SNMP Version 3 is recommended over
   prior versions for configuration control as its security model is
   improved.

   There are a number of managed objects in this MIB that may contain
   information that may be sensitive from a business perspective, in
   that they may represent a customer's service contract or the filters
   that the service provider chooses to apply to a customer's ingress or
   egress traffic. There are no objects which are sensitive in their
   own right, such as passwords or monetary amounts.

It may be important to even control GET access to these objects and
possibly to even encrypt the values of these objects when sending
them over the network via SNMP. Not all versions of SNMP provide
features for such a secure environment.

SNMPv1 by itself is not a secure environment. 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.

It is recommended that the implementors consider the security
features as provided by the SNMPv3 framework. Specifically, the use
of the User-based Security Model [RFC 2574] and the View-based Access
Control Model [RFC 2575] is recommended.

It is then a customer/user responsibility to ensure that the SNMP
entity giving access to an instance of this MIB, 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.

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12. Full Copyright Statement

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