

CISCO SYSTEMS



Latest QoS Tools and Techniques

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Agenda

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- **Introduction**
- **Classification and Marking**
- **Policing and Shaping**
- **Queuing and Congestion Avoidance**
- **Other Enhancements**
- **MPLS DS Tunnel Modes**
- **Summary and References**

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Cisco DiffServ Implementation

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Cisco leads the industry with the most **comprehensive** and **flexible** DiffServ support

- RFC 2474 - Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
- RFC 2475 - An Architecture for Differentiated Service
- RFC 2597 - Assured Forwarding PHB Group
- RFC 2598 - An Expedited Forwarding PHB
- RFC 2697 - A Single Rate Three Color Marker
- RFC 2698 - A Two Rate Three Color Marker
- RFC 3168 - The Addition of Explicit Congestion Notification (ECN) to IP
- **With a comprehensive list of knobs**
- **Plus many more related standards (header compression, IntServ, etc)**

Configuring QoS in IOS

Modular QoS CLI (MQC)

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- **Cisco IOS command syntax for QoS**
- **Template-based syntax**
- **Separates classification engine from the policy**
- **Uniform CLI for QoS features**
- **Cisco Platform independent**

Configuring QoS in IOS

MQC Abstractions and Syntax

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1. Identify traffic to differentiate

```
class-map [match-any | match-all] class-name
```

2. Define treatment for each class of traffic

```
policy-map policy-name
```

3. Define interface / PVC to implement policy

```
service-policy {input | output} policy-name
```

MQC Example

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1. Identify traffic to differentiate

2. Define treatment for each class of traffic

3. Define interface / PVC to implement policy

```
!  
class-map match-all PREMIUM  
  match ip dscp ef  
!  
class-map match-all BUSINESS  
  match ip dscp af31 af32 af33  
!  
policy-map OUT-POLICY  
  class PREMIUM  
    priority 16384  
  class BUSINESS  
    bandwidth 65536  
    random-detect dscp-based  
  class class-default  
    random-detect dscp-based  
!  
interface POS1/0  
  ip address 10.150.1.1 255.255.255.0  
  service-policy output OUT-POLICY  
!
```


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New Features

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- **Features usually are implemented first in software-based platforms**
- **Your account team can get details on current and planned support on other platforms**
- **This presentation contains limited information on new feature support on hardware-based platforms**

NBAR RTP Payload Classification

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- Eases classification of voice and video traffic
- Enables classification of RTP packets based on payload or CODECS
- Removes dependency on port ranges and guessing

```
!  
class-map match-all VOICE  
  match protocol rtp audio  
!  
policy-map IN-POLICY  
  class VOICE  
    set dscp ef  
!
```

```
match protocol rtp [audio | video | payload-type payload-string]
```

- Supported on 7500, 7200 and low end platforms starting with 12.2(8)T
- Future support expected with 12.2S on 7600

FR DLCI Classification

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- Enables new SLA
- Single policy on physical interface may contain all per-PVC policies
- Simplifies attachment of QoS policies

```
!  
class-map match-all DLCI-16  
  match fr-dlci 16  
class-map match-all DLCI-17  
  match fr-dlci 17  
!  
policy-map OUT-POLICY  
  class DLCI-17  
    bandwidth percent 50  
  class DLCI-16  
    bandwidth percent 25  
!
```

```
match fr-dlci <dlci>
```

- Supported on 7500, 7200 and low end platforms starting with 12.2(8)T (planned for 12.0(26)S)

IP Packet Length Classification

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- Helps ensure large packets do not use priority queue on slow links
- Provides safety net for voice service

```
!  
class-map match-all VOICE  
  match packet length min 64 max 128  
  match dscp ef  
!  
policy-map OUT-POLICY  
  class VOICE  
    priority 128  
!
```

`match packet length min <n> max <m>`

- Supported on 7500, 7200 and low end platforms starting with 12.2(13)T

FR DE Marking

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- QoS capabilities of Frame Relay network can be used to enhance IP SLA
- Required to provide Frame Relay service

```
!  
policy-map OUT-POLICY  
  class BUSINESS  
    police cir 64000  
      conform-action transmit  
      exceed-action set-frde-transmit  
  class class-default  
    set fr-de  
!
```

set fr-de

- Supported on 7500, 7200 and low end platforms starting with 12.2(2)T (planned for 12.0(26)S)

Enhanced Packet Marking

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- Enables flexible mappings between IP Precedence, DSCP, Ethernet COS and MPLS EXP
- Easier configuration and monitoring of QoS policies
- Easier network integration
- Facilitates QoS transparency through MPLS networks

```
!  
table-map COS-TO-DSCP  
  map from 3 to 20  
  map from 4 to 18  
  map from 5 to 46  
  default 0  
!  
policy-map IN-POLICY  
  class class-default  
    set dscp cos table COS-TO-DSCP  
!
```

```
set [dscp [cos|qos-group] | cos [dscp|prec] | qos-group [prec|dscp|mpls  
exp top] | mpls exp imp [dscp|prec]] table <table-map>
```

- Supported on 7500, 7200 and low end platforms starting with 12.2(13)T

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Percentage-Based Policing and Shaping

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- Enables re-use of policies for different links speeds
- Greatly simplifies provisioning
- Easier SLA implementation
- More intuitive SLA definitions

```
!  
policy-map IN-POLICY  
  class class-default  
    police cir percent 10 bc 1500 ms  
      conform-action set-dscp-transmit af21  
      exceed-action set-dscp-transmit af22  
!  
policy-map OUT-POLICY  
  class class-default  
    shape average percent 25 10 ms  
!
```

`police cir percent <n> bc <m> ms`

`shape average percent <n> <m> ms`

- Supported on 7500, 7200 and low end platforms starting with 12.2(13)T
- Support planned for 12.0(25)SX on 10000

Two-Rate Three-Color Policer

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- Enables enhanced SLAs with bursting capabilities
- Easier SLA implementation
- More intuitive SLA definitions

```
!  
policy-map IN-POLICY  
  class class-default  
    police cir 128000 pir 512000  
      conform-action set-dscp-transmit af21  
      exceed-action set-dscp-transmit af22  
      violate-action set-dscp-transmit af23  
!
```

```
police cir <n> pir <m>  
  conform-action <action>  
  exceed-action <action>  
  violate-action <action>
```

- Supported on 7500, 7200 and low end platforms starting with 12.2(13)T (planned for 12.0(26)S)

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Enhanced Percentage-Based Bandwidth Allocation

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- Enables re-use of policies for different links speeds
- Greatly simplifies provisioning
- Easier SLA implementation
- More intuitive SLA definitions

```
!  
policy-map OUT-POLICY  
  class VOICE  
    priority percent 25  
  class BUSINESS  
    bandwidth remaining percent 50  
    random-detect  
  class class-default  
!
```

`priority percent <percent>`

`bandwidth remaining percent <percent>`

- Supported on 7500, 7200 and low end platforms starting with 12.2(2)T (planned for 12.0(26)S)
- Support starting with 12.0(21)S on 12000

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Class-Based Header Compression

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- Easier provisioning and monitoring
- Performances improvement
- Increase manageability

```
!  
policy-map OUT-POLICY  
  class VOICE  
    priority percent 25  
    compress header ip rtp  
  class class-default  
    compress header ip tcp  
!
```

```
compress header ip [rtp | tcp]
```

- Supported on 7500, 7200 and low end starting with 12.2(13)T

Three-Level Hierarchical Policies

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- Enhanced SLA
- Better SLA control and monitoring

```
!  
policy-map OUT-POLICE  
  class BUSINESS-NO-MGMT  
    police cir 128000  
      conform-action transmit  
      exceed-action set-frde-transmit  
!  
policy-map OUT-QUEUE-POLICE  
  class VOICE  
    priority percent 25  
  class BUSINESS  
    bandwidth remaining percent 66  
    service-policy OUT-POLICE  
!  
policy-map OUT-POLICY  
  class class-default  
    shape average 512000  
    service-policy OUT-QUEUE-POLICE  
!
```

- Supported on 7500, 7200 and low end starting with 12.2(8)T
- Support planned with 12.0(25)SX on 10000

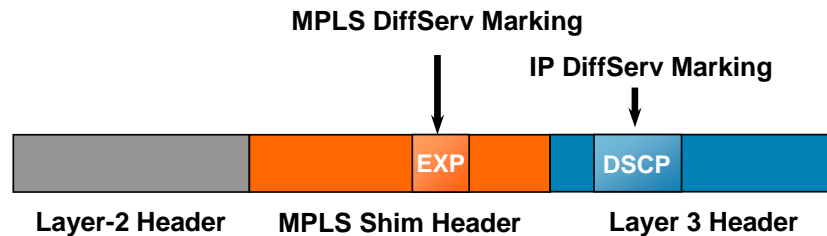
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DiffServ over MPLS Tunnel Modes

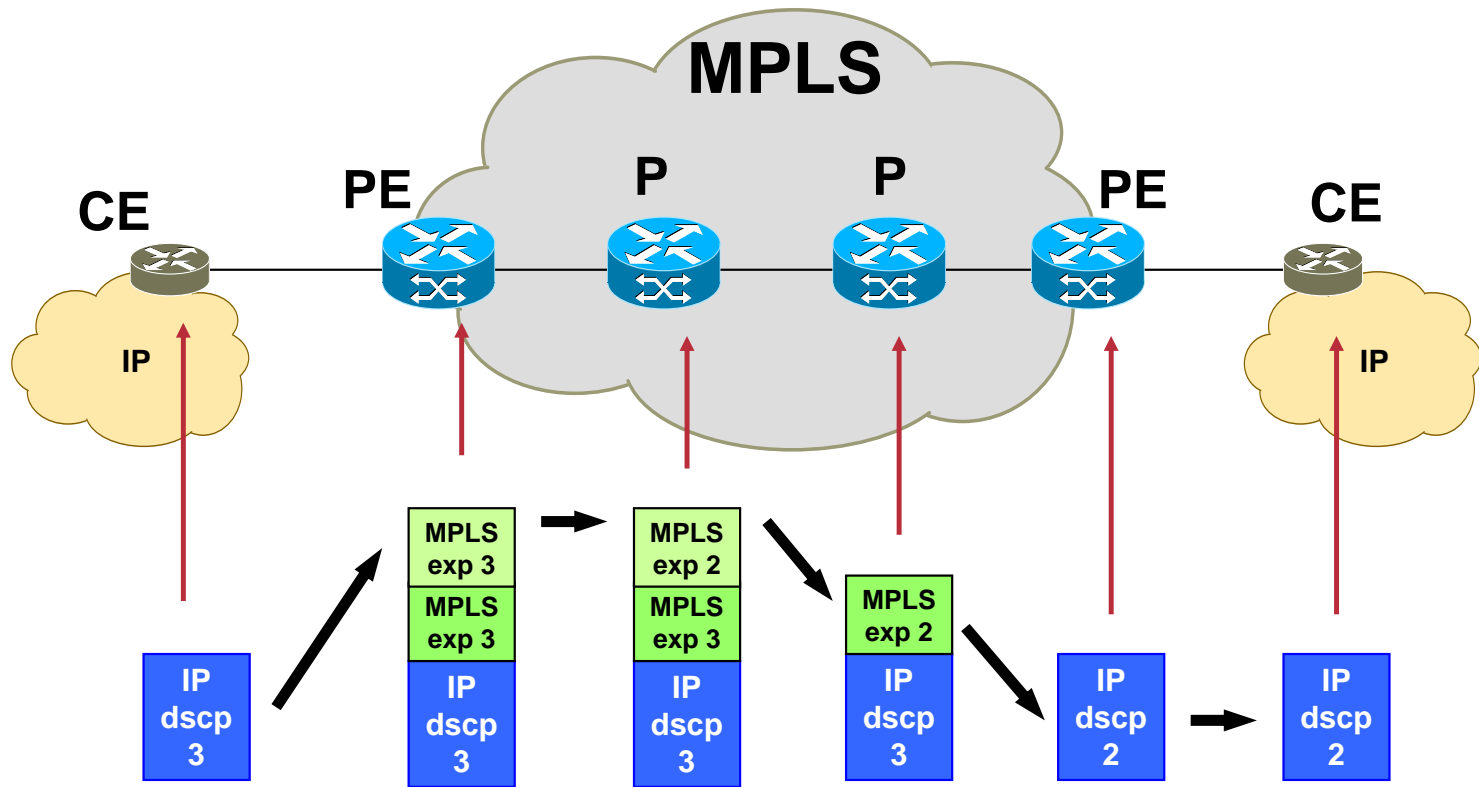
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- **An MPLS packet carries two (or more) DiffServ markings**
- **Three modes of interaction defined between markings: Uniform, Pipe and Short Pipe (under development in IOS)**
- **Modes only relevant when a label is popped/pushed**

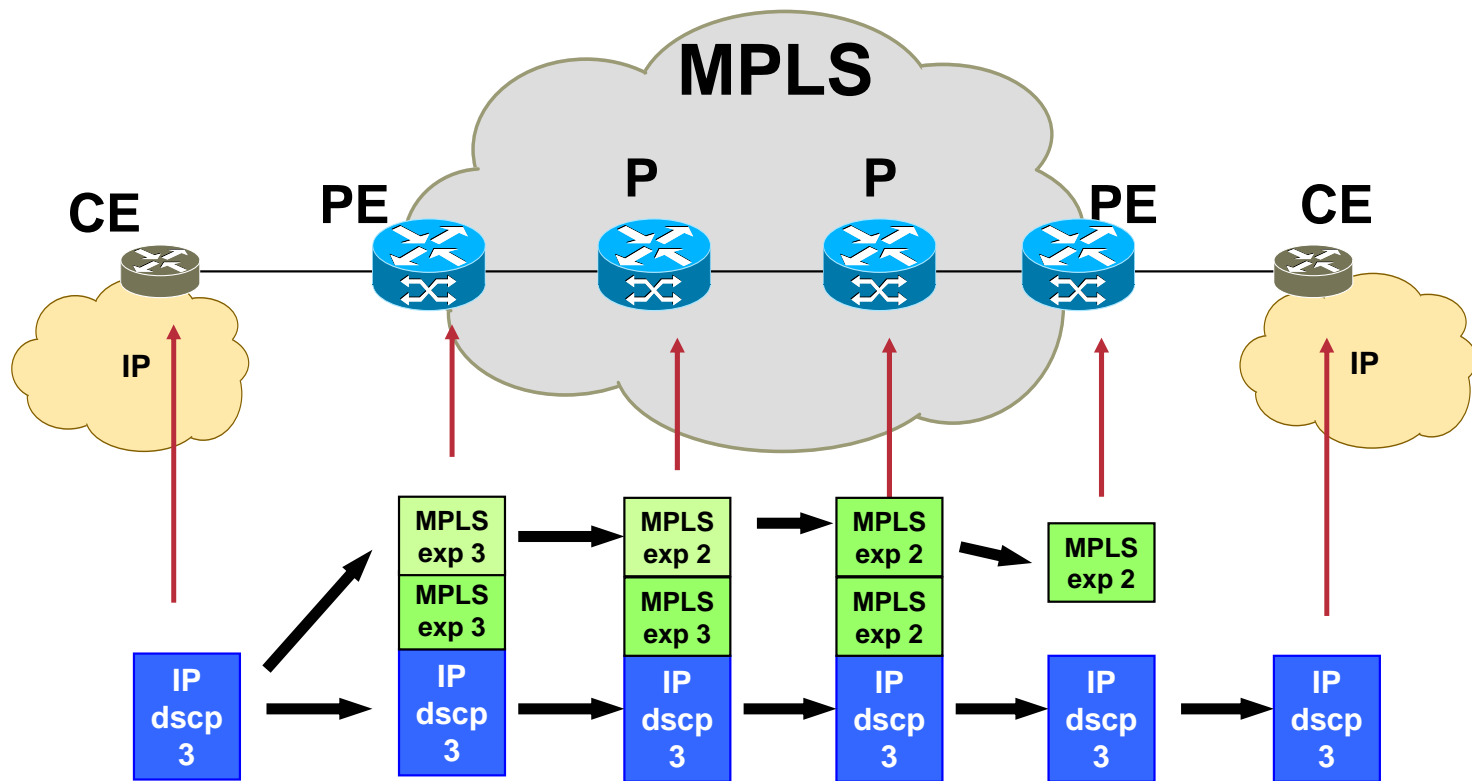
DiffServ over MPLS Uniform Mode

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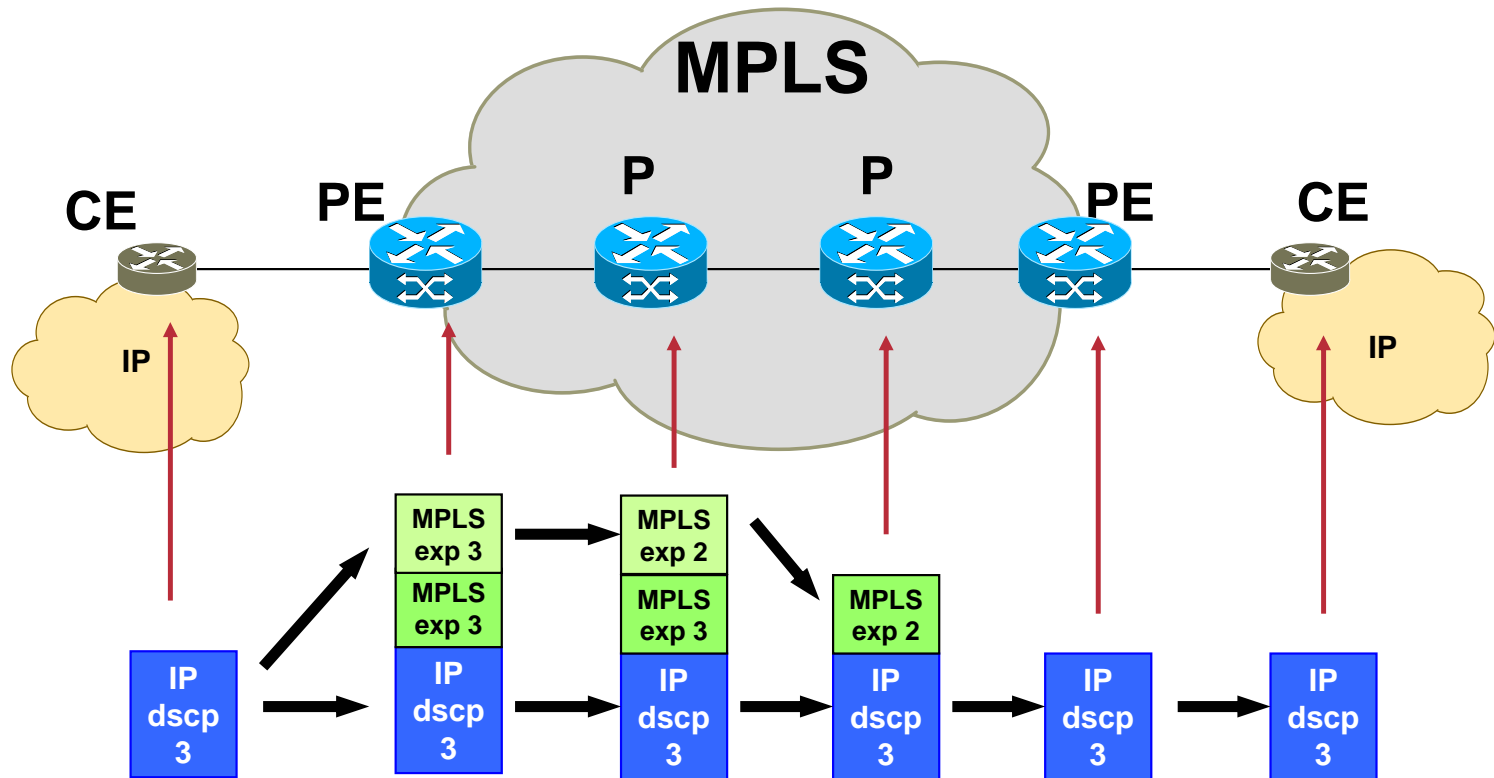
DiffServ over MPLS Pipe Mode

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DiffServ over MPLS Short-Pipe Mode

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Pipe Mode Configuration

Ingress PE

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Input Policy

```
!  
class-map match-all VOICE  
  match ip dscp ef  
class-map match-all BUSINESS  
  match ip dscp af21 af22 af23  
!  
policy-map IN-POLICY  
  class VOICE  
    police cir percent 10  
      conform-action set-mpls-exp-imposition-transmit 5  
      exceed-action drop  
  class BUSINESS  
    police cir percent 50  
      conform-action set-mpls-exp-imposition-transmit 4  
      exceed-action set-mpls-exp-imposition-transmit 3  
  class class-default  
    set mpls experimental imposition 0  
!
```

Pipe Mode Configuration

Egress PE

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Input Policy

```
!  
class-map match-all MPLS-VOICE  
  match mpls experimental topmost 5  
class-map match-all MPLS-BUSINESS-IN-P  
  match mpls experimental topmost 4  
class-map match-all MPLS-BUSINESS-OUT-P  
  match mpls experimental topmost 3  
!  
policy-map IN-POLICY  
  class MPLS-VOICE  
    set qos-group 5  
  class MPLS-BUSINESS-IN-P  
    set qos-group 4  
    set discard-class 1  
  class MPLS-BUSINESS-OUT-P  
    set qos-group 4  
    set discard-class 0  
!
```

Output Policy

```
!  
class-map match-all IP-VOICE  
  match qos-group 5  
class-map match-all IP-BUSINESS  
  match qos-group 4  
!  
policy-map OUT-POLICY  
  class IP-VOICE  
    priority percent 25  
  class IP-BUSINESS  
    bandwidth percent 50  
    random-detect discard-class-based  
!
```

- Input policy preserves packet class and drop precedence using qos-group and discard-class
- Output policy acts on qos-group and discard-class

MPLS DS Tunnel modes

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- **Supported on 7500 and 7200 starting with 12.2(13)T**
- **Support on 12000 planned for 12.0(26)S**

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Summary

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- **New options for more precise classification of traffic at the edge**
- **Feature enhancements target easier provisioning by enabling policy re-use**
- **Additional enhancements enable more sophisticated SLAs**
- **MPLS DiffServ Tunnel modes introduce new design options and QoS transparency**

References

Cisco.com

- Cisco IOS 12.2T New Feature Documentation
<http://www.cisco.com>
- Cisco IOS 12.0S New Feature Documentation
<http://www.cisco.com>
- Feature Navigator
<http://www.cisco.com/go/fn>
- QoS Page on CCO
<http://www.cisco.com/go/qos>
- MPLS Page on CCO
<http://www.cisco.com/go/mpls>

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