Class-Based Policy Provisioning:

Introducing Class-Based Policy Language (CPL)

August 2008

© 2005 Cisco Systems, Inc. All rights reserved.

Class-Based Policy Provisioning

- Introduction
- Class-Based Policy Provisioning
- Class-Based Policy Language (CPL)
- Integrated Traffic Classification
- Configuring with CPL: Examples
- Monitoring and Statistics
- Roadmap
- Q&A

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Many Features Act on Traffic

- Many features need to understand network traffic
  - Quality of Service
  - Security
  - Broadband
  - NetFlow
  - Routing
  - … and many others
- Issue: Each feature might take a unique approach
  - ➢ Different configuration command syntax
  - ➢ Unnecessary complexity for customers

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

The Opportunity

- Simplify

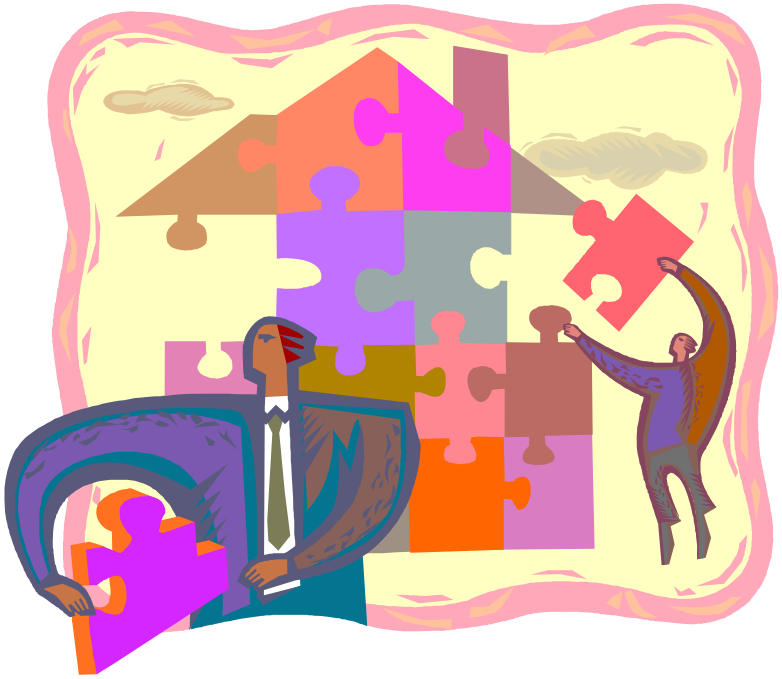
  Simplify feature provisioning

- Unify

  Unify provisioning and behavior across platforms

- Integrate

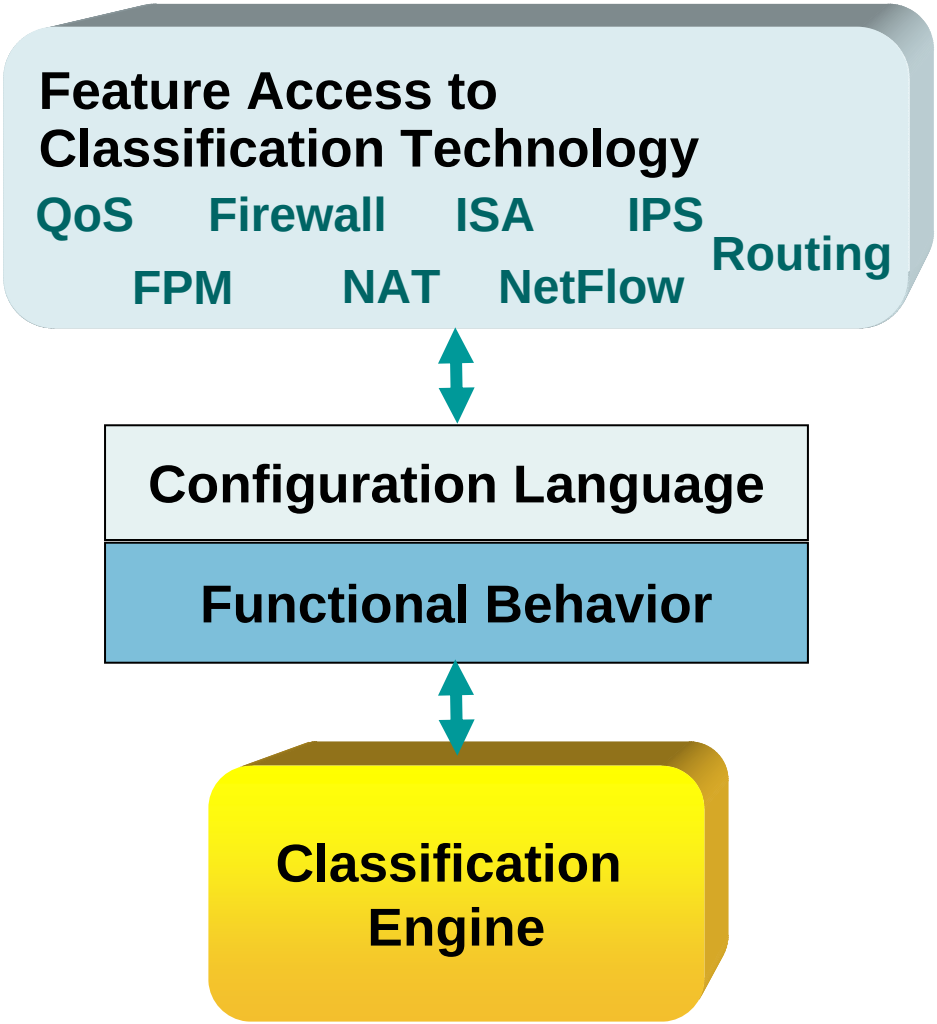
  Make it easy to add new function and new platforms



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Uniform Provisioning for Traffic Classification and Policy Actions

- Uniform Provisioning
  - Across Features
  - Across Platforms
- Unified Configuration Language
- Integrated Classification Definitions
- Greater Efficiency



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CLASS-BASED POLICY PROVISIONING

© 2005 Cisco Systems, Inc. All rights reserved.

Class-Based Policy Provisioning

A uniform, three step approach

- Classification
  - Identify traffic of interest
  - Specify match criteria that define a traffic class
- Policy
  - Specify actions to take on the traffic class
- Target
  - Apply the policy actions to a target
    - Typically an interface or subinterface

Class-Based Policy Provisioning

- *Classification*
  - *Key word: class-map*
- *Policy*
  - *Key word: policy-map*
- *Target*
  - *Key word: service-policy*

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Class-Based Policy: Terminology

- What is a *class* of traffic?
  - A class is any traffic stream of interest
    - Identify traffic streams by matching some criteria, such as
      - From a particular interface or port
      - Source or destination IP address
      - Protocol or application
- What is a *policy*?
  - A policy is any action applied to a class
    - Policies for Quality of Service, Security, Routing, Accounting, or Subscriber Service, such as
      - Assign higher or lower priority
      - Limit or drop traffic
      - Route on a different path

Example

Certain apples (the *class*) are selected for special handling (the *policy*)

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Class-Based Policy: Terminology

- What is a *target*?

  A target defines a traffic stream to which a policy is applied

- Typically identifies the location, source or destination of traffic
  - Physical interfaces
    - Serial, Ethernet, POS
  - Logical interfaces
    - Subinterface, ATM VC, Frame Relay VC, VLAN
  - Logical entities
    - Control Plane Traffic
    - A Routing Protocol

Example

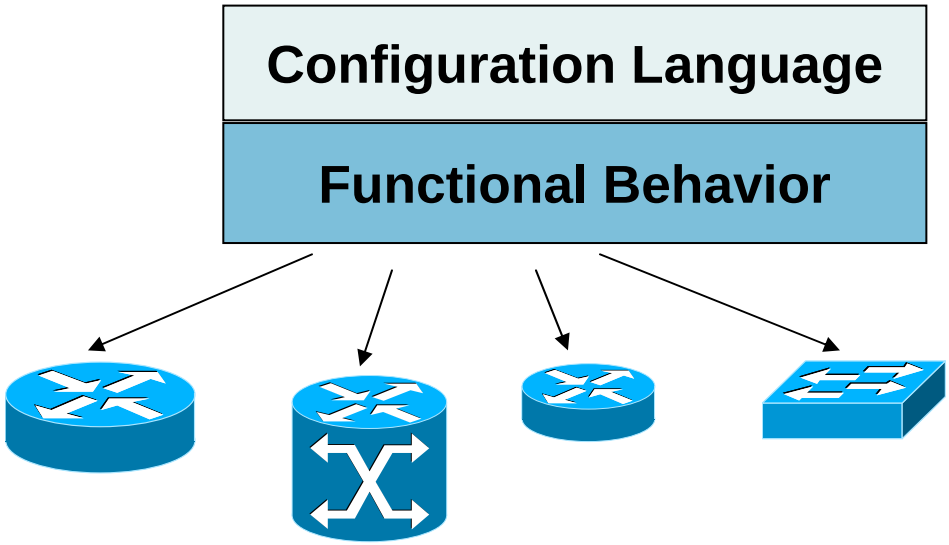
An orchard could be a source (target) to which a harvest policy is applied

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Class-Based Policy Language (CPL)

- Unified method to specify classes, policies and targets
- Same framework for provisioning multiple features

  "Type" attributes for classes & policies



Benefit: Simpler provisioning

Across features

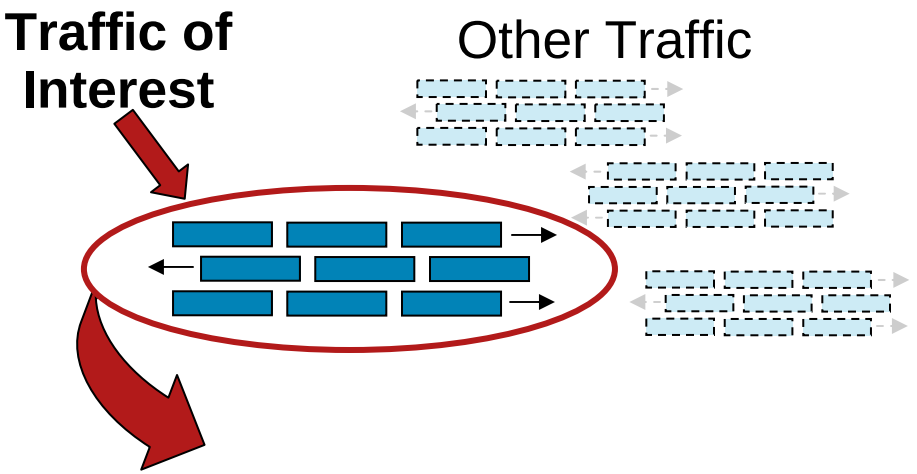
Across platforms

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Specify Traffic Once, Take Multiple Actions

- With CPL features can share a *class-map*
  - Set up the classification criteria once
  - Use the *class-map* in different feature policies
- Benefits
  - Simplified configuration – policies point to same classification
  - Assured consistency – actions applied to same traffic

Example:

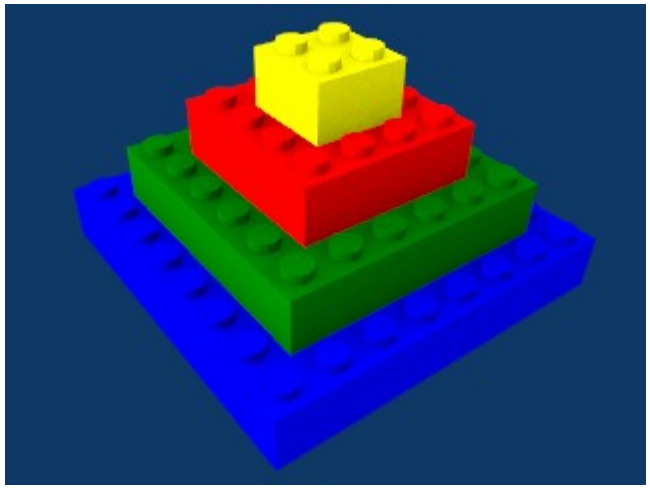


- Firewall policy permits selected traffic
- QoS policy assigns priority

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Class-Based Policy Framework: Benefits

- Simpler for customers
  - Unified method for multiple features
- Faster time-to-market for new application recognition modules
  - Leverage by multiple features
- Easier to add new features
  - Leverage familiar provisioning method
    - Example (future): anomaly detection
- Quicker integration of new classification capabilities
  - Directly available to existing features
  - Enable new policy actions



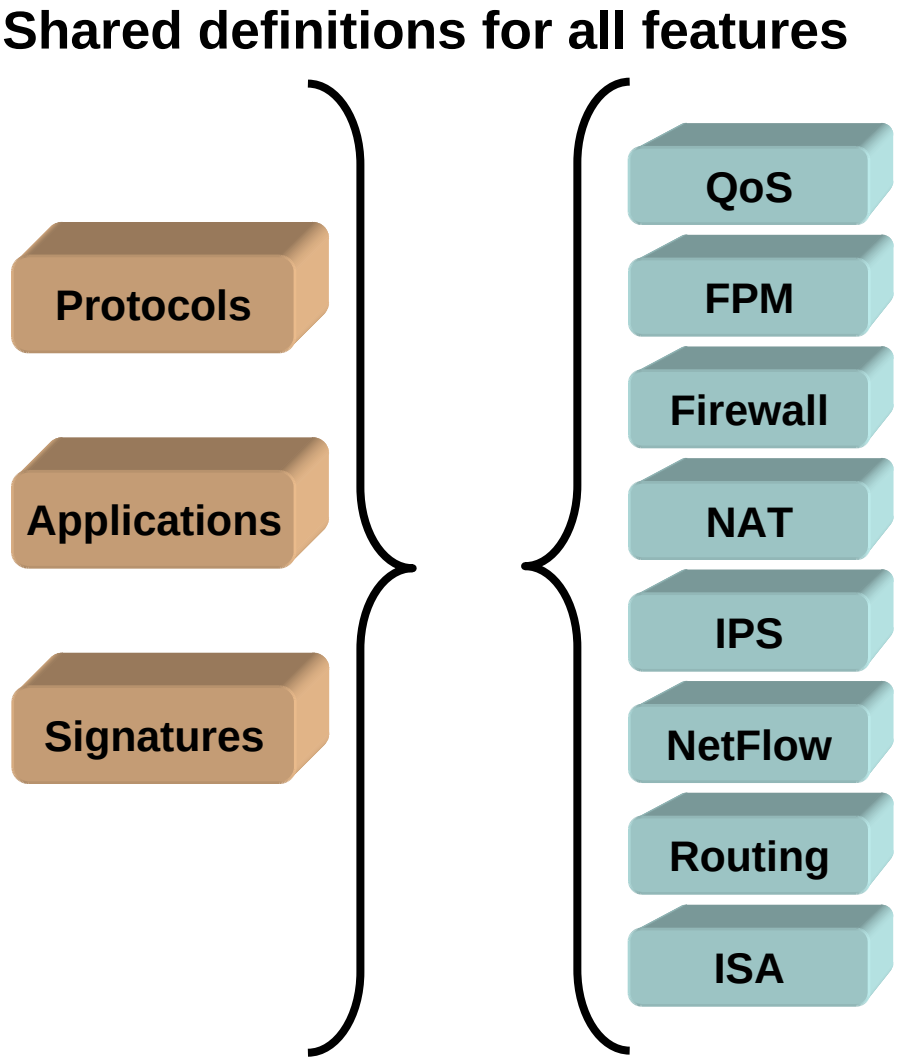
© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

INTEGRATED TRAFFIC CLASSIFICATION

© 2005 Cisco Systems, Inc. All rights reserved.

Benefit: Integrated Classification Definitions

- Common definitions for protocol and application recognition
- Benefits:
  - Consistent classification results
  - New definitions available to all features

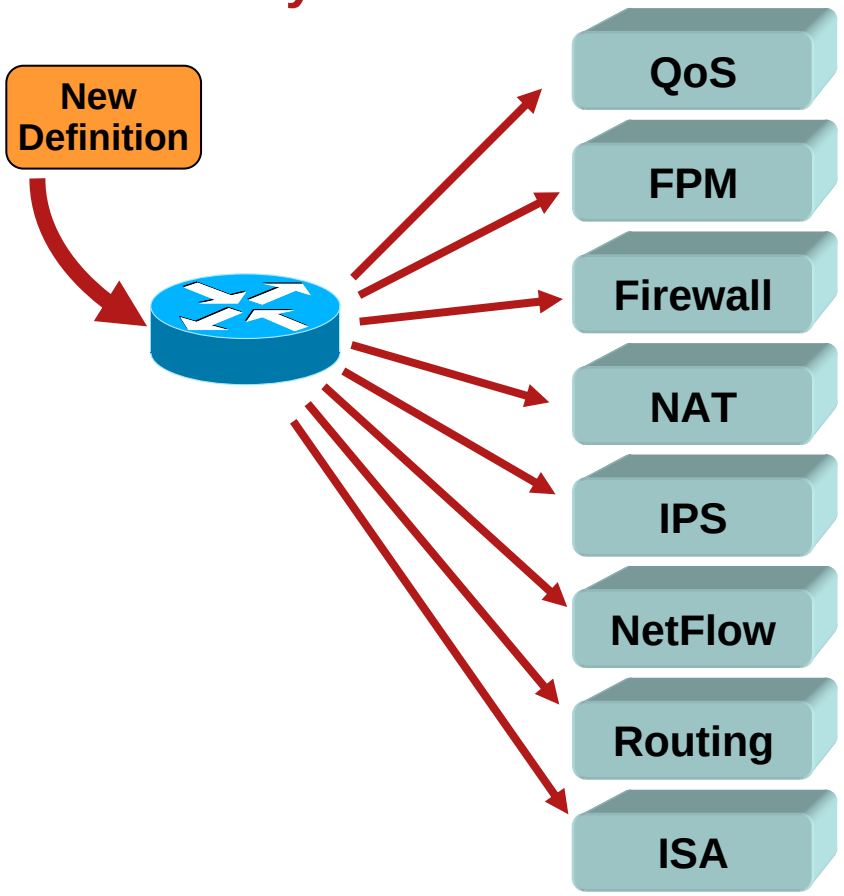


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Benefit: Dynamic Availability of New Definitions

- Dynamic addition of new definitions
  - Immediately available to all features
  - Live updates to in-service routers
    - Incorporate new definitions into live IOS images on the router

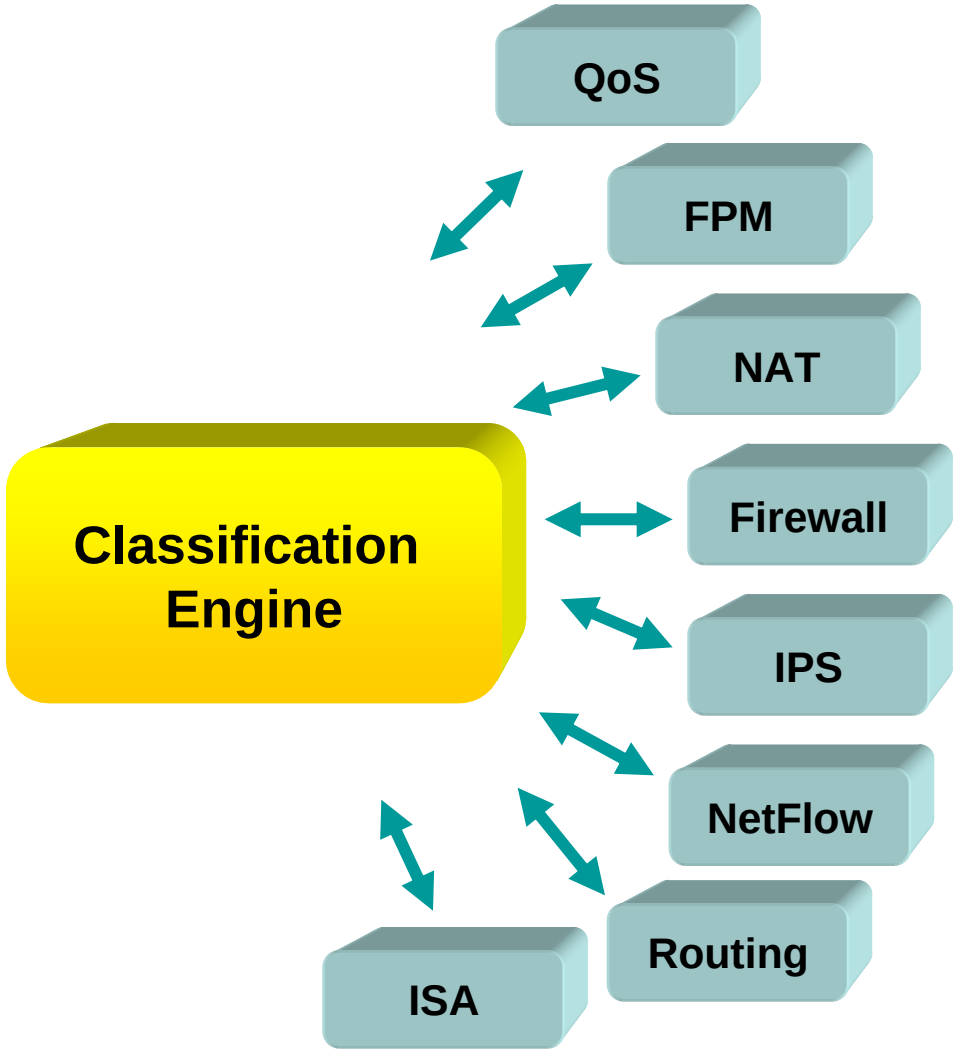
New definitions effective immediately



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Benefit: Greater Efficiency

- Performance improvement
  - Consolidated classification for multiple features
    - Not separate classification actions for each feature
- Benefits:
  - Lower CPU consumption
  - Greater throughput



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL CONFIGURATION EXAMPLES

© 2005 Cisco Systems, Inc. All rights reserved.

CPL Configuration Examples

- Quality of Service
- Flexible Packet Matching
- IOS Firewall
- Multi-Topology Routing
- IP SLAs
- NetFlow
- Summary Comparison:

  QoS, FPM, Firewall, and MTR

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
QoS Giving Priority to Interactive Traffic

Classification
Key word:
class-map

Configure *class-maps* that classify Citrix ICA traffic by ICA tag

```
class-map match-any Citrix-high-medium-low
        match protocol citrix ica-tag “0”
        match protocol citrix ica-tag “1”
        match protocol citrix ica-tag “2”
class-map Citrix-background
        match protocol citrix ica-tag “3”
```

Policy
Key word:
policy-map

Create a *policy-map* that allocates bandwidth for traffic matched by *class-maps*

```
policy-map Citrix-traffic
        class Citrix-high-medium-low
                bandwidth percent 20
        class Citrix-background
                bandwidth percent 5
                police cir 128000
                        conform-action transmit
                        exceed-action drop
```

Target
Key word:
service-policy

Assign the *policy-map* to a router interface with a *service-policy*

```
interface serial 0/0
service-policy output Citrix-traffic
```


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
FPM Used to Drop Slammer Worm

Classification
Key word:
class-map

Configure *class-maps* that classify Slammer worm

```
class-map type stack ip-udp
    match field ip protocol eq 17 next udp
class-map access-control slammer
    match class-map stack ip-udp
    match field udp dport eq 1434
    match start ip version offset 224 size 4 eq 0x04011010
```

Policy
Key word:
policy-map

Create a *policy-map* that drops traffic matched by the *class-map*

```
policy-map type access-control policy-slammer
    class slammer
        drop
```

Target
Key word:
service-policy

Assign the *policy-map* to a router interface with a *service-policy*

```
interface ethernet 1/0  service-policy type access-control input
policy-slammer
```


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
IOS Firewall Blocks Instant Messaging

Classification
Key word:
class-map

Configure *class-maps* to identify port-misuse and classify HTTP

```
class-map type inspect http port-misuse-class
     match port-misuse im
class-map type inspect http-traffic-1
     match protocol http
```

Policy
Key word:
policy-map

Create *policy-maps* to terminate IM connections but permit desired HTTP traffic

```
policy-map type inspect http myL7policy
       class port-misuse-class
         reset
policy-map type inspect firewall-policy
       class http-traffic-1
         inspect
```

Target
Key word:
service-policy

Assign the *policy-map* to a router interface with a *service-policy*

```
interface pos 0/0
service-policy type http myL7Policy
```


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
Multi-Topology Routing

Video traffic routed separately from other traffic

Classification
Key word:
class-map

```
class-map match-any STANDARD_CLASS
 match ip dscp default
class-map match-any VIDEO_CLASS
 match ip dscp af43
```

Policy
Key word:
policy-map

```
policy-map type class-routing ipv4 unicast MTR_POLICY
 class STANDARD_CLASS
  select-topology STANDARD
 class VIDEO_CLASS
  select-topology VIDEO
```

Target
Key word:
service-policy

```
global-address-family ipv4
 topology STANDARD
 !
 topology VIDEO
 !
 service-policy type class-routing MTR_POLICY
```

Source: Configuration fragment, MTR demo 9/2005

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
IP SLAs Integrated with a QoS Policy

Using IP SLAs to monitor a traffic class

Classification
Key word:
class-map

```
class-map match-any VOIP
      match ip dscp EF
class-map match-any biz
      match ip dscp AF41
class-map default
```

Policy
Key word:
policy-map

```
policy-map high-priority
      class VOIP
            measure gold-sla
            bandwidth 2000
```

IP SLAs action within a policy-map

key word: measure

```
ip sla auto-measure gold-sla
      measurement-type jitter
      dest-ip auto-discover
```

IP SLAs configuration

Target
Key word:
service-policy

```
interface serial 0/0
      service-policy output high-priority
```


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Example
NetFlow Input Filters

NetFlow sampling actions in CPL

Classification
Key word:
class-map

```
class-map high_importance_class
    match access-group 101
```

Defines traffic class

```
flow-sampler-map high_sampling
    mode random one-out-of 1
```

Defines a NetFlow sampler

Policy
Key word:
policy-map

```
policy-map mypolicy
    class high_importance_class
    flow-sampler high_sampling
```

Includes NetFlow sampling action in policy

Target
Key word:
service-policy

```
interface POS1/0
    service-policy input mypolicy
interface ATM2/0
    service-policy input mypolicy
```

Applies policy with Netflow sampling action to interfaces

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

CPL Configuration Comparisons: Classification, Policy, Target

CPL Step *key word* ***[type [subtype]]***	Quality of Service **Prioritize Citrix Traffic**	Flexible Packet Matching **Drop Slammer Worm**	IOS Firewall **Block Instant Messaging**	Multi-Topology Routing **Assign Routes by Class**
Classification *class-map* ***[type [subtype]]***	class-map match-any Citrix-high-medium-low match protocol citrix ica-tag “0” match protocol citrix ica-tag “1” match protocol citrix ica-tag “2” class-map Citrix-background match protocol citrix ica-tag “3”	class-map type stack ip-udp match field ip protocol eq 17 next udp class-map access-control slammer match class-map stack ip-udp match field udp dport eq 1434 match start ip version offset 224 size 4 eq 0x04011010	class-map type inspect http port-misuse-class match port-misuse im class-map type inspect http-traffic-1 match protocol http	class-map VIDEO_CLASS match {VIDEO DSCP value} class-map VOICE match {VOICE DSCP EF} class-map DATA match {DATA DSCP value}
Policy *policy-map* ***[type [subtype]]***	policy-map Citrix-traffic class Citrix-high-medium-low bandwidth percent 20 class Citrix-background bandwidth percent 5 police cir 128000 conform-action transmit exceed-action drop	policy-map type access-control policy-slammer class slammer drop	policy-map type inspect http myL7policy class port-misuse-class reset policy-map type inspect firewall-policy class http-traffic-1 inspect	policy-map type class-routing MTR_ROUTE_POLICY class VIDEO select-topology RED class VOICE select-topology YELLOW class DATA select-topology GREEN
Target *service-policy* ***[type [subtype]]***	interface serial 0/0 service-policy output Citrix-traffic	interface ethernet 1/0 service-policy type access-control input policy-slammer	interface pos 0/0 service-policy type http myL7Policy	global-address-family ipv4 service-policy type MTR_ROUTE_POLICY

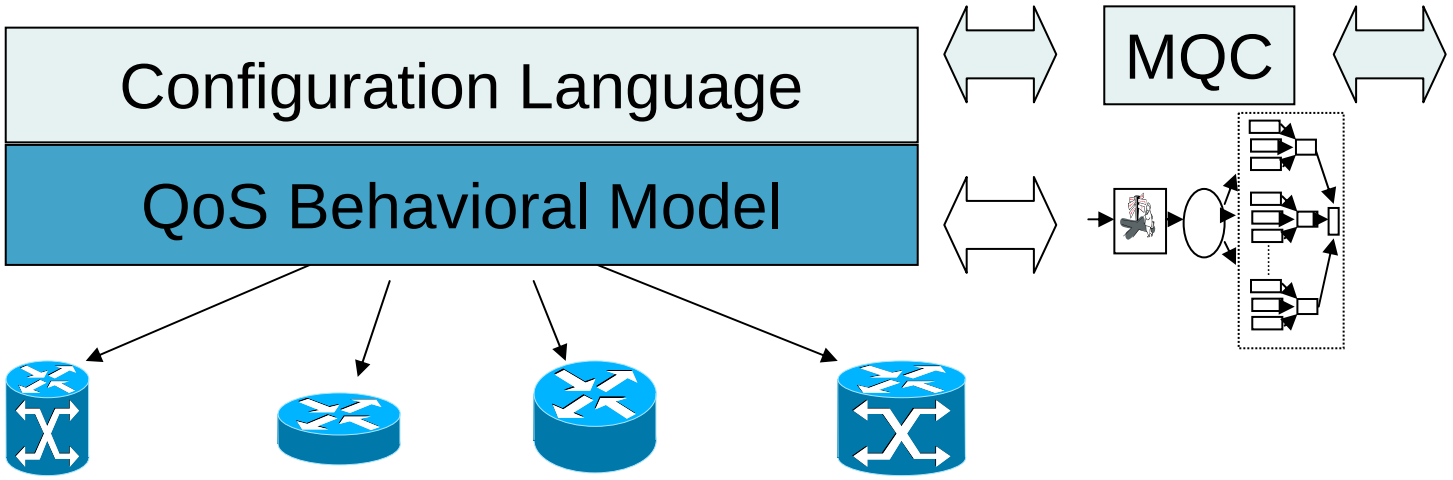
© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

MONITORING AND STATISICS: CLASS-BASED POLICY (CBP) MIB

© 2005 Cisco Systems, Inc. All rights reserved.

CBQoS MIB Shadows QoS Configuration

- Modular QoS Command Line Interface (MQC) is Cisco's configuration language for Quality of Service
  - Uniform interface for common QoS model across hardware platforms
- CBQoS MIB provides read access to configuration and statistical information for MQC
- Same structure as MQC



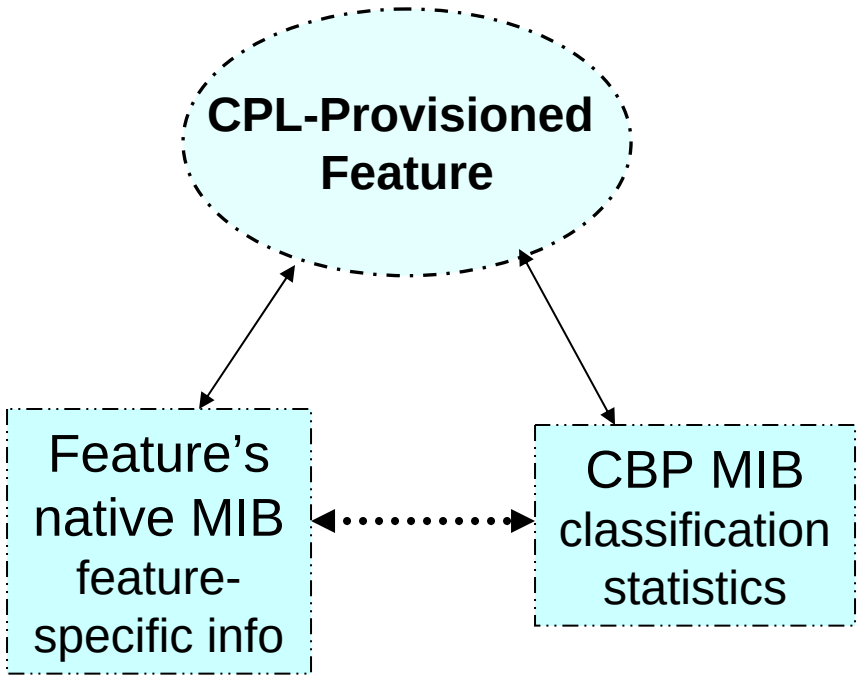
CBQoS MIB

```
1 :  cbQosServicePolicy
2 :  cbQosInterfacePolicy
3 :  cbQosFrameRelayVCPolicy
4 :  cbQosATMPVCPolicy
5 :  cbQosObjects

6 :  cbQosPolicyMapCfg
7 :  cbQosClassMapCfg
8 :  cbQosMatchStmtCfg
9 :  cbQosQueueingCfg
10:  cbQosREDCfg
11:  cbQosREDClassCfg
12:  cbQosPoliceCfg
13:  cbQosTSCfg
14:  cbQosSetCfg

15:  cbQosClassMapStats
16:  cbQosMatchStmtStats
17:  cbQosPoliceStats
18:  cbQosQueueingStats
19:  cbQosTSStats
20:  cbQosREDClassStats
```


© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Feature MIBs and CBP MIB

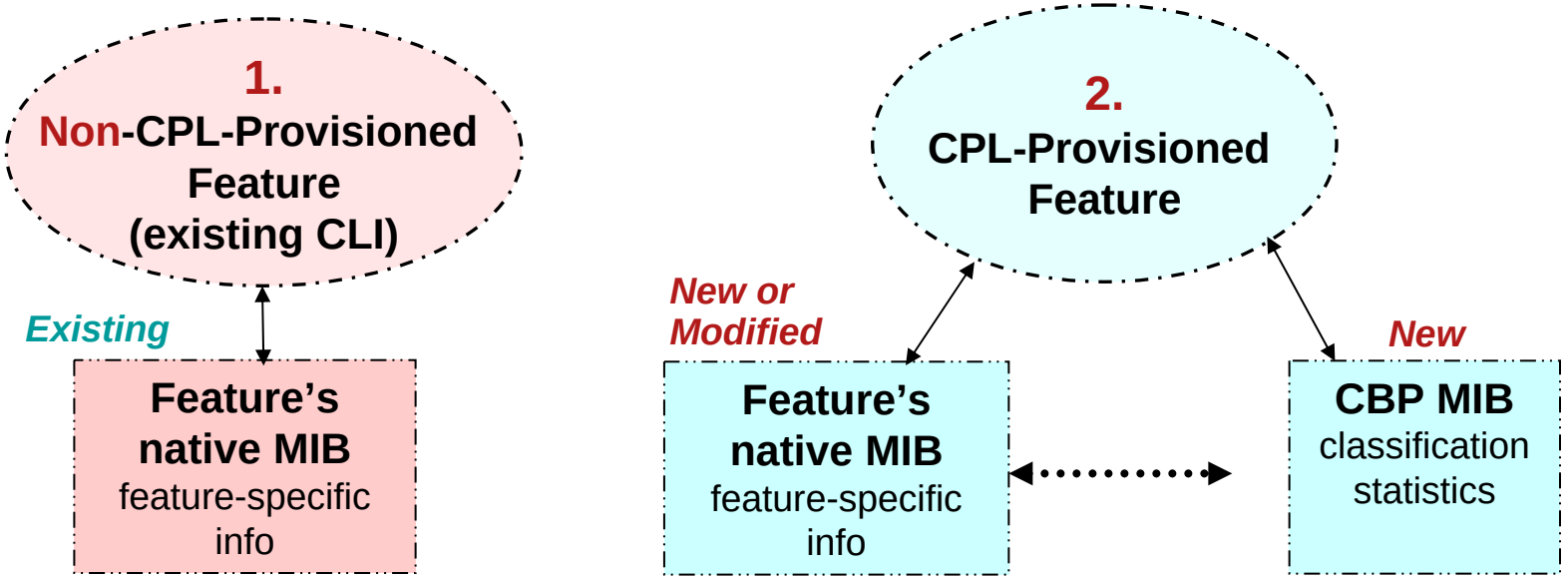
- CPL-provisioned features will link to two MIBs
  - Their own feature-specific MIB
  - The CBP MIB



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Mirrors Feature Adoption of CPL

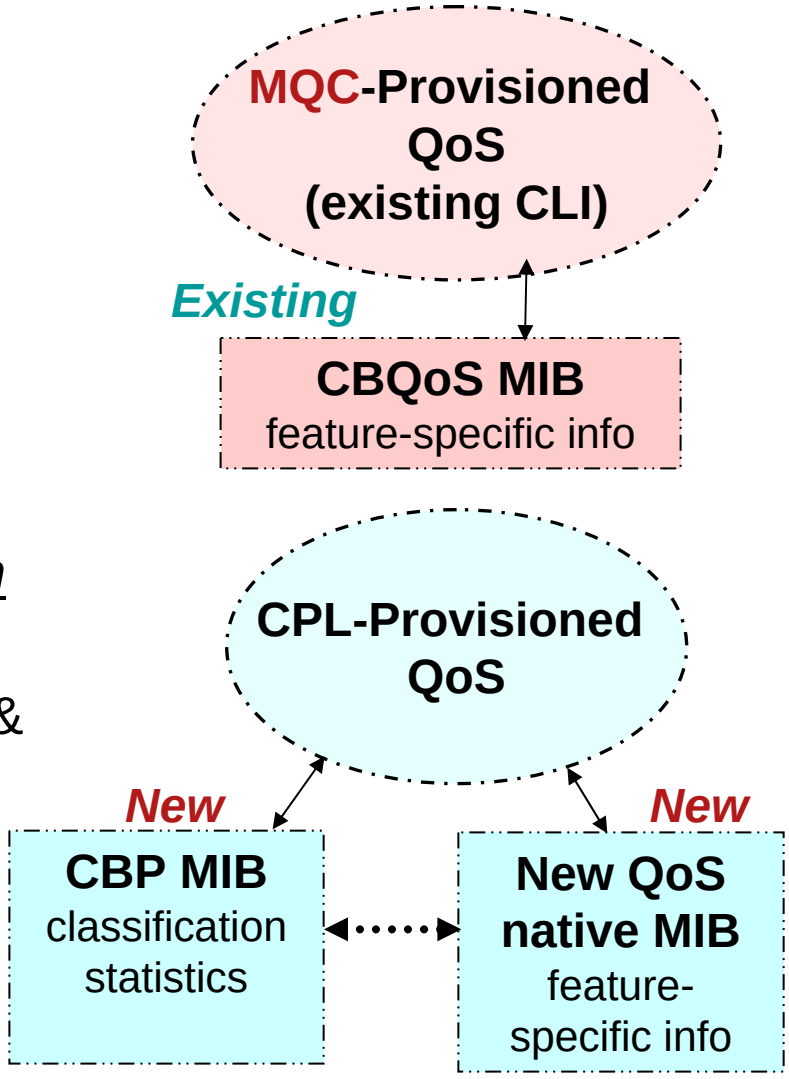
- A MIB often reflects a feature's provisioning syntax
  - The CBP MIB reflects the class-based provisioning model of CPL
  - Information that is common to multiple features must be accessible through a common MIB
- Provisioning method and feature MIBs
  1. Non-CPL Provisioned: Use existing feature MIB
  2. CPL-Provisioned: Use CBP MIB with feature-specific MIB



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Quality of Service: Evolution to CPL from MQC

- MQC is a proper subset of CPL
- Existing MQC configurations are forward-compatible to CPL
- *Router does not distinguish between CPL and MQC*
  - Common statistics are counted in *both* CBQoS MIB and new CBP MIB
  - Use one (CBQoS) *or* the other (CBP & new QoS)
  - CBQoS MIB will be supported indefinitely



© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

ROADMAP CLASS-BASED POLICY PROVISIONING

© 2005 Cisco Systems, Inc. All rights reserved.

Class-Based Policy Provisioning Roadmap – IOS Release 12.4T

Features Using CPL

Release 12.4T		Description
--	**Pre-12.4T**	▪ Quality of Service (QoS) ▪ Control Plane Protection (CPPr)
2nd	12.4(4)T **11/14/2005**	▪ Flexible Packet Matching (FPM)
3rd	**02/2006**	▪ IOS Firewall
4th	**05/2006**	▪ FPM with CPL-XML ▪ IP SLAs
6th	**2H 2006**	▪ NetFlow ▪ Intrusion Prevention System (IPS)

Platform Support

Routers	800 Series, 1700 Series, 1800 Series, 2691, 2600XM Series, 2800 Series, 3700 Series, 3800 Series, 7200 Series, 7301

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

QUESTIONS AND ANSWERS

© 2005 Cisco Systems, Inc. All rights reserved.

Q&A – 1

- Will existing MQC configurations still work?

  Yes. MQC syntax is a proper subset of CPL. Existing MQC configurations are forward-compatible with CPL.

- Will there be a “type” keyword for QoS? Will existing MQC configurations convert to it?

  Not at this time. Future evolution will determine the need. For the foreseeable future, QoS (MQC) configurations remain untyped.

- Will there be a tool to convert old style CLI to CPL syntax?

  There are no plans for a syntax conversion tool. Future evolution will determine the need. It is possible that some features may have a higher need than others and feature-specific converters may emerge.

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

Q&A – 2

- What is the order of operations when multiple CPL-configured polices are on an interface?

  CPL provisioning does not affect order of operations in the feature path.

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential

© 2006 Cisco Systems, Inc. All rights reserved. Cisco Confidential