



ATM VC Bundle Management on Cisco 12000 Series 8-Port OC-3 STM-1 ATM Line Cards

Feature History

Release	Modification
12.0(23)S	This feature was made available on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

This feature module describes the ATM virtual circuit (VC) bundle management feature. The ATM VC bundle management feature allows you to configure multiple VCs that have different QoS characteristics between any pair of ATM-connected routers. With the introduction of this feature, the 8-Port OC-3 STM-1 ATM line card provides the capability to build a quality of service (QoS) differentiated network for Cisco 12000 Series Internet Routers.

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Feature Overview

Prior to the introduction of this feature, the 8-Port OC-3 STM-1 ATM line card was capable of using Weighted Random Early Detection (WRED) and Modified Deficit Round Robin (MDRR) to classify and set priorities for packets, but they all shared a single QoS VC. The VC bundle management feature addresses this problem by allowing you to define an ATM VC bundle and add VCs to it. Each VC of a bundle has its own ATM traffic class and ATM traffic parameters. You can apply attributes and characteristics to discrete VC bundle members, or you can apply them collectively at the bundle level.

Using VC bundles, you can create differentiated service by flexibly distributing IP precedence levels over the different VC bundle members. You can map a single precedence level or a range of levels to each discrete VC in the bundle, thereby enabling individual VCs in the bundle to carry packets marked with different precedence levels. You can use WRED to further differentiate service across traffic that has different IP precedences, but that uses the same VC in a bundle.

Benefits

Here are some benefits of using VC bundle management:

- Provides flexible configuration of different traffic shaping parameters such as UBR or VBR with different parameters for traffic with different precedence levels.
- Provides flexible VC management within a VC bundle on permanent virtual circuit (PVC) failure, also referred to as VC bumping, which allows traffic assigned to a failed VC to be redirected to an alternate VC within the VC bundle.
- Allows a combination of VC bundle and per-VC WRED and per-VC MDRR.

Restrictions

The following restrictions apply for VC bundle management:

- VC bundle management on the 8-Port OC-3 STM-1 ATM line card is supported on point-to-point subinterfaces only. VC bundle management on the 8-Port OC-3 STM-1 ATM line card is not supported on either point-to-multipoint subinterfaces or main interfaces.
- On a point-to-point subinterface, you can configure either one regular PVC or one VC bundle, which can contain up to eight VC bundle members, but not both.
- VC bundle management on the 8-Port OC-3 STM-1 ATM line card is supported for PVCs only, not switched virtual circuits (SVCs).
- Only aal5snap and aal5mux encapsulation types are supported for VC bundles.

Related Features and Technologies

- Multiprotocol Label Switching (MPLS)
- Layer 3 quality-of-service (QoS)
- Weighted Random Early Detection (WRED)
- Modified Deficient Round Robin (MDRR)
- Low Latency Queueing (LLQ)

See the [“Related Documents”](#) section for a list of documents that describe these features and technologies.

Related Documents

The following documents provide additional information about installing and configuring the 8-Port OC-3 STM-1 ATM line card:

- *8-Port OC-3 STM-1 ATM Line Card Installation and Configuration*
- *Release Notes for Cisco 12000 Series Routers for Cisco IOS Release 12.0 S*
- *Release Notes for Cisco IOS Release 12.0 S*
- *Cisco IOS Release 12.0 Wide-Area Networking Configuration Guide*
- *Weighted Random Early Detection on the Cisco 12000 Series Router*
- *Multiprotocol Label Switching on Cisco Routers*
- *MPLS Virtual Private Networks*
- *Modular Quality of Service Command-Line Interface*

You can also find additional information in the installation and configuration guide for your Cisco 12000 Series Internet Router and in the Cisco IOS Release 12.0 documentation set.

Supported Platforms

The 8-Port OC-3 STM-1 ATM line card is compatible with all Cisco 12000 Series Internet Routers and Cisco 12400 Series Internet Routers that are operating with Cisco IOS Release 12.0(23)S or later.

Determining Platform Support Through Cisco Feature Navigator

Cisco IOS software is packaged in feature sets that are supported on specific platforms. To get updated information regarding platform support for this feature, access Cisco Feature Navigator. Cisco Feature Navigator dynamically updates the list of supported platforms as new platform support is added for the feature.

Cisco Feature Navigator is a web-based tool that enables you to quickly determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image. You can search by feature or release. Under the release section, you can compare releases side by side to display both the features unique to each software release and the features in common.

To access Cisco Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

<http://www.cisco.com/register>

Cisco Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Cisco Feature Navigator home page at the following URL:

<http://www.cisco.com/go/fn>

Availability of Cisco IOS Software Images

Platform support for particular Cisco IOS software releases is dependent on the availability of the software images for those platforms. Software images for some platforms may be deferred, delayed, or changed without prior notice. For updated information about platform support and availability of software images for each Cisco IOS software release, refer to the online release notes or, if supported, Cisco Feature Navigator.

Supported Standards, MIBs, and RFCs

Standards

- No new or modified standards apply to this feature.

MIBs

- No new or modified MIBs apply to this feature.

RFCs

- No new or modified RFCs apply to this feature.

Prerequisites

The Cisco 12000 Series Internet Router must be equipped with an 8-Port OC-3 STM-1 ATM line card and must be running Cisco IOS Release 12.0(23)S or later.

VC Bundle Management Configuration Task List

See the following sections for configuration tasks for the VC bundle management feature. Each task in the list is identified as either required or optional.

- [Creating a VC Bundle](#)
- [Applying Bundle-Level Parameters](#)
- [Committing a VC to a Bundle](#)
- [Applying Parameters to Individual VCs](#)

Creating a VC Bundle

To create a bundle and enter bundle configuration mode, in which you can assign attributes and parameters to the bundle and all of its member VCs, use the following command in subinterface configuration mode:

Command	Purpose
Router (config-subif)# bundle <i>bundle-name</i>	Creates the VC bundle specified as <i>bundle-name</i> and enters bundle configuration mode.

Applying Bundle-Level Parameters

Bundle-level parameters can be applied either by assigning VC classes or by directly applying them to the bundle.

Parameters applied through a VC class assigned to the bundle are superseded by those applied at the bundle level. Bundle-level parameters are superseded by parameters applied to an individual VC.

Configuring Bundle-Level Parameters

Configuring bundle-level parameters is optional if a class is attached to the bundle to configure it.

To configure parameters that apply to the bundle and all its members, use the following commands in bundle configuration mode, as needed:

Command	Purpose
Router(config-if-atm-bundle)# protocol <i>protocol</i> { <i>protocol-address</i> inarp } [[no] broadcast]	Configures a static map or enables Inverse Address Resolution (Inverse ARP) or Inverse ARP broadcasts for the bundle
Router(config-if-atm-bundle)# encapsulation <i>aal-encap</i>	Configures the ATM adaptation layer (AAL) and encapsulation type for the bundle.
Router(config-if-atm-bundle)# inarp <i>minutes</i>	Configures the Inverse ARP time period for all VC bundle members.
Router(config-if-atm-bundle)# broadcast	Enables broadcast forwarding for all VC bundle members.
Router(config-if-atm-bundle)# ilmi manage	Enables ILMI management.
Router(config-if-atm-bundle)# oam retry [<i>up-count</i>] [<i>down-count</i>] [<i>retry-frequency</i>]	Configures the VC bundle parameters related to operation, administration, and maintenance (OAM) management.
Router(config-if-atm-bundle)# oam-bundle [manage] [<i>frequency</i>]	Enables end-to-end F5 OAM loopback cell generation and OAM management for all VCs in the bundle.

Configuring VC Class Parameters to Apply to a Bundle

Use of a VC class allows you to configure a bundle by applying multiple attributes to it at the same time because you apply the class itself to the bundle. Use of a VC class allows you to generalize a parameter across all VCs, after which (for some parameters) you can modify that parameter for individual VCs. (See the section [“Applying Parameters to Individual VCs”](#) for more information.)

To configure a VC class to contain commands that configure VC members of a bundle when the class is applied to that bundle, use the following command in `vc-class` configuration mode. To enter `vc-class` configuration mode, use the `vc-class atm` command.

Command	Purpose
Router(config-vc-class)# oam-bundle [manage] [<i>frequency</i>]	Enables end-to-end F5 OAM loopback cell generation and OAM management for all VCs in the bundle.

In addition to the `oam-bundle` command, you can add the following commands to a VC class to be used to configure a bundle: `bump`, `precedence`, `mpls experimental`, and `protect` commands. For more information about these commands, see the [“Command Reference”](#) section, later in this publication.

Attaching a VC Class to a Bundle

To attach a preconfigured VC class containing bundle-level configuration commands to a bundle, use the following command in bundle configuration mode:

Command	Purpose
Router(config-if-atm-bundle)# class-bundle <i>vc-class-name</i>	Configures a bundle with the bundle-level commands contained in the specified VC class.

Parameters set through bundle-level commands contained in the VC class are applied to the bundle and all of its VC members. Bundle-level parameters applied through commands configured directly on the bundle supersede those applied through a VC class.

Note that some bundle-level parameters applied through a VC class or directly to the bundle can be superseded by commands that you directly apply to individual VCs in bundle-vc configuration mode. For more information on bundle-vc configuration mode, see [“Committing a VC to a Bundle”](#) in the following section.

Committing a VC to a Bundle

To add a VC to an existing bundle and enter bundle-vc configuration mode, use the following command in bundle configuration mode:

Command	Purpose
Router(config-if-atm-bundle)# pvc-bundle <i>pvc-name</i> [<i>vpi/</i>] [<i>vci</i>]	Adds the specified VC to the bundle and enters bundle-vc configuration mode in order to configure the specified VC bundle member.

For information on how to first create the bundle and configure it, see the sections [“Creating a VC Bundle”](#) and [“Applying Bundle-Level Parameters”](#) earlier in this publication.

Applying Parameters to Individual VCs

Parameters can be applied to individual VCs either by using VC classes or by directly applying them to the bundle members.

Parameters applied to an individual VC supersede bundle-level parameters. Parameters applied directly to a VC take precedence over the same parameters applied within a class to the VC at the bundle-vc configuration level.

Configuring a VC Bundle Member Directly

Configuring VC bundle members directly is optional if a VC class is attached to the bundle member.

To configure an individual VC bundle member directly, use the following commands in bundle-vc configuration mode:

Command	Purpose
Router(config-if-atm-member)# bump { implicit explicit <i>precedence-level</i> traffic }	Configures the bumping rules for the VC bundle member.
Router(config-if-atm-member)# mpls experimental [other <i>range</i>]	Specifies which MPLS experimental bit values can be mapped to a member of a VC bundle.
Router(config-if-atm-member)# precedence [other <i>range</i>]	Configures the precedence levels that apply to the VC bundle member.
Router(config-if-atm-member)# protect { group vc }	Configures the bundle member to be an individually protected VC bundle member.
Router(config-if-atm-member)# random-detect attach <i>WRED-group-name</i>	Enables per-virtual circuit (VC) Weighted Random Early Detection (WRED).
Router(config-if-atm-member)# service-policy { input output } <i>policy-map-name</i>	Attaches a policy map to a member of a VC bundle.
Router(config-if-atm-member)# ubr [<i>pcr</i>]	Configures Unspecified Bit Rate (UBR) as the traffic shaping rule for the VC, qualified by an optional peak cell rate (PCR).
Router(config-if-atm-member)# vbr-nrt <i>pcr scr [mbs]</i>	Configures Variable Bit Rate-Non Real Time (VBR-NRT) as the traffic shaping rule for the VC, qualified by peak cell rate, sustainable cell rate (SCR), and optional maximum burst cell size (MBS).

Parameters set directly for a VC at the bundle-vc configuration level take precedence over values for these parameters set for the VC at any other level, including application of a VC class at the bundle-vc configuration level.

Configuring VC Class Parameters to Apply to a VC Bundle Member

To configure a VC class to contain commands that configure a specific VC member of a bundle when the class is applied to it, use the following commands in `bundle-vc` configuration mode, as needed. To enter `vc-class` configuration mode, use the `vc-class atm` command in global configuration mode.

Command	Purpose
Router(config-vc-class)# oam-bundle [manage] [<i>frequency</i>]	Enables end-to-end F5 OAM loopback cell generation and OAM management for all VCs in the bundle.
Router(config-vc-class)# bump { implicit explicit <i>precedence-level</i> traffic }	Configures the bumping rules for the VC.
Router(config-vc-class)# precedence [other <i>range</i>]	Configures the precedence levels for the VC.
Router(config-vc-class)# mpls experimental [other <i>range</i>]	Specifies which MPLS experimental bit values for a virtual circuit (VC) class can be mapped to a member of the VC bundle.
Router(config-vc-class)# protect { group vc }	Configures the VC to belong to the protected group of the bundle, or to be an individually protected VC bundle member.
Router(config-vc-class)# ubr [<i>pcr</i>]	Configures Unspecified Bit Rate (UBR) as the traffic shaping rule for the VC, qualified by an optional peak cell rate (PCR).
Router(config-vc-class)# vbr-nrt <i>pcr scr [mbs]</i>	Configures Variable Bit Rate-Non Real Time (VBR-NRT) as the traffic shaping rule for the VC, qualified by peak cell rate, sustainable cell rate (SCR), and optional maximum burst cell size (MBS).

Applying a VC Class to a Discrete VC Bundle Member

To attach a preconfigured VC class containing bundle-level commands to a bundle member, use the following command in `bundle-vc` configuration mode:

Command	Purpose
Router(config-if-atm-member)# class-vc <i>vc-class-name</i>	Assigns a VC class to a VC bundle member.

Parameters that configure a VC that are contained in a VC class assigned to that VC are superseded by parameters that are directly configured for the VC through discrete commands entered in `bundle-vc` configuration mode.

Configuring a VC Not to Accept Bumped Traffic

To configure an individual VC bundle member not to accept traffic that otherwise might be directed to it if the original VC carrying the traffic goes down, use the following command in `bundle-vc` configuration mode:

Command	Purpose
Router(config-if-atm-member)# no bump traffic	Configures the VC not to accept any bumped traffic that would otherwise be redirected to it.

Monitoring and Maintaining VC Bundles and Their VC Members

To gather information on VC bundles so as to monitor them or to troubleshoot problems that pertain to their configuration or use, use the following commands in privileged EXEC mode, as needed:

Command	Purpose
Router# show atm bundle <i>bundle-name</i>	Displays the bundle attributes assigned to each VC bundle member and the current working status of the VC bundle members.
Router# show atm bundle <i>bundle-name</i> statistics [detail]	Displays statistics or detailed statistics on the specified VC bundle.
Router# show atm map	Displays a list of all configured ATM static maps to remote hosts on an ATM network and on ATM bundle maps.
Router# debug atm bundle adjacency events	Displays information about ATM bundle adjacency change events.
Router# debug atm bundle errors	Displays information on bundle errors.
Router# debug atm bundle events	Displays a record of bundle events.

Configuration Examples

This section provides the following configuration examples:

- [VC Bundle Configuration on an IP Subinterface Example](#)
- [VC Bundle Configuration Using MPLS and Service Policies Example](#)
- [VC Bundle Configuration Using a VC Class Example](#)

VC Bundle Configuration on an IP Subinterface Example

This example configures a VC bundle with eight member VCs on an IP subinterface.

```
interface ATM5/0.2 point-to-point
ip address 1.5.0.1 255.255.255.0
no ip directed-broadcast
no atm enable-ilmi-trap
bundle b502
  pvc-bundle 1/107
    precedence 7
  pvc-bundle 1/106
    precedence 6
  pvc-bundle 1/105
    precedence 5
  pvc-bundle 1/104
    precedence 4
  pvc-bundle 1/103
    precedence 3
  pvc-bundle 1/102
    precedence 2
  pvc-bundle 1/101
    precedence 1
  pvc-bundle 1/100
    precedence other
!
```

VC Bundle Configuration Using MPLS and Service Policies Example

This example configures a VC bundle with three member VCs on a MPLS-enabled subinterface. Each of the bundle members has a different service policy attached.

```
interface ATM5/1.1 point-to-point
ip address 1.1.2.1 255.255.255.0
no ip directed-broadcast
no atm enable-ilmi-trap
bundle b511
  oam retry 3 5 1
  oam-bundle manage
  pvc-bundle 1/103
    service-policy out taz_high
    mpls experimental 5-7
  pvc-bundle 1/102
    service-policy out taz_med
    mpls experimental 2-4
  pvc-bundle 1/101
    service-policy out taz_low
    mpls experimental 0-1
```

```
!  
tag-switching ip  
!
```

VC Bundle Configuration Using a VC Class Example

This example shows how to configure a VC bundle using VC classes.

```
interface ATM2/1.1 point-to-point  
 ip address 2.1.2.1 255.255.255.0  
 no ip directed-broadcast  
 no atm enable-ilmi-trap  
 bundle b211  
   pvc-bundle lab-control 0/33  
     class-vc control-class  
   pvc-bundle lab-premium 0/34  
     class-vc premium-class  
     vbr-nrt 100000 100000 8000  
     mpls experimental 0-6  
   pvc-bundle lab-priority 0/35  
     class-vc priority-class  
   pvc-bundle lab-basic 0/36  
     class-vc basic-class  
!  
tag-switching ip
```

Command Reference

This section documents new or modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0S command reference publications.

- [bump](#)
- [class-bundle](#)
- [class-vc](#)
- [mpls experimental](#)
- [oam-bundle](#)
- [oam retry](#)
- [precedence \(VC bundle\)](#)
- [protect](#)
- [pvc-bundle](#)
- [random-detect \(per VC\)](#)
- [service-policy](#)
- [show atm bundle](#)

Use the following debug commands to help troubleshoot the use of this feature on the 8-Port OC-3 STM-1 ATM line card:

- [debug atm bundle adjacency events](#)
- [debug atm bundle errors](#)
- [debug atm bundle events](#)

bump

To configure the bumping rules for a virtual circuit (VC) class that can be assigned to a VC bundle, use the **bump** *vc-class* configuration command. To remove the explicit bumping rules for the VCs assigned this class and default them to implicit bumping, use the **no bump explicit** command. To specify that the VC bundle members do not accept any bumped traffic, use the **no bump traffic** command.

To configure the bumping rules for a specific VC member of a bundle, use the **bump bundle-vc** configuration command. To remove the explicit bumping rules for the VC and default it to implicit bumping, use the **no bump explicit** command. To specify that the VC does not accept any bumped traffic, use the **no** form of this command.

bump { **implicit** | **explicit** *precedence-level* | **traffic** }

no bump { **explicit** *precedence-level* | **traffic** }

Syntax Description

implicit	Depending on the mode, applies implicit bumping rules, which is also the default, to a single VC bundle member (<i>bundle-vc</i> mode) or all VCs in the bundle (<i>bundle</i> mode). The (default) implicit bumping rule stipulates that bumped traffic is to be carried by a VC with a lower precedence.
explicit <i>precedence-level</i>	Specifies the precedence level to which traffic on a VC (<i>bundle-vc</i> mode) will be bumped when the VC goes down. Specifies a single number as the value of the <i>precedence-level</i> argument.
traffic	In its positive form, specifies that the VC accepts bumped traffic. The no form stipulates that the VC does not accept any bumped traffic.

Defaults

Implicit bumping
Bump traffic (VCs accept bumped traffic)

Command Modes

VC-class configuration (for a VC class)
Bundle-vc configuration (for a VC bundle member)

Command History

Release	Modification
12.0(3)T	This command was introduced.
12.0(23)S	This command was made available in <i>vc-class</i> and <i>bundle-vc</i> configuration modes on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

Use the **bump** command in *bundle-vc* configuration mode to configure bumping rules for a discrete VC bundle member or in *vc-class* configuration mode to configure a VC class that can be assigned to a bundle member.

The effects of different bumping configuration approaches are as follows:

- **Implicit bumping:** If you configure implicit bumping, bumped traffic is sent to the VC configured to handle the next lower precedence level. When the original VC that bumped the traffic comes back up, traffic it is configured to carry is restored to it. When no other positive forms of the bump command are configured, the **bump implicit** command takes effect.
- **Explicit bumping:** If you configure a VC with the **bump explicit** command, you can specify the precedence level to which traffic on a VC will be bumped when that VC goes down, and the traffic will be directed to a VC mapped with that precedence level. If the VC that picks up and carries the traffic goes down, the traffic is subject to the bumping rules for that VC. You can specify only one precedence level for bumping.
- **Bumped traffic:** The VC accepts bumped traffic. You can configure bumped traffic explicitly using either the **bump traffic** or the **no bump traffic** command, or let the default take effect by specifying neither.
- **No bumped traffic:** To configure a discrete VC to reject bumped traffic when the traffic is directed to the VC, use the **no bump traffic** command.



Note

When no alternative VC can be found to handle bumped traffic, the bundle is declared down. To avoid this occurrence, configure explicitly the bundle member VC that has the lowest precedence level.

To use this command in `vc-class` configuration mode, you must enter the **vc-class atm** global configuration command before you enter this command.

To use this command to configure an individual bundle member in `bundle-vc` configuration mode, first enter the **bundle** command to enact bundle configuration mode for the bundle to which you want to add or modify the VC member to be configured. Then, use the **pvc-bundle** command to specify the VC to be created or modified and enter `bundle-vc` configuration mode.

This command has no effect if the VC class that contains the command is attached to a standalone VC, that is, if the VC is not a bundle member. In this case, the attributes are ignored by the VC.

VCs in a VC bundle are subject to the following configuration inheritance guidelines (listed in order of next highest precedence):

- VC configuration in `bundle-vc` mode
- Bundle configuration in bundle mode (with effect of assigned `vc-class` configuration)
- Subinterface configuration in subinterface mode

Examples

The following example configures the class called `premium-class` to define parameters applicable to a VC in a bundle. Unless overridden with a `bundle-vc bump` configuration, the VC that uses this class will not allow other traffic to be bumped onto it.

```
vc-class atm premium-class
  no bump traffic
  bump explicitly 7
```

Related Commands	Command	Description
	class-vc	Assigns a VC class to an ATM PVC or VC bundle member.
	precedence (VC bundle)	Configures precedence levels for a VC class that can be assigned to a VC bundle and thus applied to all VC members of that bundle.
	protect	Configures a VC class with protected group or protected VC status for application to a VC bundle member.
	pvc-bundle	Adds a PVC to a bundle as a member of the bundle and enters bundle-vc configuration mode in order to configure that PVC bundle member.
	vc-class atm	Configures a VC class or an ATM VC or interface.

class-bundle

To configure a virtual circuit (VC) bundle with the bundle-level commands contained in the specified VC class, use the **class-bundle** bundle configuration command. To remove the VC class parameters from a VC bundle, use the **no** form of this command.

class-bundle *vc-class-name*

no class-bundle *vc-class-name*

Syntax Description

<i>vc-class-name</i>	Name of the VC class you are assigning to your VC bundle.
----------------------	---

Defaults

No VC class is assigned to the VC bundle.

Command Modes

Bundle configuration

Command History

Release	Modification
12.0 T	This command was introduced, replacing the class command for configuring ATM VC bundles.
12.0(23)S	This command was made available in bundle configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

To use this command, you must first enter the **bundle** command to create the bundle and enter bundle configuration mode.

Use this command to assign a previously defined set of parameters (defined in a VC class) to an ATM VC bundle. Parameters set through bundle-level commands contained in a VC class are applied to the bundle and its VC members.

You can add the following commands to a VC class to be used to configure a VC bundle: **oam-bundle**, **broadcast**, **encapsulation**, **protocol**, **oam retry**, and **inarp**.

Bundle-level parameters applied through commands configured directly on a bundle supersede bundle-level parameters applied through a VC class by the **class-bundle** command. Some bundle-level parameters applied through a VC class or directly to the bundle can be superseded by commands that you directly apply to individual VCs in bundle-vc configuration mode.

Examples

In the following example, a class called class1 is first created and then applied to the bundle called bundle1:

```
! The following commands create the class class1:
vc-class atm class1
  encapsulation aal5snap
  broadcast
  protocol ip inarp
  oam-bundle manage 3
```

```
oam 4 3 10
```

```
! The following commands apply class1 to the bundle called bundle1:
bundle bundle1
  class-bundle class1
```

Taking into account hierarchy precedence rules, VCs belonging to the bundle1 bundle will be characterized by these parameters: aal5snap, encapsulation, broadcast on, use of Inverse Address Resolution Protocol (Inverse ARP) to resolve IP addresses, and Operation, Administration, and Maintenance (OAM) enabled.

Related Commands

Command	Description
broadcast	Configures broadcast packet duplication and transmission for an ATM VC class, PVC, or VC bundle.
bundle	Creates a bundle or modifies an existing bundle to enter bundle configuration mode.
class-int	Assigns a VC class to an ATM main interface or subinterface.
class-vc	Assigns a VC class to an ATM PVC, or VC bundle member.
encapsulation	Sets the encapsulation method used by the interface.
inarp	Configures the Inverse ARP time period for an ATM PVC, VC class, or VC bundle.
oam-bundle	Enables end-to-end F5 OAM loopback cell generation and OAM management for all VC members of a bundle, or for a VC class that can be applied to a VC bundle.
oam retry	Configures parameters related to OAM management for an ATM PVC, VC class, or VC bundle.
protocol (ATM)	Configures a static map for an ATM PVC, VC class, or VC bundle. Enables Inverse ARP or Inverse ARP broadcasts on an ATM PVC by either configuring Inverse ARP directly on the PVC, on the VC bundle, or in a VC class (applies to IP and IPX protocols only).
pvc-bundle	Adds a PVC to a bundle as a member of the bundle and enters bundle-vc configuration mode in order to configure that PVC bundle member.
show atm bundle	Displays the bundle attributes assigned to each bundle VC member and the current working status of the VC members.
show atm bundle statistics	Displays statistics on the specified bundle.
show atm map	Displays the list of all configured ATM static maps to remote hosts on an ATM network.
vc-class atm	Configures a VC class for an ATM VC or interface.

class-vc

To assign a virtual circuit (VC) class to an ATM permanent virtual circuit (PVC), or VC bundle member, use the **class-vc** command in the appropriate configuration mode. To remove a VC class, use the **no** form of this command.

class-vc *vc-class-name*

no class-vc *vc-class-name*

Syntax Description

<i>vc-class-name</i>	Name of the VC class you are assigning to your ATM PVC or VC bundle member.
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Defaults

No VC class is assigned to an ATM PVC, or VC bundle member.

Command Modes

Interface-ATM-VC configuration (for ATM PVCs)
Bundle-vc configuration (for VC bundle members)

Command History

Release	Modification
11.3(4)T	This command was introduced, replacing the class command for assigning VC classes to ATM PVCs.
12.0(3)T	This command was modified to support application of a VC class to an ATM VC bundle and an ATM VC bundle member.
12.0(23)S	This command was made available in bundle-vc configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

Use this command to assign a previously defined set of parameters (defined in a VC class) to an ATM PVC or VC bundle member. To create a VC class that defines these parameters, use the **vc-class atm** command. Refer to the section “Configuring VC Classes” in the “Configuring ATM” chapter of the *Cisco IOS Wide-Area Networking Configuration Guide* for more information.

ATM PVCs

To use this command for assigning a VC class to an ATM PVC, you must first enter the **interface atm** command in global configuration mode and then the **pvc** command in interface configuration mode.

When you create a VC class for an ATM PVC, you can use the following commands to define your parameters: **broadcast**, **bump**, **encapsulation**, **idle-timeout**, **ilmi manage**, **inarp**, **oam-bundle**, **oam-pvc**, **oam retry**, **protocol**, **ubr**, and **vbr-nrt**.

Parameters that are configured for a PVC through discrete commands entered in interface-ATM-VC configuration mode supersede VC class parameters assigned to an ATM PVC by the **class-vc** command.

ATM VC Bundle Members

To use this command for assigning a VC class to a VC bundle member, you must first enter the **pvc-bundle** command to enter bundle-vc configuration mode.

When you create a VC class for a VC bundle member, you can use the following commands to define your parameters: **bump**, **precedence**, **protect**, **ubr**, and **vbr-nrt**. You cannot use the following commands in vc-class configuration mode to configure a VC bundle member: **encapsulation**, **protocol**, **inarp**, and **broadcast**. These commands are useful only at the bundle level, not the bundle member level.

Parameters applied to an individual VC supersede bundle-level parameters. Parameters that are directly configured for a VC through discrete commands entered in bundle-vc configuration mode supersede VC class parameters assigned to a VC bundle member by the **class-vc** command.

Examples

The following sections show examples for applying the **class-vc** command to ATM PVC and VC bundle members.

In the following example, a class called classA is first created and then applied to an ATM PVC:

```
! The following commands create the class classA:
vc-class atm classA
  ubr 10000
  encapsulation aal5mux ip

! The following commands apply classA to an ATM PVC:
interface atm 2/0
  pvc router5 1/32
  class-vc classA
```

In the following example, a class called classA is first created and then applied to the bundle member called vcmember, a member of bundle1:

```
! The following commands create the class classA:
vc-class atm classA
  precedence 6-5
  no bump traffic
  protect group
  bump explicitly 7
  vbr-nrt 20000 10000 32

! The following commands create bundle1, add vcmember to bundle1, and then applies classA
! to vcmember:
bundle bundle1
  pvc-bundle vcmember
  class-vc classA
```

Taking into account hierarchy precedence rules, the VC bundle member vcmember will be characterized by these parameters:

- It carries traffic whose IP Precedence level is 6 and 5.
- It does not allow other traffic to be bumped onto it. When the VC goes down, its bumped traffic will be redirected to a VC whose IP Precedence level is 7.
- It is a member of the protected group of the bundle. When all members of a protected group go down, the bundle goes down.
- It has Variable Bit Rate-Non Real Time (VBR-NRT) quality of service traffic parameters.

Related Commands	Command	Description
	broadcast	Configures broadcast packet duplication and transmission for an ATM VC class, PVC, or VC bundle.
	bump	Configures the bumping rules for a VC class that can be assigned to a VC bundle.
	bundle	Creates a bundle or modifies an existing bundle to enter bundle configuration mode.
	class-bundle	Configures a VC bundle with the bundle-level commands contained in the specified VC class.
	encapsulation	Configures the AAL and encapsulation type for an ATM PVC or VC class.
	ilmi manage	Enables ILMI management on an ATM PVC.
	inarp	Configures the Inverse ARP time period for an ATM PVC, VC class, or VC bundle.
	oam-pvc	Enables end-to-end F5 OAM loopback cell generation and OAM management for an ATM PVC or VC class.
	oam retry	Configures parameters related to OAM management for an ATM PVC, VC class, or VC bundle.
	precedence (VC bundle)	Configures precedence levels for a VC member of a bundle, or for a VC class that can be assigned to a VC bundle.
	protect	Configures a VC class with protected group or protected VC status for application to a VC bundle member.
	protocol (ATM)	Configures a static map for an ATM PVC, VC class, or VC bundle. Enables Inverse ARP or Inverse ARP broadcasts on an ATM PVC by either configuring Inverse ARP directly on the PVC, on the VC bundle, or in a VC class (applies to IP and IPX protocols only).
	pvc-bundle	Adds a PVC to a bundle as a member of the bundle and enters bundle-vc configuration mode in order to configure that PVC bundle member.
	show atm bundle	Displays the bundle attributes assigned to each bundle VC member and the current working status of the VC members.
	show atm bundle statistics	Displays statistics on the specified bundle.
	show atm map	Displays the list of all configured ATM static maps to remote hosts on an ATM network.
	ubr	Configures UBR QoS and specifies the output peak cell rate for an ATM PVC, VC class, or VC bundle member.
	vbr-nrt	Configures the VBR-NRT QoS and specifies output peak cell rate, output sustainable cell rate, and output maximum burst cell size for an ATM PVC, VC class, or VC bundle member.
	vc-class atm	Configures a VC class for an ATM VC or interface.

mpls experimental

To specify which MPLS experimental bit values for a VC class can be mapped to a VC bundle and thus applied to all VC members of that bundle, use the **mpls experimental** command in the appropriate configuration mode. To remove the experimental bit values, use the **no** form of this command.

mpls experimental {**other** | *range*}

no mpls experimental {**other** | *range*}

Syntax Description

other	(Optional) Any MPLS experimental bit values in the range from 0 to 7 that are not explicitly configured.
<i>range</i>	(Optional) A single MPLS experimental bit value specified as a number, or a range of MPLS experimental bit value, specified as a hyphenated range.

Defaults

Defaults to **other**, that is, any precedence levels in the range from 0 to 7 that are not explicitly configured.

Command Modes

VC-class configuration (for a VC class)
 Bundle-vc configuration (for ATM VC bundle members)

Command History

Release	Modification
11.1(22)CC	This command was introduced.
12.0(3)T	This command was integrated into Cisco IOS Release 12.0(3)T. This command was extended to configure precedence levels for a VC member of a bundle.
12.0(23)S	This command was integrated into Cisco IOS Release 12.0(23)S.

Usage Guidelines

This command is available only when MPLS forwarding has been enabled on the subinterface through the use of the **tag-switching ip** command. In this regard, it is a companion command to the **precedence** (VC bundle) command, which is used on subinterfaces where MPLS forwarding is not enabled.

To use this command in vc-class configuration mode, first enter the **vc-class** command in global configuration mode.

To use this command to configure an individual bundle member in bundle-vc configuration mode, first enter the **bundle** command to enact bundle configuration mode for the bundle to which you want to add or modify the VC member to be configured. Then, use the **pvc-bundle** command to specify the VC to be created or modified and enter bundle-vc configuration mode.

VCs in a VC bundle are subject to the following configuration inheritance guidelines (listed in order of next highest precedence):

- VC configuration in bundle-vc mode
- Bundle configuration in bundle mode (with effect of assigned vc-class configuration)
- Subinterface configuration in subinterface mode

Examples

The following example configures MPLS experimental bits 0 through 6 on a VC bundle member within the bundle b211.

```
bundle b211
  pvc-bundle lab-premium 0/34
    class-vc premium-class
    vbr-nrt 100000 100000 8000
    mpls experimental 0-6
```

The following example configures combinations of the MPLS experimental bits on three different VC bundle members within the bundle b511.

```
bundle b511
  oam retry 3 5 1
  oam-bundle manage
  pvc-bundle 1/103
    service-policy out taz-high
    mpls experimental 5-7
  pvc-bundle 1/102
    service-policy out taz-med
    mpls experimental 2-4
  pvc-bundle 1/101
    service-policy out taz-low
    mpls experimental 0-1
```

Related Commands

Command	Description
precedence (VC bundle)	Configures IP precedence levels in bundle-vc configuration mode on a subinterface not enabled for MPLS.
tag-switching ip	Enables MPLS forwarding in interface or subinterface configuration modes.

oam-bundle

To enable end-to-end F5 Operation, Administration, and Maintenance (OAM) loopback cell generation and OAM management for a VC class that can be applied to a VC bundle, use the **oam-bundle** *vc-class* configuration command. To remove OAM management from the class configuration, use the **no** form of this command.

To enable end-to-end F5 OAM loopback cell generation and OAM management for all VC members of a bundle, use the **oam-bundle** *bundle* configuration command. To remove OAM management from the bundle, use the **no** form of this command.

oam-bundle [**manage**] [*frequency*]

no oam-bundle [**manage**] [*frequency*]

Syntax Description

manage	(Optional) Enables OAM management. If this keyword is omitted, loopback cells are sent but the bundle is not managed.
<i>frequency</i>	(Optional) Number of seconds between sending OAM loopback cells. Values range from 0 to 600 seconds.

Defaults

End-to-end F5 OAM loopback cell generation and OAM management are disabled, but if OAM cells are received, they are looped back. The default value for the *frequency* argument is 10 seconds.

Command Modes

VC-class configuration (for a VC class)
 Bundle configuration (for an ATM VC bundle)

Command History

Release	Modification
12.0(3)T	This command was introduced.
12.0(23)S	This command was made available in <i>vc-class</i> and <i>bundle</i> configuration modes on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

This command defines whether a VC bundle is OAM-managed. If this command is configured for a bundle, every VC member of the bundle is OAM-managed. If OAM management is enabled, further control of OAM management is configured using the **oam retry** command.

This command has no effect if the VC class that contains the command is attached to a standalone VC, that is, if the VC is not a bundle member. In this case, the attributes are ignored by the VC.

To use this command in bundle configuration mode, enter the **bundle** subinterface configuration command to create the bundle or to specify an existing bundle before you enter this command.

To use this command in *vc-class* configuration mode, first enter the **vc-class atm** global configuration command.

VCs in a VC bundle are subject to the following configuration inheritance rules (listed in order of next highest precedence):

- VC configuration in bundle-vc mode
- Bundle configuration in bundle mode (with effect of assigned vc-class configuration)

Examples

The following example enables OAM management for a bundle called chicago:

```
bundle chicago
  oam-bundle manage
```

Related Commands

Command	Description
class-bundle	Configures a VC bundle with the bundle-level commands contained in the specified VC class.
oam-pvc	Enables end-to-end F5 OAM loopback cell generation and OAM management for an ATM PVC or VC class.
oam retry	Configures parameters related to OAM management for an ATM PVC, VC class, or VC bundle.

oam retry

To configure parameters related to Operation, Administration, and Maintenance (OAM) management for an ATM permanent virtual circuit (PVC), VC class, or VC bundle, use the **oam retry** command in the appropriate command mode. To remove OAM management parameters, use the **no** form of this command.

oam retry *up-count down-count retry-frequency*

no oam retry *up-count down-count retry-frequency*

Syntax Description

<i>up-count</i>	Number of consecutive end-to-end F5 OAM loopback cell responses that must be received in order to change a PVC connection state to up.
<i>down-count</i>	Number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to change a PVC state to down.
<i>retry-frequency</i>	The frequency (in seconds) that end-to-end F5 OAM loopback cells are transmitted when a change in the up/down state of a PVC is being verified. For example, if a PVC is up and a loopback cell response is not received after the <i>frequency</i> (in seconds) argument is specified using the oam-pvc command, then loopback cells are sent at the <i>retry-frequency</i> to verify whether the PVC is down.

Defaults

up-count = 3

down-count = 5

retry-frequency = 1 second

This set of defaults assumes that OAM management is enabled using the **oam-pvc** command.

Command Modes

Interface-ATM-VC configuration (for an ATM PVC)

VC-class configuration (for a VC class)

Bundle configuration mode (for a VC bundle)

Command History

Release	Modification
11.3 T	This command was introduced.
12.0(3)T	This command allows you to configure parameters related to OAM management for ATM VC bundles.
12.0(23)S	This command was made available in bundle configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

If the **oam retry** command is not explicitly configured on an ATM PVC or VC bundle, the VC inherits the following default configuration (listed in order of precedence):

- Configuration of the **oam retry** command in a VC class assigned to the PVC itself.
- Configuration of the **oam retry** command in a VC class assigned to the PVC's ATM subinterface.
- Configuration of the **oam retry** command in a VC class assigned to the PVC's ATM main interface.
- Global default: *up-count* = 3, *down-count* = 5, *retry-frequency* = 1 second. This set of defaults assumes that OAM management is enabled using the **oam-pvc** command.

To use this command in bundle configuration mode, enter the **bundle** command to create the bundle or to specify an existing bundle before you enter this command.

If you use the **oam retry** command to configure a VC bundle, you configure all VC members of that bundle. VCs in a VC bundle are further subject to the following inheritance rules (listed in order of precedence):

- VC configuration in bundle-vc mode
- Bundle configuration in bundle mode (with effect of assigned VC-class configuration)
- Subinterface configuration in subinterface mode

Examples

The following example configures the OAM management parameters with *up-count* 3, *down-count* 3, and the *retry-frequency* at 10 seconds:

```
oam retry 3 3 10
```

Related Commands

Command	Description
class-int	Assigns a VC class to an ATM main interface or subinterface.
class-vc	Assigns a VC class to an ATM PVC, or VC bundle member.
oam-bundle	Enables end-to-end F5 OAM loopback cell generation and OAM management for a virtual circuit class that can be applied to a virtual circuit bundle.
oam-pvc	Enables end-to-end F5 OAM loopback cell generation and OAM management for an ATM PVC or virtual circuit class.

precedence (VC bundle)

To configure precedence levels for a VC class that can be assigned to a VC bundle and thus applied to all VC members of that bundle, use the **precedence** vc-class configuration command. To remove the precedence levels from the VC class, use the **no** form of this command.

To configure the precedence levels for a VC member of a bundle, use the **precedence** bundle-vc configuration command. To remove the precedence levels from the VC, use the **no** form of this command.

precedence [**other** | *range*]

no precedence

Syntax Description

other	(Optional) Any precedence levels in the range from 0 to 7 that are not explicitly configured.
<i>range</i>	(Optional) A single precedence level specified as a number, or a range of precedence levels, specified as a hyphenated range.

Defaults

Defaults to **other**, that is, any precedence levels in the range from 0 to 7 that are not explicitly configured.

Command Modes

VC-class configuration (for a VC class)

Bundle-vc configuration (for ATM VC bundle members)

Command History

Release	Modification
11.1(22)CC	This command was introduced.
12.0(3)T	This command was integrated into Cisco IOS Release 12.0(3)T. This command was extended to configure precedence levels for a VC member of a bundle.
12.0(23)S	This command was made available in vc-class and bundle-vc configuration modes on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

Assignment of precedence levels to VC bundle members allows you to create differentiated service because you can distribute the IP Precedence levels over the different VC bundle members. You can map a single precedence level or a range of levels to each discrete VC in the bundle, thereby enabling VCs in the bundle to carry packets marked with different precedence levels. Alternatively, you can configure a VC with the **precedence other** command to indicate that it can carry traffic marked with precedence levels not specifically configured for it. Only one VC in the bundle can be configured with the **precedence other** command to carry all precedence levels not specified. This VC is considered the default one.

To use this command in `vc-class` configuration mode, enter the **vc-class atm** global configuration command before you enter this command. This command has no effect if the VC class that contains the command is attached to a standalone VC, that is, if the VC is not a bundle member.

To use this command to configure an individual bundle member in `bundle-vc` configuration mode, first enter the **bundle** command to enact bundle configuration mode for the bundle to which you want to add or modify the VC member to be configured. Then, use the **pvc-bundle** command to specify the VC to be created or modified and enter `bundle-vc` configuration mode.

VCs in a VC bundle are subject to the following configuration inheritance guidelines (listed in order of next highest precedence):

- VC configuration in `bundle-vc` mode
- Bundle configuration in `bundle` mode (with effect of assigned `vc-class` configuration)
- Subinterface configuration in subinterface mode

Examples

The following example configures a class called `control-class` that includes a **precedence** command that, when applied to a bundle, configures all VC members of that bundle to carry IP Precedence level 7 traffic. Note, however, that VC members of that bundle can be individually configured with the **precedence** command at the `bundle-vc` level, which would supervene.

```
vc-class atm control-class
  precedence 7
```

The following example configures permanent virtual circuit (PVC) 401 (with the name of `control-class`) to carry traffic with IP Precedence levels in the range of 4-2, overriding the precedence level mapping set for the VC through `vc-class` configuration:

```
pvc-bundle control-class 401
  precedence 4-2
```

Related Commands

Command	Description
bump	Configures the bumping rules for a VC class that can be assigned to a VC bundle.
class-vc	Assigns a VC class to an ATM PVC or VC bundle member.
mpls experimental	Configures the MPLS experimental bit values for a virtual circuit (VC) class that can be mapped to a VC bundle and thus applied to all VC members of that bundle.
protect	Configures a VC class with protected group or protected VC status for application to a VC bundle member.

protect

To configure a VC class with protected group or protected VC status for application to a VC bundle member, use the **protect** command in `vc-class` configuration mode. To remove the protected status from the VC class, use the **no** form of this command.

To configure a specific VC as part of a protected group of the bundle or to configure it as an individually protected VC bundle member, use the **protect** command in `bundle-vc` configuration mode. To remove the protected status from the VC, use the **no** form of this command.

```
protect {group | vc}
```

```
no protect {group | vc}
```

Syntax Description

group	Configures the VC bundle member as part of the protected group of the bundle.
vc	Configures the VC member as individually protected.

Defaults

The VC neither belongs to the protected group nor is it an individually protected VC.

Command Modes

VC-class configuration (for a VC class)

Bundle-vc configuration (for ATM VC bundle members)

Command History

Release	Modification
12.0(3)T	This command was introduced.
12.0(23)S	This command was made available in <code>vc-class</code> and <code>bundle-vc</code> configuration modes on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

Use this command in `vc-class` configuration mode to configure a VC class to contain protected group or individual protected VC status. When the class is applied to the VC bundle member, that VC is characterized by the protected status. You can also apply this command directly to a VC in `bundle-vc` configuration mode.

When a protected VC goes down, it takes the bundle down. When all members of a protected group go down, the bundle goes down.

To use this command in `vc-class` configuration mode, first enter the **vc-class atm** global configuration command.

This command has no effect if the VC class that contains the command is attached to a standalone VC, that is, if the VC is not a bundle member.

To use this command in `bundle-vc` configuration mode, first enter the **bundle** command to enact bundle configuration mode for the bundle containing the VC member to be configured. Then enter the **pvc-bundle** configuration command to add the VC to the bundle as a member of it.

VCs in a VC bundle are subject to the following configuration inheritance guidelines (listed in order of next highest precedence):

- VC configuration in bundle-vc mode
- Bundle configuration in bundle mode (with effect of assigned vc-class configuration)
- Subinterface configuration in subinterface mode

Examples

The following example configures a class called control-class to include a **protect** command, which, when applied to a VC bundle member, configures the VC as an individually protected VC bundle member. When this protected VC goes down, it takes the bundle down.

```
vc-class atm control-class
  protect vc
```

Related Commands

Command	Description
bump	Configures the bumping rules for a VC class that can be assigned to a VC bundle.
bundle	Creates a bundle or modifies an existing bundle to enter bundle configuration mode.
class-vc	Assigns a VC class to an ATM PVC or VC bundle member.
precedence (VC bundle)	Configures precedence levels for a VC class that can be assigned to a VC bundle and thus applied to all VC members of that bundle.
pvc-bundle	Adds a PVC to a bundle as a member of the bundle and enters bundle-vc configuration mode in order to configure that PVC bundle member.
vc-class atm	Configures a VC class for an ATM VC or interface.

pvc-bundle

To add a VC to a bundle as a member of the bundle and enter bundle-vc configuration mode in order to configure that VC bundle member, use the **pvc-bundle** bundle configuration command in bundle configuration mode. To remove the VC from the bundle, use the **no** form of this command.

```
pvc-bundle pvc-name [vpi/] [vci]
```

```
no pvc-bundle pvc-name [vpi/] [vci]
```

Syntax Description

<i>pvc-name</i>	The name of the permanent virtual circuit (PVC) bundle.
<i>vpi/</i>	(Optional) ATM network virtual path identifier (VPI) for this PVC. The absence of the “/” and a <i>vpi</i> value defaults the <i>vpi</i> value to 0. The <i>vpi</i> and <i>vci</i> arguments cannot both be set to 0; if one is 0, the other cannot be 0.
<i>vci</i>	(Optional) ATM network virtual channel identifier (VCI) for this PVC. The value range is from 0 to 1 less than the maximum value set for this interface by the atm vc-per-vc command. Typically, lower values 0 to 31 are reserved for specific traffic (F4 Operation, Administration, and Maintenance (OAM), and so on) and should not be used. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has local significance only. The <i>vpi</i> and <i>vci</i> arguments cannot both be set to 0; if one is 0, the other cannot be 0.

Defaults

This command has no default behavior or values.

Command Modes

Bundle configuration

Command History

Release	Modification
12.0(3)T	This command was introduced.
12.0(23)S	This command was made available in bundle configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

Each bundle can contain multiple VCs having different QoS attributes. This command associates a VC with a bundle, making it a member of that bundle. Before you can add a VC to a bundle, the bundle must exist. Use the **bundle** command to create a bundle. You can also use this command to configure a VC that already belongs to a bundle. You enter the command in the same way, giving the name of the VC bundle member.

The **pvc-bundle** command enters bundle-vc configuration mode, in which you can specify VC-specific and VC class attributes for the VC.

Examples

The following example specifies an existing bundle called `chicago` and enters bundle configuration mode. Then it adds two VCs to the bundle. For each added VC, `bundle-vc` mode is entered and a VC class is attached to the VC to configure it.

```
bundle chicago
  pvc-bundle chicago-control 207
    class control-class
  pvc-bundle chicago-premium 206
    class premium-class
```

The following example configures the PVC called `chicago-control`, an existing member of the bundle called `chicago`, to use Modified Deficit Round Robin (MDRR). The example configuration attaches the policy map called `policy1` to the PVC. Once the policy map is attached, the classes comprising `policy1` determine the service policy for the PVC `chicago-control`.

```
bundle chicago
  pvc-bundle chicago-control 207
    class control-class
    service-policy output policy1
```

Related Commands

Command	Description
bump	Configures the bumping rules for a VC class that can be assigned to a VC bundle.
class-bundle	Configures a VC bundle with the bundle-level commands contained in the specified VC class.
class-vc	Assigns a VC class to an ATM PVC or VC bundle member.
precedence (VC bundle)	Configures precedence levels for a VC member of a bundle, or for a VC class that can be assigned to a VC bundle.
protect	Configures a VC class with protected group or protected VC status for application to a VC bundle member.

random-detect (per VC)

To enable per-virtual circuit (VC) Weighted Random Early Detection (WRED), use the **random-detect** VC submode command. To disable per-VC WRED, use the **no** form of this command.

random-detect [**attach** *group-name*]

no random-detect [**attach** *group-name*]

Syntax Description

attach *group-name* (Optional) The name of the WRED group.

Defaults

WRED is disabled by default.

Command Modes

VC submode

Bundle-vc configuration (for ATM VC bundle members)

Command History

Release	Modification
12.0(3)T	This command was introduced.
12.0(23)S	This command was made available in bundle-vc configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. WRED is most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

WRED is configurable at the interface and per-VC levels. The VC-level WRED configuration will override the interface-level configuration if WRED is also configured at the interface level.

Use this command to configure a single ATM VC or a VC that is a member of a bundle.

Note the following points when using the **random-detect** (per VC) command:

- If you use this command without the optional **attach** keyword, default WRED parameters (such as minimum and maximum thresholds) are used.
- If you use this command with the optional **attach** keyword, the parameters defined by the specified WRED parameter group are used. (WRED parameter groups are defined through the **random-detect-group** command.) If the specified WRED group does not exist, the VC is configured with default WRED parameters.

When this command is used to configure an interface-level WRED group to include per-VC WRED as a drop policy, the configured WRED group parameters are inherited under the following conditions:

- All existing VCs will inherit the interface-level WRED group parameters.
- Except for the VC used for signalling and the Interim Local Management Interface (ILMI) VC, any VCs created after the configuration of an interface-level WRED group will inherit the parameters.

When an interface-level WRED group configuration is removed, per-VC WRED parameters are removed from any VC that inherited them from the configured interface-level WRED group.

When an interface-level WRED group configuration is modified, per-VC WRED parameters are modified accordingly if the WRED parameters were inherited from the configured interface-level WRED group configuration.

This command is only supported on interfaces that are capable of VC-level queuing, such as the 8-Port OC-3 STM-1 ATM line card.

Examples

The following example configures per-VC WRED for the permanent virtual circuit (PVC) called cisco. Because the **attach** keyword was not used, WRED uses default parameters.

```
pvc cisco 46
  random-detect
```

Related Commands

Command	Description
class (policy-map)	Specifies the name of the class whose policy you want to create or change, and the default class (commonly known as the class-default class) before you configure its policy.
random-detect exponential-weighting-constant	Configures the WRED exponential weight factor for the average queue size calculation.
random-detect-group	Defines the WRED parameter group.
random-detect precedence	Configures WRED parameters for a particular IP Precedence.
show interfaces	Displays the statistical information specific to a serial interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queuing strategies.

service-policy

To attach a policy map to an input interface or virtual circuit (VC), or an output interface or VC, to be used as the service policy for that interface or VC, use the **service-policy** interface configuration command. To remove a service policy from an input or output interface or input or output VC, use the **no** form of this command.

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

```
no service-policy {input | output} policy-map-name
```

Syntax Description	input	Attaches the specified policy map to the input interface or input VC.
	output	Attaches the specified policy map to the output interface or output VC.
	<i>policy-map-name</i>	The name of a service policy map (created using the policy-map command) to be attached.

Defaults No service policy is specified.

Command Modes

- Interface configuration
- VC submode (for a standalone VC)
- Bundle-vc configuration (for ATM VC bundle members)
- Map-class configuration (for Frame Relay VCs)

Command History	Release	Modification
	12.0(5)T	This command was introduced.
	12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE.
	12.0(7)S	This command was integrated into Cisco IOS Release 12.0(7)S.
	12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.
	12.1(2)T	This command was integrated into Cisco IOS Release 12.1(2)T. This command was modified to enable low latency queueing (LLQ) on Frame Relay VCs.
	12.0(23)S	This command was integrated into Cisco IOS Release 12.0(23)S, and made available in bundle-vc configuration mode on the 8-Port OC-3 STM-1 ATM line card for Cisco 12000 Series Internet Routers.

Usage Guidelines You can attach a single policy map to one or more interfaces or one or more VCs to specify the service policy for those interfaces or VCs.

Currently a service policy specifies MDRR. The class policies comprising the policy map are then applied to packets that satisfy the class map match criteria for the class.

To successfully attach a policy map to an interface or a VC, the aggregate of the configured minimum bandwidths of the classes comprising the policy map must be less than or equal to 75 percent of the interface bandwidth or the bandwidth allocated to the VC.

To enable LLQ for Frame Relay (priority queueing (PQ)/MDRR), you must first enable Frame Relay Traffic Shaping (FRTS) on the interface using the **frame-relay traffic-shaping** command in interface configuration mode. You will then attach an output service policy to the Frame Relay VC using the **service-policy** command in map-class configuration mode.

For a policy map to be successfully attached to an interface or ATM VC, the aggregate of the configured minimum bandwidths of the classes that make up the policy map must be less than or equal to 75 percent of the interface bandwidth or the bandwidth allocated to the VC. For a Frame Relay VC, the total amount of bandwidth allocated must not exceed the minimum committed information rate (CIR) configured for the VC less any bandwidth reserved by the **frame-relay voice bandwidth** or **frame-relay ip rtp priority** map-class commands. If not configured, the minimum CIR defaults to half of the CIR.

Configuring MDRR on a physical interface is only possible if the interface is in the default queueing mode. Serial interfaces at E1 (2.048 Mbps) and below use WFQ by default. Other interfaces use FIFO by default. Enabling MDRR on a physical interface overrides the default interface queueing method. Enabling MDRR on an ATM permanent virtual circuit (PVC) does not override the default queueing method.

Attaching a service policy and enabling MDRR on an interface renders ineffective any commands related to fancy queueing such as commands pertaining to fair queueing, custom queueing, priority queueing, and Weighted Random Early Detection (WRED). You can configure these features only after you remove the policy map from the interface.

You can modify a policy map attached to an interface or a VC, changing the bandwidth of any of the classes comprising the map. Bandwidth changes that you make to an attached policy map are effective only if the aggregate of the bandwidth amounts for all classes comprising the policy map, including the modified class bandwidth, less than or equal to 75 percent of the interface bandwidth or the VC bandwidth. If the new aggregate bandwidth amount exceeds 75 percent of the interface bandwidth or VC bandwidth, the policy map is not modified.

Examples

The following example shows how to attach the service policy map called policy9 to data-link connection identifier (DLCI) 100 on output serial interface 1 and enables LLQ for Frame Relay:

```
interface Serial1/0.1 point-to-point
  frame-relay interface-dlci 100
    class fragment
  !
map-class frame-relay fragment
  service-policy output policy9
```

The following example attaches the service policy map called policy9 to input serial interface 1:

```
interface Serial1
  service-policy input policy9
```

The following example attaches the service policy map called policy9 to the input PVC called cisco:

```
pvc cisco 0/34
  service-policy input policy9
vbr-nt 5000 3000 500
precedence 4-7
```

The following example attaches the policy called policy9 to output serial interface 1 to specify the service policy for the interface and enable MDRR on it:

```
interface serial1
  service-policy output policy9
```

The following example attaches the service policy map called policy9 to the output PVC called cisco:

```
pvc cisco 0/5
  service-policy output policy9
vbr-nt 4000 2000 500
  precedence 2-3
```

Related Commands

Command	Description
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.
show frame-relay pvc	Displays statistics about PVCs for Frame Relay interfaces.
show policy-map	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
show policy-map interface	Displays the configuration of all classes configured for all service policies on the specified interface or displays the classes for the service policy for a specific PVC on the interface.

The following is sample output from the **show atm bundle statistics detail** command:

```

Router# show atm bundle b211 statistics detail

Bundle Name:b211Bundle State:UP
AAL5-LLC/SNAP
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
BUNDLE is not managed.
InARP frequency:15 minutes(s)
InPkts:0, OutPkts:4608, InBytes:0, OutBytes:297276
InPProc:0, OutPProc:4632, Broadcasts:0
InFast:0, OutFast:0, InAS:0, OutAS:0

ATM2/1.1:VCD:1, VPI:0, VCI:33, Connection Name:lab-control
VBR-NRT, PeakRate:50000, Average Rate:50000, Burst Cells:8000
AAL5-LLC/SNAP, etype:0x0, Flags:0x20, VCmode:0x0
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC state:Not Managed
ILMI VC state:Not Managed
InARP frequency:15 minutes(s)
InPkts:0, OutPkts:0, InBytes:0, OutBytes:0
InPProc:0, OutPProc:0
InFast:0, OutFast:0, InAS:0, OutAS:0
Out CLP=1 Pkts:0
OAM cells received:0
F5 InEndloop:0, F5 InSegloop:0, F5 InAIS:0, F5 InRDI:0
OAM cells sent:0
F5 OutEndloop:0, F5 OutSegloop:0, F5 OutAIS:0, F5 OutRDI:0
OAM cell drops:0
Status:UP

ATM2/1.1:VCD:2, VPI:0, VCI:34, Connection Name:lab-premium
VBR-NRT, PeakRate:100000, Average Rate:100000, Burst Cells:8000
AAL5-LLC/SNAP, etype:0x0, Flags:0x20, VCmode:0x0
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC state:Not Managed
ILMI VC state:Not Managed
InARP frequency:15 minutes(s)
InPkts:0, OutPkts:4608, InBytes:0, OutBytes:297276
InPProc:0, OutPProc:4633
InFast:0, OutFast:0, InAS:0, OutAS:0
Out CLP=1 Pkts:0
OAM cells received:0
F5 InEndloop:0, F5 InSegloop:0, F5 InAIS:0, F5 InRDI:0
OAM cells sent:0
F5 OutEndloop:0, F5 OutSegloop:0, F5 OutAIS:0, F5 OutRDI:0
OAM cell drops:0
Status:UP

ATM2/1.1:VCD:3, VPI:0, VCI:35, Connection Name:lab-priority
UBR, PeakRate:50000
AAL5-LLC/SNAP, etype:0x0, Flags:0x20, VCmode:0x0
OAM frequency:0 second(s), OAM retry frequency:1 second(s)

```

■ show atm bundle

```
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC state:Not Managed
ILMI VC state:Not Managed
InARP frequency:15 minutes(s)
InPkts:0, OutPkts:0, InBytes:0, OutBytes:0
InProc:0, OutProc:0
InFast:0, OutFast:0, InAS:0, OutAS:0
Out CLP=1 Pkts:0
OAM cells received:0
F5 InEndloop:0, F5 InSegloop:0, F5 InAIS:0, F5 InRDI:0
OAM cells sent:0
F5 OutEndloop:0, F5 OutSegloop:0, F5 OutAIS:0, F5 OutRDI:0
OAM cell drops:0
Status:UP
```

```
ATM2/1.1:VCD:4, VPI:0, VCI:36, Connection Name:lab-basic
UBR, PeakRate:50000
AAL5-LLC/SNAP, etype:0x0, Flags:0x20, VCmode:0x0
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC state:Not Managed
ILMI VC state:Not Managed
InARP frequency:15 minutes(s)
InPkts:0, OutPkts:0, InBytes:0, OutBytes:0
InProc:0, OutProc:0
InFast:0, OutFast:0, InAS:0, OutAS:0
Out CLP=1 Pkts:0
OAM cells received:0
F5 InEndloop:0, F5 InSegloop:0, F5 InAIS:0, F5 InRDI:0
OAM cells sent:0
F5 OutEndloop:0, F5 OutSegloop:0, F5 OutAIS:0, F5 OutRDI:0
OAM cell drops:0
Status:UP
Router#
```

debug atm bundle adjacency events

To display information about ATM bundle adjacency change events, use the **debug atm bundle adjacency events** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug atm bundle adjacency events

no debug atm bundle adjacency events

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(3)T	This command was introduced to support VC bundle management on Cisco Enhanced ATM Port Adapters (PA-A3) on Cisco 7200 and 7500 Series routers.
12.0(23)S	This command was made available to support VC bundle management on the 8-Port OC-3 STM-1 ATM line card.

Usage Guidelines

This command enables the displaying of bundle adjacency event information for a VC bundle, such as occurrences of VC bumping, when bundles were brought up, when they were taken down, and so forth.

Examples

The following is sample output from the **debug atm bundle adjacency events** command:

```
Router# debug atm bundle adjacency events
```

Related Commands

Command	Description
debug atm bundle errors	Displays information about ATM bundle errors.
debug atm bundle events	Displays information about ATM bundle events.

debug atm bundle errors

To display information about ATM bundle errors, use the **debug atm bundle errors** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug atm bundle errors

no debug atm bundle errors

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(3)T	This command was introduced to support VC bundle management on Cisco Enhanced ATM Port Adapters (PA-A3) on Cisco 7200 and 7500 Series routers.
12.0(23)S	This command was modified to support VC bundle management on the 8-Port OC-3 STM-1 ATM line card.

Usage Guidelines

This command enables the displaying of error information for a VC bundle, such as reports of inconsistent mapping in the bundle.

Examples

The following is sample output from the **debug atm bundle errors** command:

```
Router# debug atm bundle errors
```

Related Commands

Command	Description
bump	Configures the bumping rules for a VC class that can be assigned to a VC bundle.
bundle	Creates a bundle or modifies an existing bundle to enter bundle configuration mode.
debug atm bundle events	Displays information about ATM bundle events.

debug atm bundle events

To display information about ATM bundle events, use the **debug atm bundle events** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug atm bundle events

no debug atm bundle events

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(3)T	This command was introduced to support VC bundle management on Cisco Enhanced ATM Port Adapters (PA-A3) on Cisco 7200 and 7500 Series routers.
12.0(23)S	This command was modified to support VC bundle management on the 8-Port OC-3 STM-1 ATM line card.

Usage Guidelines

This command enables the displaying of event information for a VC bundle, such as occurrences of VC bumping, when bundles were brought up, when they were taken down, and so forth.

Examples

The following is sample output from the **debug atm bundle events** command:

```
Router# debug atm bundle events
```

Related Commands

Command	Description
debug atm bundle errors	Displays information about ATM bundle errors.

■ debug atm bundle events