Configuring Resource Management

This chapter describes resource management, which involves modeling and managing switch, interface, and connection resources. Such resources include equivalent bandwidth and buffering to support the provision of specified traffic classes.

Note This chapter provides advanced configuration instructions for the Catalyst 8540 MSR, Catalyst 8510 MSR, and LightStream 1010 ATM switch routers. For detailed descriptions of traffic management mechanisms and their operation, refer to the *Guide to ATM Technology.* For complete descriptions of the commands mentioned in this chapter, refer to the *ATM Switch Router Command Reference* publication.

This chapter includes the following sections:

Note The traffic and resource management features of the ATM switch router are presented in a different order in this guide and in the *Guide to ATM Technology.* In this guide the sequence of features follows configuration scope and proceeds from global to per-interface features. In the *Guide to ATM Technology* the sequence of features follows the phases of a connection and proceeds from traffic contract to management of hardware resources.

Resource Management Functions

The ATM switch router resource management software provides the following functions:

- Network management interface—Includes operational configuration changes (take place immediately), proposed configuration changes (take place on restart), user interface, and status.

- Default quality of service (QoS) objective table management—Since User-Network Interface 3 (UNI 3) signalling does not provide information elements to signal QoS values, resource management provides a table that contains default values for QoS.

- Connection Traffic Table (CTT) management—Rather than store traffic parameters for each connection in that connection's data structure, resource management manages a table of connection traffic parameters, used by network and connection management.

- Hardware resource management (Catalyst 8540 MSR)—The switch processor feature card provides functionality that include statistic collection, and traffic policing usage parameter control (UPC). See the "Configuring Global Resource Management" section on page 8-4 for detailed information.

- Hardware resource management (Catalyst 8510 MSR and LightStream 1010)—Different sets of functionality are available with feature card per-class queueing (FC-PCQ) and feature card per-flow queueing (FC-PFQ). FC-PCQ features include switch cell priority limits, interface queue sizes, and thresholds. FC-PFQ features include threshold group configuration. The interface pacing feature is available with both feature cards. See the "Processor Feature Card Functionality (Catalyst 8510 MSR and LightStream 1010)" section on page 8-3 for detailed information.

- Resource Call Admission Control (RCAC)—Determines whether a virtual channel connection/virtual path connection (VCC/VPC) can be admitted (allowed to be set up), based on the available connection resources and requested traffic characteristics.

- Logical interface creation and deletion.

- Private Network-Network Interface (PNNI) metrics—resource management supplies PNNI with link metrics for connection routing.

Switch Fabric Functionality (Catalyst 8540 MSR)

The switch fabric for the Catalyst 8540 MSR provides the required ATM Forum Traffic Management features as described in Table 8-1.

Table 8-1   Switch Processor Feature Card

Feature	Description
Traffic classes:	CBR[1], VBR-RT[2], VBR-NRT[3], UBR[4], ABR[5](EFCI)[6]
Output queuing	Per-VC or per-VP
Output scheduling	RS[7] and WRR[8]
Intelligent early packet discard	Multiple dynamic thresholds
Intelligent tail (partial) packet discard	Supported
Selective cell marking and discard	Multiple, weighted, dynamic thresholds

Table 8-1   Switch Processor Feature Card (continued)

Feature	Description
Shaping	Per-port pacing, per-CBR VC, per-CBR transit VP, per-shaped CBR VP tunnel (128 shaped VP tunnels total), and hierarchical VP tunnels
Policing (UPC[9])[10]	Dual leaky bucket
Frame mode VC-merge	Supported
Point-to-multipoint VC (multicast)	Multiple leafs per output port, per point-to-multipoint
Network clock switchover[10]	Programmable clock selection criteria
Nondisruptive snooping	Per-VC or per-VP
Hierarchical VP tunnel	Maximum of 240 VP tunnels.

1. CBR = constant bit rate

2. VBR-RT = variable bit rate real time

3. VBR-NRT = variable bit rate non-real time

4. UBR = unspecified bit rate

5. ABR = available bit rate

6. EFCI = explicit forward congestion indication

7. RS = rate scheduling

8. WRR = weighted round-robin

9. UPC = usage parameter control

10. Performed by feature card

Processor Feature Card Functionality (Catalyst 8510 MSR and LightStream 1010)

Two types of feature cards are available for the Catalyst 8510 MSR and LightStream 1010 ATM switch routers: FC-PCQ and FC-PFQ. Each card provides the required ATM Forum Traffic Management features. FC-PCQ contains a subset of the FC-PFQ features, as described in Table 8-2.

Note   To determine which feature card you have installed, enter the **show hardware** EXEC command. Either FeatureCard1, for FC-PCQ, or FC-PFQ displays in the Ctrlr-Type column.

Table 8-2   FC-PCQ and FC-PFQ Feature Comparison

Feature	FC-PCQ	FC-PFQ
Traffic classes	CBR[1], VBR-RT[2], VBR-NRT[3], ABR[4] (EFCI[5] and RR[6]), UBR[7]	CBR, VBR-RT, VBR-NRT, ABR (EFCI and RR), UBR
Output queuing	Four classes per port	Per-VC or per-VP
Output scheduling	SP[8]	RS[9] and WRR[10]
Intelligent early packet discard	Multiple fixed thresholds	Multiple dynamic thresholds

Table 8-2   FC-PCQ and FC-PFQ Feature Comparison (continued)

Feature	FC-PCQ	FC-PFQ
Intelligent tail (partial) packet discard	Supported	Supported
Selective cell marking and discard	Multiple fixed thresholds	Multiple, weighted, dynamic thresholds
Shaping	Per-port (pacing)	Per-port pacing, per-CBR VC, per-CBR transit VP, per-shaped CBR VP tunnel (128 shaped VP tunnels total), and hierarchical VP tunnels
Policing (UPC[11])	Dual mode, single leaky bucket	Dual leaky bucket
Point-to-multipoint VC (multicast)	One leaf per output port, per point-to-multipoint	Multiple leafs per output port, per point-to-multipoint
Network clock switch over	Automatic upon failure	Programmable clock selection criteria
Nondisruptive snooping	Per-port transmit or receive	Per-VC or per-VP
Hierarchical VP tunnel[12]	–	Maximum of 62 VP tunnels

1. CBR = constant bit rate
2. VBR-NT = variable bit rate real time
3. VBR-NRT = variable bit rate non-real time
4. ABR = available bit rate
5. EFCI = explicit forward congestion indication
6. RR = relative rate
7. UBR = unspecified bit rate
8. SP = strict priority
9. RS = rate scheduling
10. WRR = weighted round-robin
11. UPC = usage parameter control
12. Available with FC-PFQ only

Configuring Global Resource Management

Global resource management configurations affect all interfaces on the switch. The following sections describe global resource management tasks:

- Configuring the Default QoS Objective Table on page 8-5
- Configuring the Switch Oversubscription Factor (Catalyst 8510 MSR and LightStream 1010) on page 8-6
- Configuring the Service Category Limit (Catalyst 8510 MSR and LightStream 1010) on page 8-7
- Configuring the ABR Congestion Notification Mode (Catalyst 8510 MSR and LightStream 1010) on page 8-8
- Configuring the Connection Traffic Table on page 8-10

- Configuring the Connection Traffic Table on page 8-10
- Configuring the Sustainable Cell Rate Margin Factor on page 8-13
- Overview of Threshold Groups on page 8-15

Configuring the Default QoS Objective Table

Resource management provides a table of default objective values for quality of service (QoS) for guaranteed service categories. These default values—either metrics or attributes—are used as the criteria for connection setup requirements when values are not present the in received setup message.

> **Note** Default objective values for QoS for guaranteed service categories can be configured for for UNI signalling.

Table 8-3 lists the default values of the QoS objective table.

Table 8-3   Default QoS Objective Table Row Contents

Service Category	Max Cell Transfer Delay (clp01)	Peak-to-Peak Cell Delay Variation (clp01)	Cell Loss Ratio (clp0)	Cell Loss Ratio (clp0+1)
CBR	Undefined	Undefined	Undefined	Undefined
VBR-RT	Undefined	Undefined	Undefined	Undefined
VBR-NRT	—	—	Undefined	Undefined

Each objective can have a default defined or undefined value. If undefined, the objective is not considered in connection setup. The table should be configured with the same default values for an entire network.

To configure the default QoS objective table, perform the following tasks in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm qos default** {**cbr** | **vbr-rt**} **max-cell-transfer-delay** {*microseconds* | **any**}	Configures the ATM QoS default CBR or VBR-RT maximum cell transfer delay value.
Step 2	Switch(config)# **atm qos default** {**cbr** | **vbr-rt**} **peak-to-peak- cell-delay variation** {*microseconds* | **any**}	Configures the ATM QoS default CBR or VBR-RT peak-to-peak cell delay variation value.
Step 3	Switch(config)# **atm qos default** {**cbr** | **vbr-rt** | **vbr-nrt**} **max-cell-loss-ratio** [**clp0** | **clp1plus0**] {*loss-ratio-exponent* | **any**}	Configures the ATM QoS default CBR, VBR-RT, or VBR-NRT maximum cell loss ratio value.

Example

The following example shows how to configure the default constant bit rate (CBR) maximum cell loss ratio objective for cell loss priority (CLP) = 0+1 to 10^{-12} cells per second:

```
Switch(config)# atm qos default cbr max-cell-loss-ratio clp1plus0 12
```

Displaying the ATM QoS Objective Table

To display the default QoS objective table, use the following EXEC command:

Command	Purpose
show atm qos-defaults	Displays the ATM QoS objective table configuration.

The per-service category, maximum cell transfer delay, peak-to-peak cell delay variation, and maximum cell loss ratio objectives are displayed.

Example

The ATM QoS objective table configuration is displayed in the following example:

```
Switch> show atm qos-defaults
Default QoS objective table:
    Max cell transfer delay (in microseconds): any cbr, any vbr-rt
    Peak-to-peak cell  delay variation (in microseconds): any cbr, any vbr-rt
    Max cell loss ratio for CLP0 cells: any cbr, any vbr-rt, any vbr-nrt
    Max cell loss ratio for CLP0+1 cells:  10**(-12) cbr, any vbr-rt, any vbr-nrt
```

Configuring the Switch Oversubscription Factor (Catalyst 8510 MSR and LightStream 1010)

The switch oversubscription factor (OSF) feature on the Catalyst 8510 MSR and LightStream 1010 ATM switch routers is used in determining initial port maximum queue sizing for variable bit rate non-real time (VBR-NRT) and available bit rate/unspecified bit rate (ABR/UBR) queues.

Note   Over subscription factor configuration is only possible on switches with FC-PCQ installed.

The size of the VBR-NRT queue and ABR/UBR queues is determined by the following equations, where the default size of the CBR and VBR-RT queues vary by interface type, as listed in Table 8-4:

```
Default Size (VBR-NRT) = 0.25 * ((OSF * 2048) – DefaultSize(CBR) – DefaultSize (VBR-RT))
Default Size (ABR-UBR) = 0.75 * ((OSF * 2048) – DefaultSize(CBR) – DefaultSize (VBR-RT))
```

Table 8-4   Default CBR and VBR Determined by Interface Type

Interface Type	Default Max Size CBR Queue	Default Max Size Type VBR-RT Queue
SONET	256	256
DS3/E3	256	512

To configure the OSF, use the following global configuration command:

Command	Purpose
atm over-subscription-factor *o-value*	Configures the switch OSF from 1 to 32.

Note   This value can be changed at any time, but it is only used at start-up and when a module is hot-swapped from the chassis.

Example

The following example shows how to set the switch oversubscription factor to 16:

```
Switch(config)# atm over-subscription-factor 16
```

Displaying the OSF Configuration (Catalyst 8510 MSR and LightStream 1010)

To display the OSF configuration, use the following EXEC command:

Command	Purpose
show atm resource	Displays the OSF configuration.

Note   The following examples differ depending on the feature card installed in your switch.

Examples

The following example shows the switch OSF configuration with FC-PCQ installed:

```
Switch> show atm resource
Resource configuration:
➔     Over-subscription-factor 16  Sustained-cell-rate-margin-factor 1%
    Abr-mode:    relative-rate
    Atm service-category-limit (in cells):
        64544 cbr 64544 vbr-rt 64544 vbr-nrt 64544 abr-ubr
Resource state:
    Cells per service-category:
        0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr
```

Configuring the Service Category Limit (Catalyst 8510 MSR and LightStream 1010)

The service category limit configuration restricts the number of cells admitted into the switch, as determined by the type of output queues.

Note   Service category limit configuration is only possible on switches with FC-PCQ installed.

⚠

Caution   Setting a service category limit to 0 causes the connection requests for the associated service categories to be rejected.

To configure the service category limits, use the following global configuration command:

Command	Purpose
atm service-category-limit {**cbr**	**vbr-rt**	**vbr-nrt**	**abr-ubr**} *value*	Configures ATM service category limits for a specific output queue.

✏

Note   The **atm service-category-limit** command affects all connections, including those already established.

Example

The following example shows how to change the service category limit for the CBR cells within the switch fabric to 3000 cells:

```
Switch(config)# atm service-category-limit cbr 3000
```

Displaying the Service Category Limit Configuration (Catalyst 8510 MSR and LightStream 1010)

To display the service category limit configuration, use the following EXEC command:

Command	Purpose
show atm resource	Displays the service category limits configuration.

Example

The following example shows the service category limits configuration:

```
Switch> show atm resource
Resource configuration:
    Over-subscription-factor 16  Sustained-cell-rate-margin-factor 1%
    Abr-mode:   relative-rate
→   Atm service-category-limit (in cells):
        3000 cbr 64544 vbr-rt 64544 vbr-nrt 64544 abr-ubr
Resource state:
    Cells per service-category:
        0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr
```

Configuring the ABR Congestion Notification Mode (Catalyst 8510 MSR and LightStream 1010)

The available bit rate (ABR) congestion notification mode changes the type of notification used on ABR connections to alert the end station of congestion. ABR mode configuration determines whether ABR uses explicit forward congestion indication (EFCI) marking, relative-rate marking, or both, for rate management on ABR connections.

The global configuration function is used to modify the ABR mode selection for all ABR connections.

To configure the ABR mode, use the following global configuration command:

Command	Purpose
atm abr-mode {**efci**	**relative-rate**	**all**}	Configures ABR congestion notification mode.

> **Note** The **atm abr-mode** command affects all connections, including those already established.

Example

The following example shows how to configure the entire switch to set the EFCI bit whenever a cell arrives on a congested ABR connection:

```
Switch(config)# atm abr-mode efci
```

Displaying the ABR Congestion Notification Mode Configuration (Catalyst 8510 MSR and LightStream 1010)

To display the ABR congestion notification mode configuration, use the following EXEC command:

Command	Purpose
show atm resource	Displays the ABR congestion notification mode configuration.

> **Note** The following examples differ depending on the feature card installed in your switch.

Examples

The following example shows the ABR mode configuration with FC-PCQ installed:

```
Switch> show atm resource
Resource configuration:
    Over-subscription-factor 16  Sustained-cell-rate-margin-factor 1%
    Abr-mode: efci
    Atm service-category-limit (in cells):
        3000 cbr 64544 vbr-rt 64544 vbr-nrt 64544 abr-ubr
Resource state:
    Cells per service-category:
        0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr
```

The following example shows the ABR mode configuration with FC-PFQ installed:

```
Switch> show atm resource
Resource configuration:
    Over-subscription-factor 8  Sustained-cell-rate-margin-factor 1%
    Abr-mode:  efci
    Service Category to Threshold Group mapping:
     cbr 1 vbr-rt 2 vbr-nrt 3 abr 4 ubr 5
    Threshold Groups:
    Group Max     Max Q  Min Q  Q thresholds  Cell  Name
          cells   limit  limit  Mark Discard  count
          instal  instal instal
    ------------------------------------------------------
      1   65535   63     63     25 %  87 %     0     cbr-default-tg
      2   65535   127    127    25 %  87 %     0     vbrrt-default-tg
      3   65535   511    31     25 %  87 %     0     vbrnrt-default-tg
      4   65535   511    31     25 %  87 %     0     abr-default-tg
      5   65535   511    31     25 %  87 %     0     ubr-default-tg
      6   65535   1023   1023   25 %  87 %     0     well-known-vc-tg
```

Configuring the Connection Traffic Table

A row in the connection traffic table (CTT) must be created for each unique combination of traffic parameters. Virtual path links (VPLs) and virtual channel links (VCLs) then specify traffic by specifying a row in the table per flow (receive and transmit). Many VCL/VPLs can refer to the same row in the traffic table.

The following two subsections outline the differences in the CTT feature according to platform and feature card.

CTT Supported Features (Catalyst 8540 MSR)

The rows corresponding to various service categories support the following features on the Catalyst 8540 MSR.

- Non-zero minimum cell rate (MCR) for UBR+ service categories. UBR+ is a variant of UBR, in which peak cell rate (PCR), MCR, and cell delay variation tolerance (CDVT) are specified in the traffic contract, with a guarantee on MCR.

- Both CDVT and maximum burst size (MBS) for VBR rows. Dual-leaky-bucket UPC is allowed.

- Whether SCR applies to either the CLP0 or CLP0+1 flow of cells. Only one or the other of these flows can be policed.

CTT Supported Features (Catalyst 8510 MSR and LightStream 1010)

ATM switch routers with feature card per-flow queuing (FC-PFQ) and software version 11.2(8) or later have more rows of various service categories that allow you to specify the following features:

- Non-zero minimum cell rate (MCR) for ABR and UBR+ service categories. UBR+ is a variant of UBR, in which peak cell rate (PCR), MCR, and cell delay variation tolerance (CDVT) are specified in the traffic contract, with a guarantee on MCR.
- Both CDVT and maximum burst size (MBS) for VBR rows. FC-PFQ allows dual-leaky-bucket UPC.
- Whether SCR applies to either the CLP0 or CLP0+1 flow of cells. FC-PFQ can police one or the other of these flows.

If your switch has FC-PCQ installed on the route processor you cannot take advantage of these new capabilities. CTT rows specifying these new parameters can be configured with FC-PCQ installed, with the following effect:

- Non-zero MCR is not supported. Requests for connections specifying non-zero MCR are rejected.
- On VBR connections, only SCR and MBS are used for UPC, and policing is done only on the CLP0+1 flow of cells.

PVC Connection Traffic Rows

The CTT in a permanent virtual channel (PVC) setup requires storing PVC traffic values in a CTT data structure. Rows used for PVCs are called stable rows, and contain traffic parameters.

SVC Connection Traffic Rows

The CTT in a switched virtual channel (SVC) setup provides a row identifier that Simple Network Management Protocol (SNMP) or the user interface can use to read or display SVC traffic parameters. A CTT row index is stored in the connection-leg data structure for each flow of the connection.

Note   Rows cannot be deleted while in use by a connection.

CTT Row Allocations and Defaults

To make CTT management software more efficient, the CTT row-index space is split into rows allocated as a result of signalling and rows allocated from the command-line interface (CLI) and SNMP. Table 8-5 describes the row-index range for both.

Table 8-5   CTT Row-Index Allocation

Allocated by	Row-index range
ATOMMIB Traffic Descriptor Table or CLI connection-traffic-table-row creation	1 through 1,073,741,823
Signalling VxL creation	1,073,741,824 through 2,147,483,647

Table 8-6 describes the well-known, predefined ATM CTT rows.

Table 8-6   Default ATM Connection Traffic Table Rows

CTT Row Index	Service Category	Peak-Cell-Rate (clp01)	Sustained-Cell-Rate (clp01)	Tolerance	Use
1	UBR	7,113,539	—	None	Default PVP/PVC row index
2	CBR	424 kbps	—	None	CBR tunnel well-known (WK) VCs
3	VBR-RT	424 kbps	424 kbps	50	Physical interface/VBR-RT WK VCs
4	VBR-NRT	424 kbps	424 kbps	50	VBR-NRT tunnel WK VCs
5	ABR	424 kbps	—	None	—
6	UBR	424 kbps	—	None	UBR tunnel WK VCs

The **atm connection-traffic-table-row** command supports these service categories: CBR, VBR-RT, VBR-NRT, ABR, and UBR. To create or delete an ATM CTT row, perform the following tasks in global configuration mode:

> **Note** Your CTT feature set depends on the type of feature card that is installed on the Catalyst 8510 MSR and LightStream 1010 ATM switch routers route processor.

	Command	Purpose
Step 1	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] {**vbr-rt**	**vbr-nrt**} **pcr** *pcr-value* {**scr0**	**scr10**} *scr-value* [**mbs** *mbs-value*] [**cdvt** *cdvt_value*]	Configures an ATM CTT VBR row.
Step 2	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] **cbr pcr** *pcr-value* [**cdvt** *cdvt-value*]	Configures an ATM CTT CBR row.
Step 3	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] **abr pcr** *pcr-value* [**mcr** *mcr-value*] [**cdvt** *cdvt-value*]	Configures an ATM CTT ABR row.
Step 4	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] **ubr pcr** *pcr-value* [**mcr** *mcr-value*] [**cdvt** *cdvt-value*]	Configures an ATM CTT UBR row.

If you do not specify an index row number, the system software determines if one is free and displays it in the allocated index field if the command is successful.

Example

The following example shows how to configure an ATM CTT row with an ABR peak cell rate of 30,000 kilobits per second:

```
Switch(config)# atm connection-traffic-table-row abr pcr 30000
 Allocated index = 63999
```

Displaying the ATM Connection Traffic Table

To display the CTT configuration, use the following EXEC command:

Command	Purpose
show atm connection-traffic-table [**row** *row-index* | **from-row** *row-index*]	Displays the CTT configuration.

Example

The following example shows how to display the CTT configuration table:

```
Switch> show atm connection-traffic-table
Row       Service-category     pcr         scr/mcr       mbs          cdvt
1            ubr           7113539        none                        none
2            cbr              424                                     none
3            vbr-rt           424          424           50           none
4            vbr-nrt          424          424           50           none
5            abr              424            0                        none
6            ubr              424         none                        none
64000        cbr             1741                                     none
2147483645*  ubr                0         none                        none
2147483646*  ubr                1         none                        none
2147483647*  ubr           7113539        none                        none
```

Configuring the Sustainable Cell Rate Margin Factor

The sustained cell rate margin factor determines the aggressiveness of weighting sustainable cell rate (SCR) compared to peak cell rate (PCR). It uses the connection admission control algorithm in admitting VBR connections.

To configure the SCR for your ATM switch router, use the following global configuration command:

Command	Purpose
atm sustained-cell-rate-margin-factor *s-value*	Configures the sustained cell rate margin factor.

Note The **atm sustained-cell-rate-margin-factor** command affects subsequent connections but not connections that are already established.

Example

The following example shows how to configure the SCR margin factor as 85 percent of maximum:

```
Switch(config)# atm sustained-cell-rate-margin-factor 85
```

Displaying the SCR Margin Configuration

To display the SCR margin factor configuration, use the following EXEC command:

Command	Purpose
show atm resource	Displays the SCR margin factor configuration.

Example

The following example shows the SCR margin factor configuration:

```
Switch> show atm resource
Resource configuration:
Sustained-cell-rate-margin-factor 85%
     Abr-mode:   EFCI
     Service Category to Threshold Group mapping:
      cbr 1 vbr-rt 2 vbr-nrt 3 abr 4 ubr 5
     Threshold Groups:
  Module    Group Max     Max Q  Min Q  Q thresholds  Cell  Name
   ID             cells   limit  limit  Mark Discard  count
                  instal  instal instal
  -------------------------------------------------------------
   1        1     131071  63     63     25 %  87 %    0     cbr-default-tg
            2     131071  127    127    25 %  87 %    0     vbrrt-default-tg
            3     131071  511    31     25 %  87 %    0     vbrnrt-default-tg
            4     131071  511    31     25 %  87 %    0     abr-default-tg
            5     131071  511    31     25 %  87 %    0     ubr-default-tg
            6     131071  1023   1023   25 %  87 %    0     well-known-vc-tg
  =============================================================
   2        1     131071  63     63     25 %  87 %    0     cbr-default-tg
            2     131071  127    127    25 %  87 %    0     vbrrt-default-tg
            3     131071  511    31     25 %  87 %    0     vbrnrt-default-tg
            4     131071  511    31     25 %  50 %    0     abr-default-tg
            5     131071  511    31     25 %  87 %    0     ubr-default-tg
            6     131071  1023   1023   25 %  87 %    0     well-known-vc-tg
  =============================================================
   7        1     131071  63     63     25 %  87 %    0     cbr-default-tg
            2     131071  127    127    25 %  87 %    0     vbrrt-default-tg
            3     131071  511    31     25 %  87 %    0     vbrnrt-default-tg
            4     131071  511    31     25 %  87 %    0     abr-default-tg
            5     131071  511    31     25 %  87 %    0     ubr-default-tg
            6     131071  1023   1023   25 %  87 %    0     well-known-vc-tg
  =============================================================
   8        1     131071  63     63     25 %  87 %    0     cbr-default-tg
            2     131071  127    127    25 %  87 %    0     vbrrt-default-tg
            3     131071  511    31     25 %  87 %    0     vbrnrt-default-tg
            4     131071  511    31     25 %  87 %    0     abr-default-tg
            5     131071  511    31     25 %  87 %    0     ubr-default-tg
            6     131071  1023   1023   25 %  87 %    0     well-known-vc-tg
  =============================================================
```

Overview of Threshold Groups

Threshold groups combine VCs/VPs to determine per-connection thresholds, based on the use of memory by the group.

Note Threshold groups are supported on the Catalyst 8540 MSR, and on the Catalyst 8510 MSR and LightStream 1010 ATM switch routers equipped with the FC-PFQ feature card.

The initial default configuration of per-VC queueing on the switch has all connections of a service category assigned to one threshold group. However, the assignment of service categories to threshold groups is configurable. A service category cannot be mapped to more than one threshold group. If you configure a service category to a threshold group more than once, the last configuration stays in effect. The default assigns each service category to a different threshold group. However, you can assign more than one service category to a threshold group.

Note The configuration of threshold groups is static, not dynamic.

For a description of how the threshold group feature works, refer to the *Guide to ATM Technology*.

Table 8-7 lists the configuration parameter defaults.

Table 8-7   Threshold Group Configuration Parameter Defaults

Group	Maximum Cells[1]	Maximum Queue Limit[2]	Minimum Queue Limit[3]	Mark Threshold[4]	Discard Threshold[5]	Use
1	65,535	63	63	25%	87%	CBR
2	65,535	127	127	25%	87%	VBR-RT
3	65,535	511	31	25%	87%	VBR-NRT
4	65,535	511	31	25%	87%	ABR
5	65,535	511	31	25%	87%	UBR
6	65,535	1023	1023	25%	87%	well-known VCs

1. Maximum number of cells in threshold group

2. Maximum (uncongested) per-VC queue limit in cells

3. Minimum (congested) per-VC queue limit in cells

4. Marking threshold percent full of per-VC queue

5. Discard threshold percent full of per-VC queue

Configuring the Threshold Group

To configure the threshold groups on a ATM switch router, perform the following tasks in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm threshold-group service** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} *group*	Assigns a service category to a threshold group.
Step 2	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **max-cells** *number*	Configures the maximum number of cells queued for all connections that are members of the threshold group.
Step 3	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **discard-threshold** *percent*	Configures the threshold of per-connection queue-full at which the queue is considered full for CLP[2] discard and EPD[3].
Step 4	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **max-queue-limit** *number*	Configures the largest per-VC queue limit that is applied to connections in the threshold group.
Step 5	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **min-queue-limit** *number*	Configures the smallest per-VC queue-limit that is applied to connections in the threshold group.
Step 6	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **name** *name*	Configures the name associated with a threshold group.
Step 7	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **max-cells** *number*	Configures the maximum number of cells queued for specified threshold group for all module-ids.[4] Optionally, configure for the specified threshold group for the specified module-id.
Step 8	Switch(config)# **atm threshold-group** [**module-id** *module*][1] *group* **marking-threshold** *percent*	Configures the threshold of per-connection queue-full at which the queue is considered full for EFCI marking and ABR relative-rate marking.

1. The **module-id** identifier is only supported on the Catalyst 8540 MSR.

2. CLP = cell loss priority

3. EPD = early packet discard

4. Each module on the Catalyst 8540 MSR has its own cell memory and threshold groups. There are eight of these modules in a 20 gigabyte configuration. Each module has a 64 kbps cell memory, and the threshold groups can be configured per module. By default, all the threshold groups of all the modules are configured identically.

Example

The following example shows how to configure ATM threshold group 5 with a maximum number of cells before the cells are discarded:

```
Switch(config)# atm threshold-group 5 max-cells 50000
```

Displaying the Threshold Group Configuration

To display the threshold group configuration, use the following user EXEC command:

Command	Purpose
show atm resource	Displays the threshold group configuration.

Example

The following example displays the threshold group configuration:

```
Switch> show atm resource
Resource configuration:
Sustained-cell-rate-margin-factor 1%
    Abr-mode:    EFCI
    Service Category to Threshold Group mapping:
     cbr 1 vbr-rt 2 vbr-nrt 3 abr 4 ubr 5
    Threshold Groups:
 Module    Group Max    Max Q  Min Q  Q thresholds  Cell  Name
  ID             cells  limit  limit  Mark Discard  count
                 instal instal instal
    ----------------------------------------------------------
  1        1     131071 63     63     25 %  87 %     0     cbr-default-tg
           2     131071 127    127    25 %  87 %     0     vbrrt-default-tg
           3     131071 511    31     25 %  87 %     0     vbrnrt-default-tg
           4     131071 511    31     25 %  87 %     0     abr-default-tg
           5     131071 511    31     25 %  87 %     0     ubr-default-tg
           6     131071 1023   1023   25 %  87 %     0     well-known-vc-tg
 ============================================================
  2        1     131071 63     63     25 %  87 %     0     cbr-default-tg
           2     131071 127    127    25 %  87 %     0     vbrrt-default-tg
           3     131071 511    31     25 %  87 %     0     vbrnrt-default-tg
           4     131071 511    31     25 %  50 %     0     abr-default-tg
           5     131071 511    31     25 %  87 %     0     ubr-default-tg
           6     131071 1023   1023   25 %  87 %     0     well-known-vc-tg
 ============================================================
<information deleted>
```

Configuring Physical Interfaces

Physical interface resource management configurations affect only specific interfaces on the switch. The following sections describe physical interface configuration resource management tasks:

- Configuring the Interface Maximum Queue Size (Catalyst 8510 MSR and LightStream 1010) on page 8-18
- Configuring the Interface Queue Thresholds per Service Category (Catalyst 8510 MSR and LightStream 1010) on page 8-20
- Configuring Interface Output Pacing on page 8-21
- Configuring Controlled Link Sharing on page 8-23
- Configuring the Scheduler and Service Class on page 8-25

Configuring the Interface Maximum Queue Size (Catalyst 8510 MSR and LightStream 1010)

Maximum queue size feature on the Catalyst 8510 MSR and LightStream 1010 ATM switch routers is used to determine the following:

- Maximum number of cells in the switch fabric queue
- Maximum cell transfer delay (CTD)
- Peak-to-peak cell delay variation (CDV) provided on an output switch interface

Note   Interface maximum queue size configuration is only possible on switches with FC-PCQ installed on your route processor.

Because not all queue size values are supported by the switch fabric, the value installed is displayed, as well as the configuration value requested. The value installed is always greater than or equal to that requested.

To configure the maximum queue size, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm output-queue** [**force**] {**cbr** | **vbr-rt** | **vbr-nrt** | **abr-ubr**} **max-size** *number*	Configures the ATM output queue maximum size.

Note   The **atm output-queue** command affects all connections, including those already established.

This command is not applicable for subinterface level configuration. For other restrictions, refer to the *ATM Switch Router Command Reference* publication.

If the interface status is up, the **force** parameter is required before the request is completed. If the request is forced, output on the interface is briefly disabled, cells on the output queue are discarded, and the queue size is changed to the new limit. Any impact on existing connections by the implicit change in guaranteed maximum CTD and peak-to-peak CDV is not considered before making the change. Subsequent setup of switched virtual channel (SVC) connections will be affected.

Note   The queue must be momentarily disabled to change the threshold.

Example

The following example shows how to configure the CBR ATM output queue maximum size to 30,000 cells:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm output-queue force cbr max-size 30000
```

Displaying the Output Queue Maximum Configuration (Catalyst 8510 MSR and LightStream 1010)

To display the output queue maximum size configuration, use the following user EXEC command:

Command	Purpose
show atm interface resource atm *card/subcard/port*	Displays the output queue maximum size configuration.

Example

The following example displays the interface output queue maximum size configuration with FC-PCQ installed:

```
Switch> show atm interface resource atm 3/0/0
Resource Management configuration:
    Output queues:
→       Max sizes(explicit cfg): 30000  cbr, none vbr-rt, none vbr-nrt, none abr-ubr
        Max sizes(installed): 30208 cbr, 256 vbr-rt, 4096 vbr-nrt, 12032 abr-ubr
        Efci threshold: 25% cbr, 25% vbr-rt, 25% vbr-nrt, 25% abr, 25% ubr
        Discard threshold: 87% cbr, 87% vbr-rt, 87% vbr-nrt, 87% abr, 87% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        147743 cbr RX, 147743 cbr TX, 147743 vbr RX, 147743 vbr TX,
        0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
        0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
    Best effort connections: 1 pvcs,  0 svcs
```

Configuring the Interface Queue Thresholds per Service Category (Catalyst 8510 MSR and LightStream 1010)

The queue thresholds can be specified for the different levels of service and configured on each interface queue. The following queue thresholds can be configured:

- Output queue EFCI threshold
- Output queue cell loss priority (CLP) and packet discard (PD) threshold
- ABR relative rate threshold

Note Interface queue threshold per-service category configuration is only possible on switches with FC-PCQ installed on your route processor.

These queue thresholds can be changed at any time. The result changes the threshold for all connections of that service category using the interface for output and for any subsequent connections.

Note The CLP and PD discard threshold and ABR relative rate threshold have finer granularity than the explicit forward congestion indication (EFCI) threshold.

To configure the output threshold, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm output-threshold** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} **discard-threshold** *disc-thresh-num*	Configures the ATM output discard threshold.
Step 3	Switch(config-if)# **atm output-threshold** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} **efci-threshold** *efci-thresh-number*	Configures the ATM output threshold.
Step 4	Switch(config-if)# **atm output-threshold abr relative-rate** *abr-thresh-number*	Configures the ATM output threshold ABR.

Note These commands affect all connections, including those already established.

These commands are not applicable for subinterface level configurations. For other restrictions, refer to the *ATM Switch Router Command Reference* publication.

Examples

The following example shows how to configure the interface output threshold CBR discard threshold to 87 percent of maximum size:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm output-threshold cbr discard 87
```

The following example shows how to configure the interface output discard threshold for CBR EFCI threshold to 50 percent of maximum size:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm output-threshold cbr efci 50
```

Displaying the Output Threshold Maximum Configuration (Catalyst 8510 MSR and LightStream 1010)

To display the output threshold maximum size configuration, use the following user EXEC command:

Command	Purpose
show atm interface resource atm *card/subcard/port*	Displays the output threshold maximum size configuration.

Example

The following example shows the interface output threshold maximum size configuration with FC-PCQ installed:

```
Switch> show atm interface resource atm 3/0/0
Resource Management configuration:
    Output queues:
        Max sizes(explicit cfg): 30000  cbr, none vbr-rt, none vbr-nrt, none abr-ubr
        Max sizes(installed): 30208 cbr, 256 vbr-rt, 4096 vbr-nrt, 12032 abr-ubr
→       Efci threshold: 50% cbr, 25% vbr-rt, 25% vbr-nrt, 25% abr, 25% ubr
        Discard threshold: 87% cbr, 87% vbr-rt, 87% vbr-nrt, 87% abr, 87% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
<information deleted>
```

Configuring Interface Output Pacing

Output pacing is used to artificially reduce the output speed of an interface in kbps. Output pacing can be changed at any time, enabled, or disabled. When an output pacing change request is made, resource management determines if the change will not provide the guaranteed bandwidth at the outbound port for the existing virtual channels or virtual paths (VCs or VPs). Guaranteed bandwidth is reserved for constant bit rate (CBR) and variable bit rate (VBR) connections.

> **Note** Pacing is only allowed for carrier module ports on the Catalyst 8540 MSR.

To enable or change an interface output pacing rate, perform the following tasks, beginning in global configuration mode:

Command	Purpose
interface atm *card*/*subcard*/*port*	Selects the interface to be configured.
atm pacing *kbps* [**force**]	Configures the interface output pacing.

The **force** argument indicates that the change should be made even if it results in an output cell rate that does not provide sufficient bandwidth for guaranteed service on the interface transmit flow. The **force** argument has no effect on Catalyst 8510 MSR and LightStream 1010 ATM switch routers with FC-PFQ installed on the route processor.

> **Note** The **atm pacing** command affects all connections, including those already established.

This command does not apply to the CPU interfaces (atm0 and ethernet0) or subinterfaces. For other restrictions, refer to the *ATM Switch Router Command Reference* publication.

> **Note** Since the 12.0(1a)W5(5b) release of the system software, addressing the interface on the route processor (CPU) has changed. The ATM interface is now called atm0, and the Ethernet interface is now called ethernet0. Old formats (atm 2/0/0 and ethernet 2/0/0) are still supported.

Example

The following example shows how to configure the interface output pacing to 10,000 kbps:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm pacing 10000
```

Displaying the Output Pacing Configuration

To display the output pacing configuration, use the following EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*	Displays the output pacing configuration.

Example

The following example shows the interface output pacing configuration:

```
Switch> show atm interface resource atm 0/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX,
        Tolerance RX: none cbr, none vbr, none abr, none ubr
        Tolerance TX: none cbr, none vbr, none abr, none ubr
<information deleted>
```

→ (arrow pointing at Pacing line)

Configuring Controlled Link Sharing

Resource management allows fine-tuning of the connection admission control functions on a per-interface and direction (receive and transmit) basis. The reservations are specified with the following three parameters:

- Maximum aggregate guaranteed cell rate on an interface, which limits the guaranteed bandwidth that can be allocated on an interface
- Maximum guaranteed cell rates on an interface per-service category
- Minimum guaranteed cell rates on an interface per-service category

Table 8-8 shows the minimum and maximum parameter relationships.

Table 8-8   Connection Admission Control Parameter to Bandwidth Relationships

Service Category	Value	Service Category	Bandwidth
Minimum CBR	+	Minimum VBR	<= 95 percent
Minimum CBR	<=	Maximum CBR	<= 95 percent
Minimum VBR	<=	Maximum VBR	<= 95 percent
Minimum CBR	<=	Maximum Aggregate	<= 95 percent
Minimum VBR	<=	Maximum Aggregate	<= 95 percent
Maximum CBR	<=	Maximum Aggregate	<= 95 percent
Maximum VBR	<=	Maximum Aggregate	<= 95 percent

To configure controlled link sharing, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[.*vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm cac link-sharing max-guaranteed-service-bandwidth** {**receive** | **transmit**} *percent*	Configures controlled link sharing for the maximum guaranteed service bandwidth.
Step 3	Switch(config-if)# **atm cac link-sharing max-bandwidth** {**abr** | **cbr** | **ubr** | **vbr**} {**receive** | **transmit**} *percent*	Configures controlled link sharing for the maximum guaranteed service bandwidth by service category.
Step 4	Switch(config-if)# **atm cac link-sharing min-bandwidth** {**cbr** | **vbr** | **abr** | **ubr**} {**receive** | **transmit**} *percent*	Configures controlled link sharing for the minimum guaranteed service bandwidth by service category.

Note   These commands affect subsequent connections but not connections that are already established.

For restrictions to these commands, refer to the *ATM Switch Router Command Reference* publication.

Example

The following example shows how to configure the controlled link sharing, maximum guaranteed service bandwidth, and receive configuration to 87 percent:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac link-sharing max-guaranteed-service-bandwidth receive 87
```

Displaying the Controlled Link Sharing Configuration

To display the controlled link sharing configuration, perform the following task in user EXEC mode:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*	Displays the controlled link sharing configuration.

Example

The following example displays the controlled link sharing configuration:

```
Switch> show atm interface resource atm 0/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Link Distance: 0 kilometers
→   Controlled Link sharing:
→       Max aggregate guaranteed services: none RX,  none TX
→       Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
→       Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX,
        Tolerance RX: none cbr, none vbr, none abr, none ubr
        Tolerance TX: none cbr, none vbr, none abr, none ubr
<information deleted>
```

Configuring the Scheduler and Service Class

A service class denotes one of the scheduling classes referred to as output virtual circuit (OVC) QoS classes. Up to eight service classes can be allocated to each physical interface (PIF) port. In scheduling the next cell to be transmitted from a port, the rate scheduler (RS) has first call on supplying an eligible cell. If RS does not have one, then weighted round-robin (WRR) scheduler chooses a service class with an OVC ready to transmit, and finally a VC within the service class is selected.

Note Scheduler and service class configuration is only possible on Catalyst 8510 MSR and LightStream 1010 ATM switch routers with FC-PFQ installed on your route processor.

ATM service categories are mapped statically to service classes, as shown in Table 8-9, where service class 2 has the highest scheduling priority.

Table 8-9   ATM Service Category to Service Class

Service Category	Service Class
VBR-RT	2
VBR-NRT	3
ABR	4
UBR	5

Each service class is assigned a weight. These weights are configurable, in the range of 1 to 15. The default weighting is {15,2,2,2} for classes {2,3,4,5}, respectively. The weighting is not modified dynamically.

Within service classes, individual PVCs are also weighted, again in the range of 1 to 15. A standard weight (2) is assigned to all PVCs in a service class. Optionally, PVCs can be configured with a specific weight per half-leg (applying to the transmit OVC weight). SVCs take the value 2.

> **Note**   For a detailed description of rate and WRR scheduling, refer to the *Guide to ATM Technology.*

To configure the interface service class and WRR value, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[*.vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm service-class** {**2**	**3**	**4**	**5**} **wrr-weight** *weight*	Configures the weight given to each service class.

Example

The following example shows how to configure service class 3 on interface ATM 0/1/0 with a WRR weight of 5:

```
Switch(config)# interface atm 0/1/0
Switch(config-if)# atm service-class 3 wrr-weight 5
```

Displaying the Interface Service Class Information

To display the configuration of an interface in a service class, use the following user EXEC command:

Command	Purpose
show atm interface resource {**atm**	**atm-p**} *card*/*subcard*/*port*	Displays the configured membership of the interface in a service class.

Example

The following example shows the configuration of the interface in a service class:

```
Switch> show atm interface resource atm 0/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX,
        Tolerance RX: none cbr, none vbr, none abr, none ubr
        Tolerance TX: none cbr, none vbr, none abr, none ubr
<information deleted>
```

Configuring Physical and Logical Interface Parameters

The following sections describe interface configuration resource management tasks for both physical and logical interface types:

- Configuring the Interface Link Distance on page 8-28
- Configuring the Limits of Best-Effort Connections on page 8-29
- Configuring the Interface Maximum of Individual Traffic Parameters on page 8-31
- Configuring the ATM Default CDVT and MBS on page 8-33
- Configuring Interface Service Category Support on page 8-35

Configuring the Interface Link Distance

Specifying the physical link distance for the next ATM hop in the outbound direction allows you to increase the propagation delay. Propagation delay is used in determining the connection admission control (CAC) maximum cell transfer delay (CTD) provided on the output by a switch interface, which can affect the switched virtual channel (SVC) connection requests accepted.

> **Note** For a detailed description of the CAC algorithm pseudo-code on the ATM switch router, refer to the *Guide to ATM Technology*.

To configure the interface link distance, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[*.vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm link-distance** *kilometers*	Configures the interface link distance for the interface.

> **Note** The **atm link-distance** command affects subsequent connections but not connections that are already established.

Example

The following example shows how to configure the outbound link distance to 150 kilometers:

```
Switch(config-if)# atm link-distance 150
```

Displaying the Interface Link Distance Configuration

To display the interface link distance configuration, use the following EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*[*.vpt#*]	Displays the interface link distance configuration.

Example

The following example shows the configuration of the interface link distance with switch processor feature card installed:

```
Switch> show atm interface resource atm 0/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 150 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                        none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                        none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
<information deleted>
```

Configuring the Limits of Best-Effort Connections

Each interface can be configured to allow a specific number of best-effort available bit rate (ABR) and unspecified bit rate (UBR) connections.

To configure the number of best-effort connections, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[.*vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm cac best-effort-limit** *conn-value*	Configures the connection best-effort limit.

Note   These commands affect subsequent connections but not connections that are already established.

Example

The following example shows how to configure the connection best-effort limit configuration to 2000:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac best-effort-limit 2000
```

Displaying the Interface Best-Effort Limit Configuration

To display the interface best-effort configuration, use the following EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*[**.***vpt#*]	Displays the subinterface best-effort configuration.

Example

The following example shows the interface best-effort configuration with the switch processor feature card installed:

```
Switch> show atm interface resource atm 3/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled    0 Kbps rate configured, 0 Kbps rate installed
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
→   Best effort connection limit: enabled  2000 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
<information deleted>
```

Configuring the Interface Maximum of Individual Traffic Parameters

When a VCC is set up, you can specify per-flow (receive and transmit traffic) parameters. Traffic parameter limits may be configured independently by service category and traffic direction for the following:

- Maximum peak cell rate (PCR)
- Maximum sustained cell rate (SCR)
- Maximum cell delay variation tolerance (CDVT)
- Maximum burst size (MBS)
- Maximum minimum cell rate (MCR)

To configure the traffic parameters, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[.*vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm cac max-peak-cell-rate** {**cbr** | **vbr** | **abr** | **ubr**} {**receive** | **transmit**} *rate*	Configures the connection maximum PCR.
Step 3	Switch(config-if)# **atm cac max-sustained-cell-rate** {**receive** | **transmit**} *rate*	Configures the connection SCR.
Step 4	Switch(config-if)# **atm cac max-cdvt** {**abr** | **cbr** | **ubr** | **vbr**} {**receive** | **transmit**} *cell-count*	Configures the connection maximum CDVT.
Step 5	Switch(config-if)# **atm cac max-mbs** {**receive** | **transmit**} *cell-count*	Configures the connection maximum MBS.
Step 6	Switch(config-if)# **atm cac max-min-cell-rate** {**abr** | **ubr**} {**receive** | **transmit**} *rate*	Configures the connection maximum MCR per service category flow.

> **Note** These commands affect subsequent connections but not connections that are already established.

Examples

The following example shows how to configure the maximum PCR for constant bit rate (CBR) connections on interface 3/0/0, specified in receive mode, to 100,000 kbps:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac max-peak-cell-rate cbr receive 100000
```

The following example shows how to configure the maximum SCR for connections on interface 3/0/0, specified in receive mode, to 60,000 kbps:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac max-sustained-cell-rate receive 60000
```

The following example shows how to configure the maximum tolerance for CBR connections on interface 3/0/0, specified in receive mode, 75,000 kbps:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac max-cdvt cbr receive 75000
```

Displaying the Interface Maximum Individual Traffic Parameter Configuration

To display the interface maximum individual traffic parameter configuration, use the following EXEC command:

Command	Purpose
show atm interface resource atm [*card*/*subcard*/*port*[*.vpt#*]]	Displays the controlled link sharing configuration.

Example

The following example shows the interface maximum individual traffic configuration with switch processor feature card installed:

```
Switch> show atm interface resource atm 3/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: enabled  2000 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
<information deleted>
```

Configuring the ATM Default CDVT and MBS

You can change the default cell delay variation tolerance (CDVT) and maximum burst size (MBS) to request for UPC of cells received on the interface for connections that do not individually request a CDVT or MBS value.

You can specify CDVT or MBS for PVCs through a connection traffic table row. If no CDVT or MBS is specified in the row, then a per-interface, per-service category default is applied for purposes of usage parameter control (UPC) on the connection.

> **Note**   For signalled connections, CDVT or MBS cannot be signalled and the defaults specified on the interface apply.

To configure the default CDVT and MBS parameters, perform the following task, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Specifies an ATM interface and enter interface configuration mode.
Step 2	Switch(config-if)# **atm cdvt-default** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} *number*	Configures the ATM CDVT default.
Step 3	Switch(config-if)# **atm mbs-default** {**vbr-rt** | **vbr-nrt**} *number*	Configures the ATM MBS default.

Example

The following example shows how to change the default tolerance for received cells on VBR-RT connections:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cdvt-default vbr-rt 4000
```

Displaying the ATM CDVT and MBS Configuration

To display the ATM CDVT and MBS configuration, use the following EXEC commands:

Command	Purpose
show atm vc	Displays the ATM VC CDVT configuration.
show atm vp	Displays the ATM VP CDVT configuration.

Examples

The following example shows the ATM CDVT and MBS configuration of an ATM VC:

```
Switch> show atm vc interface atm 0/0/3 0 100

Interface: ATM0/0/3, Type: oc3suni
VPI = 0   VCI = 100
Status: UP
Time-since-last-status-change: 00:00:08
Connection-type: PVC
Cast-type: point-to-point
Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/0/2, Type: oc3suni
Cross-connect-VPI = 0
Cross-connect-VCI = 100
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 2, Cells queued: 0
Rx cells: 0, Tx cells: 0
Tx Clp0:0,  Tx Clp1: 0
Rx Clp0:0,  Rx Clp1: 0
Rx Upc Violations:0, Rx cell drops:0
Rx Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 9999
Rx service-category: VBR-RT (Realtime Variable Bit Rate)
Rx pcr-clp01: 40000
Rx scr-clp0 : 30000
Rx mcr-clp01: none
Rx       cdvt: 1024 (from default for interface)
Rx       mbs: 1024 (from default for interface)
Tx connection-traffic-table-index: 9999
Tx service-category: VBR-RT (Realtime Variable Bit Rate)
Tx pcr-clp01: 40000
Tx scr-clp0 : 30000
Tx mcr-clp01: none
Tx       cdvt: none
Tx       mbs: none
```

The following example shows the ATM CDVT and MBS configuration of an ATM VP:

```
Switch> show atm vp interface atm0/0/3 4

Interface: ATM0/0/3, Type: oc3suni
VPI = 4
Status: UP
Time-since-last-status-change: 00:00:10
Connection-type: PVP
Cast-type: point-to-point
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/0/2, Type: oc3suni
Cross-connect-VPI = 4
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 5, Cells queued: 0
Rx cells: 0, Tx cells: 0
Tx Clp0:0,  Tx Clp1: 0
Rx Clp0:0,  Rx Clp1: 0
Rx Upc Violations:0, Rx cell drops:0
Rx Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
```
→   Rx   cdvt: 1024 (from default for interface)
→   Rx   mbs: none
```
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
```
→   Tx   cdvt: none
→   Tx   mbs: none

Configuring Interface Service Category Support

You can configure which service categories connection admission control (CAC) allows on an interface. You can configure interface service category support only on physical interfaces and shaped and hierarchical logical virtual path (VP) tunnel interfaces.

✎

Note   For information on how to configure your physical and logical VP tunnel interfaces, see the "Configuring VP Tunnels" section on page 6-33.

The underlying service category for shaped and hierarchical VP tunnels is CBR. For VP shaped tunnels, interface service category support can be used to configure a service category other than CBR for VCs within the tunnel. For physical interfaces and hierarchical VP tunnels, all service category VCs (by default) can migrate across the interface. However, you can use the interface service category support feature to explicitly allow or prevent VCs of specified service categories to migrate across the interface.

Table 8-10 shows the service category of the shaped VP (always CBR), the service categories you can configure for transported VCs, and a suggested transit VP service category for the tunnel.

Table 8-10   Service Category Support for Physical and Logical Interfaces

Shaped VP Tunnel Service Category	VC Service Category	Suggested Transit VP Service Category
CBR	CBR	CBR
CBR	VBR	CBR or VBR
CBR	ABR[1]	CBR or VBR
CBR	UBR	Any service category

1. We recommend ABR only if the transit VP is set up so that congestion occurs at the shaped tunnel, not in the transit VP.

The following restrictions apply to interface service category support:

- This configuration is allowed on physical interfaces and shaped and hierarchical VP tunnel logical interfaces.

- On shaped VP tunnel logical interfaces, only one service category is permitted at a time. To replace CBR with another service category on these interfaces, you must first deny the CBR service category, then permit the chosen service category. To deny a service category, you must delete all user VCs of that service category on the interface.

- For ABR and UBR, only zero MCR is supported on VCs on a shaped VP tunnel.

To configure a service category on an interface, perform the following tasks, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port*[*.vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	**atm cac service-category** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} {**permit** | **deny**}	Configures the service category on the interface.

Example

The following example shows how to configure the ABR service category on ATM interface 3/0/0:

```
Switch(config)# interface atm 3/0/0
Switch(config-if)# atm cac service-category cbr deny
Switch(config-if)# atm cac service-category abr permit
```

Displaying the Service Category on an Interface

To display the service category configured on an interface, use the following user EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*[.*vpt#*]	Displays the controlled link sharing configuration.

Example

The following example shows the service category configuration:

```
Switch> show atm interface resource atm 3/0/0
Resource Management configuration:
    Service Classes:
        Service Category map: c1 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 8 c2, 1 c3, 1 c4, 1 c5
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
→     Service Categories supported: cbr,vbr-rt,vbr-nrt,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
<information deleted>
```

Configuring Interface Overbooking

The interface overbooking feature allows the available equivalent bandwidth of an interface to exceed the maximum cell rate (MaxCR) or physical line rate on ATM and inverse multiplexing over ATM (IMA) interfaces. The available equivalent bandwidth is by default limited by the MaxCR. Increasing the available equivalent bandwidth beyond the MaxCR allows the configuration of more connections on an interface than its physical bandwidth would allow. Overbooking allows more flexibility when configuring an interface when the traffic over the interface will be less than the MaxCR.

The following restrictions apply to interface overbooking:

- Regular VP tunnels do not support interface overbooking.
- You cannot add new hierarchical VP tunnels on a physical interface if the interface's bandwidth guarantees exceed the MaxCR regardless of any overbooking configured on that interface.

- On IMA interfaces, the available equivalent bandwidth for PVCs differs from the available equivalent bandwidth for SVCs. The available equivalent bandwidth for PVCs is based on the number of interfaces configured as part of the IMA group. The available equivalent bandwidth for SVCs on an IMA interface is based on the number of interfaces that are active in the IMA group. Overbooking increases both the available equivalent bandwidth values by the same configured percentage.

- The MaxCR for transmit and receive flows might differ on output-paced physical interfaces. Configuring overbooking on such interfaces results in different maximum guaranteed services bandwidth values and available cell rates for service categories for transmit and receive flows. Maximum guaranteed services bandwidth is the maximum equivalent bandwidth allocated for guaranteed services on the interface.

- When an interface is overbooked with traffic, cell flow through the well-known VCs might be reduced.

- Although overbooking increases the available cell rates for various service categories on an interface, various traffic parameters of a connection are still limited by the MaxCR.

- If the overbooking configuration results in a maximum guaranteed services bandwidth that is below the currently allocated bandwidth guarantees on an interface, the configuration is rejected.

⚠ **Caution**   Overbooking can cause interface traffic to exceed the guaranteed bandwidth that the switch can provide.

✎ **Note**   Interface overbooking configuration is not supported on switches with feature card per-flow queuing (FC-PCQ) installed.

To configure overbooking, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	**interface atm** *card*/*subcard*/*slot* Switch(config-if)# or **interface atm** *card*/*subcard*/**ima***group* Switch(config-if)#	Specifies the physical interface to configure. Specifies the IMA group interface to configure.
Step 2	Switch(config-if)# **shutdown**	Shuts down the interface prior to configuring overbooking.
Step 3	Switch(config-if)# **atm cac overbooking** *percent*	Configures overbooking on an interface as a percentage of the maximum equivalent bandwidth available on the interface from 100 to 1000. A value of 100 disables overbooking on the interface.
Step 4	Switch(config-if)# **no shutdown**	Reenables the interface

Example

The following example shows how to set the interface overbooking percentage to 300:

```
Switch(config)# interface atm 4/1/0
Switch(config-if)# shutdown
Switch(config-if)# atm cac overbooking 300
Switch(config-if)# no shutdown
```

Displaying the Interface Overbooking Configuration

To display the interface overbooking configuration, use the following user EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*[.*vpt#*]	Displays the interface overbooking configuration.

Example

The following example shows the interface overbooking configuration with FC-PFQ installed:

```
Switch> show atm interface resource atm 4/1/0
Resource Management configuration:
    Service Classes:
        Service Category map: c2 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 15 c2, 2 c3, 2 c4, 2 c5
    CAC Configuration to account for Framing Overhead : Disabled
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
→   overbooking :  300
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: none vbr RX, none vbr TX
        Minimum-cell-rate RX: none abr, none ubr
        Minimum-cell-rate TX: none abr, none ubr
        CDVT RX: none cbr, none vbr, none abr, none ubr
        CDVT TX: none cbr, none vbr, none abr, none ubr
        MBS: none vbr RX, none vbr TX
Resource Management state:
    Available bit rates (in Kbps):
        72959 cbr RX, 72959 cbr TX, 72959 vbr RX, 72959 vbr TX,
        72959 abr RX, 72959 abr TX, 72959 ubr RX, 72959 ubr TX
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
        0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
    Best effort connections: 0 pvcs,  0 svcs
```

Configuring Framing Overhead

The interface framing overhead feature determines whether the MaxCR of a physical interface conforms to the actual physical line rate, including framing overhead. By default, the unframed rate is used for determining the MaxCR.

When framing overhead is considered, the MaxCR is less than the unframed rate and some previously configured connections might not be established. Table 8-11 provides the MaxCR values for the different framing modes, with and without framing overhead configured.

Table 8-11   MaxCR For Different Framing Overhead Configurations

Interface Type	Framing Mode	With Framing Overhead Configured	Without Framing Overhead Configured
OC-3	–	149,759 kbps	155,519 kbps
OC-12	–	599,032 kbps	622,079 kbps
OC-48c[1]	–	2,396,156 kbps	2,488,319 kbps
DS3	M23 ADM	44,209 kbps	44,735 kbps
	M23 PLCP	40,704 kbps	44,735 kbps
	CBIT ADM	44,209 kbps	44,735 kbps
	CBIT PLCP	40,704 kbps	44,735 kbps
E3	G 832 ADM	33,920 kbps	34,367 kbps
	G 751 ADM	34,009 kbps	34,367 kbps
	G 751 PLCP	30,528 kbps	34,367 kbps
E1	CRC4 ADM	1919 kbps	2047 kbps
	CRC4 PLCP	1785 kbps	2047 kbps
	PCM30 ADM	1919 kbps	2047 kbps
	PCM30 PLCP	1785 kbps	2047 kbps
T1	SF ADM	1535 kbps	1543 kbps
	SF PLCP	1413 kbps	1543 kbps
	ESF ADM	1535 kbps	1543 kbps
	ESF PLCP	1413 kbps	1543 kbps

1.   OC-48c is only available on the Catalyst 8540 MSR.

The framing mode changes when you issue the **framing** command on an interface and the MaxCR is adjusted accordingly. If enabling framing overhead reduces the maximum guaranteed service bandwidth supported on a direction of an interface below the current allocation, use the **force** option to ensure that the configuration takes effect.

To configure framing overhead, use the following interface configuration commands:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*slot* Switch(config-if)#	Specifies the physical interface to configure.
Step 2	Switch(config-if)# **atm cac framing overhead** [**force**]	Configures framing overhead on an interface

Example

The following example shows how to enable framing overhead on an interface:

```
Switch(config)# interface atm 4/1/0
Switch(config-if)# atm cac framing overhead
```

Displaying the Framing Overhead Configuration

To display the framing overhead configuration, use the following user EXEC command:

Command	Purpose
show atm interface resource atm *card*/*subcard*/*port*[.*vpt#*]	Displays the interface framing overhead configuration.

Example

The following example shows the framing overhead configuration:

```
Switch> show atm interface resource atm 4/1/0
Resource Management configuration:
    Service Classes:
        Service Category map: c2 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
        Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
        WRR Weight: 15 c2, 2 c3, 2 c4, 2 c5
→   CAC Configuration to account for Framing Overhead : Enabled
    Pacing: disabled   0 Kbps rate configured, 0 Kbps rate installed
    overbooking :  disabled
    Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: none RX,  none TX
        Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
        Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
                       none abr RX, none abr TX, none ubr RX, none ubr TX
    Best effort connection limit: disabled  0 max connections
<information deleted>
```