CHAPTER 9

Configuring Resource Management Functions

Resource Management (RM) involves the modeling and management of switch, interface, and connection resources such as equivalent bandwidth and buffering to support the provision of specified traffic classes.

The LightStream 1010 asynchronous transfer mode (ATM) switch software uses RM to provide the following functions:

- Network Management interface. Includes operational configuration change (changes that take place immediately), proposed configuration change (changes that must take place on restart), user interface, and status.
- User-Network Interface (UNI) 3 default quality of service (QOS) Objective Table management. As UNI 3 signaling does not provide information elements to signal QOS values, RM provides a table containing default values for QOS.
- Connection Traffic Table (CTT) management. Rather than store traffic parameters for each connection in that connection's data structure, RM manages a table of connection traffic parameters, used by network and connection management.
- Hardware resource management. Includes switch cell priority limits, interface queue sizes and thresholds, and output interface pacing.
- Resource Call Admission Control (RCAC). 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.
- Hot-swapped port adapter modules.
- Logical interface creation and deletion.
- Private Network-Network Interface (PNNI) metrics. RM supplies PNNI with link metrics for connection routing.

Resource Management Configuration Tasks

Resource management configuration is separated into the following configuration tasks:

- Configure Global Resource Management Tasks
- Configure Physical Interface Tasks
- Configure Interface Tasks

Configure Global Resource Management Tasks

Global resource management configurations affect all interfaces on the switch.

The following sections describe global resource management tasks:

- Configure the UNI 3 Default QOS Objective Table
- Configure the Switch Oversubscription Factor (OSF)
- Configure Service Category Limits
- Configure Available Bit Rate Congestion Notification Mode
- Sustained Cell Rate Margin Factor

Configure the UNI 3 Default QOS Objective Table

As UNI 3 signaling does not provide Information Elements to signal QOS values, RM provides a table of default objective values for QOS for Guaranteed Service Categories. These values are used as criteria for connection setup requirements. These are either metric values (accumulated over multiple-hops of a call) or attributes (a gating criterion not accumulated, but checked at each interface). Maximum Cell Transfer Delay and Peak-to-Peak Cell Delay Variation are metrics, while Cell Loss Ratio is an attribute.

Table 9-1 provides default values of the UNI 3 QOS objective table.

Table 9-1 UNI 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)
cbr	Undefined	Undefined	Undefined
vbr-rt	Undefined	Undefined	Undefined
vbr-nrt	—	—	Undefined

Each of the objectives can have a defined or undefined value. If undefined, then that objective is not considered in connection setup.

This table should be configured with the same values for an entire network.

To configure the UNI 3 default QOS objective table, perform the following task in global configuration mode:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure the ATM QOS default CBR[2] or VBR-RT[3] maximum-cell transfer delay.	**atm qos uni3-default** {*cbr* | *vbr-rt*} **max-cell-transfer-delay** {*microseconds* | **any**}
Configure the ATM QOS default CBR or VBR-RT peak-to-peak cell-delay variation.	**atm qos uni3-default** {*cbr* | *vbr-rt*} **peak-to-peak-cell-delay-variation** {microseconds | **any**}
Configure the ATM QOS default CBR, VBR-RT, or VBR-NRT maximum cell-loss ratio.	**atm qos uni3-default** {*cbr* | *vbr-rt* | *vbr-nrt*} **max-cell-loss-ratio** {*loss-ratio* | **any**}
Reset the ATM QOS defaults for CBR, VBR-RT, or VBR-NRT[4] .	**no atm uni3-default-qos-table-row** {*cbr* | *vbr-rt* | *vbr-nrt*}

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.
2. CBR = constant bit rate
3. VBR-RT = variable bit rate-real time
4. VBR-NRT = variable bit rate-nonrealtime

Example

The following example changes the maximum cell loss ratio objective for CBR to 10^{-12} cells-per-second:

```
Switch(config)#atm qos uni3-default cbr max-cell-loss-ratio 12
Switch(config)#
```

Display the ATM QOS Objective Table

Use the **show atm** qos command to display the UNI 3 Default QOS objective table. In particular, the service category (cbr, vbr-rt or vbr-nrt), maximum Cell Transfer Delay (CTD), peak-to-peak Cell Delay Variation and maximum Cell Loss Ratio objectives are displayed.

To display the ATM QOS objective table configuration, perform the following task in user EXEC mode:

Task	Command
Display the ATM QOS objective table configuration.	**show atm qos**

Example

The following example displays the ATM QOS objective table configuration:

```
Switch> show atm qos
UNI 3 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:  10**(-12) cbr, any vbr-rt, any vbr-nrt
Switch>
```

Configure the Switch Oversubscription Factor (OSF)

The switch oversubscription factor (OSF) is used in determining initial port maximum queue sizing for VBR-NRT and ABR/unspecified bit rate (UBR) queues.

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

The sizing of the VBR-NRT and ABR-UBR queues are determined by the following equations where the default size of the CBR and VBR queues vary by interface type:

```
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 9-2 Default CBR and VBR Determined by Interface Type

Interface type	Default Max Size CBR[1] queue	Default Max Size type VBR-RT[2] queue
SONET	256	256
DS3/E3	256	512

1. CBR = constant bit rate
2. VBR = variable bit rate-real-time

To configure the OSF, perform the following task in global configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure the switch over-subscription factor from 1-32.	**atm over-subscription-factor** *o-value*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Example

The following example sets the switch over subscription factor to 16:

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

Display the Resource Management Configuration

Use the **show atm resource** command to display the OSF configuration.

To display the OSF configuration, perform the following task in user EXEC mode:

Task	Command
Display the oversubscription factor configuration.	**show atm resource**

Example

The following example displays the switch oversubscription factor 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):
         65535 cbr 65535 vbr-rt 65535 vbr-nrt 65535 abr-ubr
Resource state:
    Cells per service-category:
         0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr
Switch>
```

Configure Service Category Limits

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

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, perform the following task in global configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure ATM service-category limits for a specific output queue.	**atm service-category-limit** {*cbr* | *vbr-rt* | *vbr-nrt* | a*br-ubr*} *l-value*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects all connections, including those already established.

Example

The following example changes the service-category limit for the CBR cells within the switch fabric to 3000 cells:

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

Display the Resource Management Configuration

Use the **show atm resource** command to display the service-category limits configuration.

To display the service-category limits configuration, perform the following task in user EXEC mode:

Task	Command
Display the service-category limits configuration.	**show atm resource**

Example

The following example displays 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 65535 vbr-rt 65535 vbr-nrt 65535 abr-ubr
Resource state:
    Cells per service-category:
         0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr

Switch>
```

Configure Available Bit Rate Congestion Notification Mode

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 or 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, perform the following task in global configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure ABR congestion notification mode.	**atm abr-mode** {*efci* | *relative-rate* | *all*}

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects all connections, including those already established.

Example

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

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

Display the Resource Management Configuration

Use the **show atm resource** command to display the ABR congestion notification mode configuration.

To display the ABR congestion notification mode configuration, perform the following task in user EXEC mode:

Task	Command
Display the ABR congestion notification mode configuration.	**show atm resource**

Example

The following example displays the ABR mode configuration:

```
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 65535 vbr-rt 65535 vbr-nrt 65535 abr-ubr
Resource state:
    Cells per service-category:
         0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr

Switch>
```

Configure 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.

PVC Connection Traffic Rows

The function of the CTT in PVC setup requires storing PVC traffic values in a CTT data structure. Rows used for permanent virtual channels (PVCs) called stable rows, contain traffic parameters and are larger than rows used for switched virtual channel (SVCs).

SVC Connection Traffic Rows

The function of the CTT in 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. Rows used for SVCs, called transient rows, are smaller than PVC rows.

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

To make CTT management software more efficient, the CTT row-index space is split into those allocated as a result of signaling and those allocated from the command line interface and SNMP. Table 9-3 describes the row-index range for both.

Table 9-3 CTT Row-index Allocation

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

Table 9-4 describes the six well-known predefined rows.

Table 9-4 Default Connection-Traffic-Table Rows

CTT Row index	Service Category	peak-cell-rate (clp01)	Sustained-cell -rate(clp01)	Tolerance	Use
1	ubr	0	—	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	ABR Tunnel WK VCs
6	ubr	424 Kbps	—	none	UBR Tunnel WK VCs

There are five variations of the **atm connection-traffic-table-row** command—one for each service category (CBR, VBR-RT, VBR-NRT, ABR and UBR). To create or delete a CTT row, perform the following task in global configuration mode using the **no** form of this commands to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure an ATM CTT variable bit rate row.	**atm connection-traffic-table-row** [**index** *row-index*] {*vbr-rt* | *vbr-nrt*} **peak-cell-rate** *rate* **sustained-cell-rate** *rate* [**tolerance** *cell-count*]
Configure an ATM CTT CBR constant bit rate row.	**atm connection-traffic-table-row** [**index** *row-index*] **cbr peak-cell-rate** *rate* [**tolerance** *cell-count*]
Configure an ATM CTT available bit rate row.	**atm connection-traffic-table-row** [**index** *row-index*] **abr peak-cell-rate** *rate* [**tolerance** *cell-count*]
Configure an ATM CTT unspecified bit rate row.	**atm connection-traffic-table-row** [**index** *row-index*] **ubr** [**peak-cell-rate** *rate* [**tolerance** *cell-count*]]

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects all connections, including those already established.

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

Example

The following example configures an ATM CTT row with an ABR peak-cell-rate of 30000 kilobits per second:

```
Switch#(config)#atm connection-traffic-table-row abr peak-cell-rate 30000
 Allocated index = 64000
Switch#(config)#
```

Display the ATM Connection Traffic Table

Use the **show atm connection-traffic-table** command to display the CTT configuration.

To display the CTT configuration, perform the following task in user EXEC mode:

Task	Command
Display the CTT configuration.	s**how atm connection-traffic-table** [**row** *row-index* | **from-row** *row-index*]

Example

The following example displays the CTT configuration table:

```
Switch> show atm connection-traffic-table
Row      Service-category  peak-cell-rate  sustained-cell-rate  tolerance
1              ubr                 0                                none
2              cbr               424                                none
3              vbr-rt            424              424                50
4              vbr-nrt           424              424                50
5              abr               424                                none
6              ubr               424                                none
64000          abr             30000                                none
Switch>
```

Sustained Cell Rate Margin Factor

SCRMF 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 sustained cell rate for the LightStream 1010, perform the following task in global configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Configure the sustained cell rate margin factor.	**atm sustained-cell-rate-margin-factor** *s-value*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects subsequent connections but not connections already established.

Example

The following example configures the sustained cell-rate margin factor as 85 percent of maximum:

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

Display the Resource Management Configuration

Use the **show atm resource** command to display the sustainable cell-rate margin factor mode configuration.

To display the sustainable cell-rate margin factor configuration, perform the following task in user EXEC mode:

Task	Command
Display the sustainable cell-rate margin factor configuration.	**show atm resource**

Note This command affects subsequent connections but not connections already established.

Example

The following example displays the sustainable cell-rate margin factor configuration:

```
Switch> show atm resource
Resource configuration:
    Over-subscription-factor 16  Sustained-cell-rate-margin-factor 85%
    Abr-mode:   relative-rate
    Atm service-category-limit (in cells):
         65535 cbr 65535 vbr-rt 65535 vbr-nrt 65535 abr-ubr
Resource state:
    Cells per service-category:
         0 cbr 0 vbr-rt 0 vbr-nrt 0 abr-ubr

Switch>
```

Configure Physical Interface Tasks

Physical interface resource management configurations affect only specific interfaces on the switch.

The following sections describe physical interface configuration resource management tasks:

- Configure Interface Maximum Queue Size
- Configure Interface Queue Thresholds per Service Category
- Configure Interface Output Pacing
- Configure Controlled Link Sharing

Configure Interface Maximum Queue Size

Maximum Queue Size is used to determine the following:

- Maximum number of cells in the switch fabric queue
- CTD
- Peak-to-peak Cell Delay Variation (CDV) provided on an output switch interface

Note Not all values of queue size are supported by the switch fabric, so 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 task in interface configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port*
Configure the ATM output queue maximum size.	**atm output-queue** [**force**] {**cbr** | **vbr-rt** | **vbr-nrt** | **abr-ubr**} **max-size**- *size-number*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects all connections, including those already established.

This command is not applicable on subinterface level configuration.

If the interface status is up, then 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 of the implicit change in guaranteed maximum CTD and Peak-to-peak CDV is not considered before making the change. Subsequent setup of SVC connections will be affected.

The *size-number* argument is the queue-size in cells 32 to 65,504. The number is rounded up to the closest multiple of 32.

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

Example

The following example configures 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
Switch(config-if)#
```

Display the Output Queue Maximum Configuration

Use the **show atm interface rm atm** command to display the output queue maximum size configuration.

To display the output queue maximum size configuration, perform the following task in user EXEC mode:

Task	Command
Display the output queue maximum size configuration.	**show atm interface rm atm** *card/sub_card/port*

Example

The following example displays the interface output queue maximum size configuration:

```
Switch>show atm interface rm 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: 50% cbr, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    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
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,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 0 pvcs,  0 svcs
Switch>
```

Configure Interface Queue Thresholds per Service Category

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 explicit forward congestion control indicator (EFCI) threshold
- Output queue cell loss priority (CLP) and packet discard (PD) threshold
- ABR relative rate threshold

These queue thresholds can be changed at any time. The result is to change 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 EFCI threshold.

To configure the output threshold, perform the following task in interface configuration mode using the **no** form of these commands to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port*
Configure the ATM output discard threshold.	**atm output-threshold {cbr | vbr-rt | vbr-nrt | abr | ubr} discard-threshold** *disc-thresh-num*
Configure the ATM output threshold.	**atm output-threshold** {**cbr** | **vbr-rt** | **vbr-nrt** | **abr** | **ubr**} **efci-threshold** *efci-thresh-number*
Configure the ATM output threshold ABR.	**atm output-threshold abr relative-rate** *abr-thresh-number*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects all connections, including those already established.

These commands are not applicable on subinterface level configuration.

The *disc-thresh-number* and *abr-thresh-number* arguments are 12, 25, 37, 50, 62, 75, 87, or 100 indicating the percentage of queue-full. The *efci-thresh-number* argument is 12, 25, 50, or 100, indicating the percentage of queue-full.

The associated threshold function can be disabled by setting the threshold to 100 percent.

Default:

For all service categories, discard-threshold is 50 percent, efci-threshold is 25 percent, and abr-relative-rate is 25 percent.

Examples

The following example configures 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
Switch(config-if)#
```

The following example configures the interface output discard threshold for CBR explicit forward congestion-control indicator threshold to 50 percent of maximum size:

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

Display the Output Threshold Maximum Configuration

Use the **show atm interface rm atm** command to display the output threshold maximum size configuration.

To display the output threshold maximum size configuration, perform the following task in user EXEC mode:

Task	Command
Display the output threshold maximum size configuration.	**show atm interface rm atm** *card/sub_card/port*

Example

The following example displays the interface output threshold maximum size configuration:

```
Switch>show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    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
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,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 0 pvcs,  0 svcs
Switch>
```

Configure Interface Output Pacing

Output pacing is used to artificially reduce the output speed of an interface in kilobits per second (kbps).

Output pacing can be changed at any time or enabled or disabled. When an output pacing change request is made, resource management will determine whether the change would result in not providing the guaranteed bandwidth at the outbound port for existing virtual channels/virtual paths (VC/VPs). Guaranteed bandwidth is reserved for CBR and VBR connections.

To enable or change an interface output pacing rate, perform the following task in interface configuration mode using the **no** form of these commands to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port*
Configure the interface output pacing.	**atm pacing** *kbps* [**force**]

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

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 transmit flow of the interface.

Note This command affects all connections, including those already established.

The granularity of pacing rate is determined by the physical interface and varies with the size of the bit rate requested. The value entered is rounded-up to the closest value available.

This command does not apply to the CPU interface (2/0/0) or subinterfaces.

Example

The following example configures the interface output pacing to 10,000 kbps:

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

Display the Output Pacing Configuration

Use the **show atm interface rm** command to display the output pacing configuration.

To display the output pacing configuration, perform the following task in user EXEC mode:

Task	Command
Display the output pacing configuration.	**show atm interface rm atm** *card/sub_card/port*

Example

The following example displays the interface output pacing configuration:

```
Switch> show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: enabled   10000 Kbps rate configured, 10000 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
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        147743 cbr RX, 9499 cbr TX, 147743 vbr RX, 9499 vbr TX,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 0 pvcs,  0 svcs
Switch>
```

Configure Controlled Link Sharing

Resource management allows fine tuning 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. This limits the guaranteed bandwidth which 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.

These minimum and maximum parameters are related using the values in Table 9-5.

Table 9-5 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 task in interface configuration mode using the **no** form of these commands to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port* [*.vpt #*]
Configure controlled link sharing for the maximum guaranteed service bandwidth.	**atm cac link-sharing max-guaranteed-service-bandwidth** {**receive** | **transmit**} *percent*
Configure controlled link sharing for the maximum guaranteed service bandwidth by service category.	**atm cac link-sharing max-bandwidth** {**cbr** | **vbr**} {**receive** | **transmit**} *percent*
Configure controlled link sharing for the minimum guaranteed service bandwidth by service category.	**atm cac link-sharing min-bandwidth** {**cbr** | **vbr**} {**receive** | **transmit**} *percent*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects subsequent connections but not connections already established.

Example

The following example configures 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
Switch(config-if)#
```

Display the Controlled Link Sharing Configuration

Use the **show atm interface rm** command to display the controlled link sharing configuration.

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

Task	Command
Display the controlled link sharing configuration.	**show atm interface rm atm** *card/sub_card/port*

Example

The following example displays the controlled link sharing configuration:

```
Switch> show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: enabled   10000 Kbps rate configured, 10000 Kbps rate installed
    Link Distance: 0 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: 87% 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
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        135302 cbr RX, 9499 cbr TX, 135302 vbr RX, 9499 vbr TX,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 0 pvcs,  0 svcs
Switch>
```

Configure Interface Tasks

The following sections describe interface configuration resource management tasks:

- Configure Outbound Link Distance
- Configure the Limitations of Best-Effort Connections
- Configure Interface Maximum of Individual Traffic Parameters

Configure Outbound Link Distance

Specifying the physical link distance for the for the next ATM hop in the outbound direction allows the user to increase the propagation-delay component of delay. Propagation delay is used in determining the Connection admission Control (CAC) maximum cell transfer delay provided on the output by a switch interface, which can affect the SVC connection requests accepted.

To configure the ATM link distance, perform the following task in subinterface configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port* [*.vpt #*]
Configure the subinterface link distance.	**atm link-distance** *kilometers*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects subsequent connections but not connections already established.

Example

The following example configures the interface link distance configuration to 150 kilometers:

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

Display the Interface Link Distance Configuration

Use the **show atm interface rm** command to display the interface link distance configuration.

To display the interface link distance configuration, perform the following task in user EXEC mode:

Task	Command
Display the interface link distance configuration.	**show atm interface rm atm** *card/sub_card/port* [*.vpt #*]

Example

The following example displays the interface link distance configuration:

```
Switch> show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: enabled   10000 Kbps rate configured, 10000 Kbps rate installed
    Link Distance: 150 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: 87% 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
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        135302 cbr RX, 9499 cbr TX, 135302 vbr RX, 9499 vbr TX,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 0 pvcs,  0 svcs
Switch>
```

Configure the Limitations of Best-Effort Connections

Each interface may be configured to allow a specific number of best-effort (ABR and UBR) connections.

To configure the number of best-effort connections, perform the following task in subinterface configuration mode using the **no** form of this command to assign the default value.

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port* [*.vpt #*]
Configure the connection best-effort limit.	**atm cac best-effort-limit** *conn-value*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects subsequent connections but not connections already established.

Example

The following example configures the connection best-effort limit configuration to 2000:

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

Display the Interface Best-Effort Limit Configuration

Use the **show atm interface rm** command to display the subinterface best-effort configuration.

To display the interface best effort configuration, perform the following task in user EXEC mode:

Task	Command
Display the subinterface best-effort configuration.	**show atm interface rm atm** *card/sub_card/port* [*.vpt #*]

Example

The following example displays the subinterface best-effort configuration:

```
Switch> show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: enabled   10000 Kbps rate configured, 10000 Kbps rate installed
    Link Distance: 150 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: 87% 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: 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,
        Tolerance RX: none cbr, none vbr, none abr, none ubr
        Tolerance TX: none cbr, none vbr, none abr, none ubr
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        135302 cbr RX, 9499 cbr TX, 135302 vbr RX, 9499 vbr TX,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 1 pvcs,  0 svcs
Switch>
```

Configure Interface Maximum of Individual Traffic Parameters

At the time a virtual circuit connection is set up, per-flow (receive and transmit traffic) parameters can be specified. Traffic parameter limits may be configured independently by service category and traffic direction for the following:

- Maximum peak cell rate
- Maximum sustained cell rate
- Maximum tolerance

To configure the traffic parameters, perform the following task in interface configuration mode using the **no** form of this command to assign the default value:

Task	Command
At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure**[1] [**terminal**]
Select the interface to be configured.	**interface atm** *card/sub_card/port* [*.vpt #*]
Configure the connection maximum peak cell rate.	**atm cac max-peak-cell-rate** {**cbr** | **vbr** | **abr** | **ubr**} {**receive** | **transmit**} *rate*
Configure the connection sustained cell rate.	**atm cac max-sustained-cell-rate** {**receive** | **transmit**} *rate*
Configure the connection maximum tolerance.	**atm cac max-tolerance** {**cbr** | **vbr** | **abr** | **ubr**} {**receive** | **transmit**} *cell-count*

1. These commands are documented in the *LightStream 1010 ATM Switch Command Reference* publication.

Note This command affects subsequent connections but not connections already established.

Examples

The following example configures interface 3/0/0 connection's maximum peak cell rate specified in receive mode on the interface for CBR connections to 100,000 kbps:

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

The following example configures interface 3/0/0 connection's maximum sustained cell rate, receive, to 60,000 kbps:

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

The following example configures interface 3/0/0 connection's maximum tolerance, receive, constant bit rate to 75,000 kbps:

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

Display the Interface Individual Traffic Configuration

Use the **show atm interface rm** command to display the interface individual traffic configuration.

To display the interface individual traffic configuration, perform the following task in user EXEC mode:

Task	Command
Display the controlled link sharing configuration.	**show atm interface rm**

Example

The following example displays the interface output pacing configuration:

```
Switch> show atm interface rm 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, 50% vbr-rt, 50% vbr-nrt, 50% abr, 50% ubr
        Abr-relative-rate threshold: 25% abr
    Pacing: enabled   10000 Kbps rate configured, 10000 Kbps rate installed
    Link Distance: 150 kilometers
    Controlled Link sharing:
        Max aggregate guaranteed services: 87% 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: enabled  2000 max connections
    Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
        Peak-cell-rate RX: 100000 cbr, none vbr, none abr, none ubr
        Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
        Sustained-cell-rate: 60000 vbr RX, none vbr TX,
        Tolerance RX: 75000 cbr, none vbr, none abr, none ubr
        Tolerance TX: none cbr, none vbr, none abr, none ubr
Resource Management state:
    Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
    Available bit rates (in Kbps):
        135302 cbr RX, 9499 cbr TX, 135302 vbr RX, 9499 vbr TX,
    Allocated bit rates:
        0 cbr RX, 0 cbr TX, 0 vbr RX, 0 vbr TX,
    Best effort connections: 1 pvcs,  0 svcs
Switch>
```