# 43 Advanced CSM Management

This chapter covers the following advanced software features for CSMs:

### *Configuring and Monitoring Soft PVCs*

Soft PVCs, like PVCs but unlike SVCs, must be configured by the user. Soft PVCs differ from PVCs because they do not use static routes. If a link fails, a Soft PVC will reroute its path and will not go down.

This chapter describes User Interface (UI) commands for Soft PVCs. The **scvc** command, which is described in *Creating a Soft PVC* on page 43-3, is used to configure Soft PVCs. The **svvc** command, which is described in *Viewing Soft PVCs* on page 43-17, is used to display Soft PVC parameters.

### *Configuring and Monitoring Virtual Path (VP) Tunneling*

You can create multiple UNI or NNI instances on a CSM physical port through the use of virtual path (VP) tunneling (see *Virtual UNI/NNI Using Virtual Path (VP) Tunneling* on page 43-20). VP tunneling can be used in many applications, including extending a Private Network-to-Network Interface (PNNI) network over a public ATM network.

UI commands to create, modify, display, and delete VP tunnels are described in this chapter. The **cvpt** command, which is described in *Creating a VP Tunnel* on page 43-22, is used to create a VP tunnel. The **lvpt** command, which is used to display VP tunnel parameters, is described in *Displaying VP Tunnel Information* on page 43-24. The **mvpt** command, which is used to modify VP tunnel parameters, is described in *Modifying a VP Tunnel* on page 43-29. And the **dvpt** command, which is described in *Deleting a VP Tunnel* on page 43-29, is used to delete a VP tunnel.

### *Configuring a LECS ATM Address*

The **masrt** command, which is used to configure a LANE Configuration Server (LECS) ATM address, is described in *Configuring a LECS ATM Address* on page 43-30.

### *Viewing ATM Layer Statistics*

The **vls** command, which is described in *Viewing ATM Layer Statistics* on page 43-33, is used to display ATM layer statistics tables for CSM and ATM access ports. And the **vlrs** command, which is described in *Viewing ATM Layer Receive Error Statistics* on page 43-35, is used to display ATM layer receive error statistics for CSM and ATM access ports.

### *Viewing ATM Connection Statistics*

The **vcs** command, which is described in *Viewing ATM Connection Statistics Table* on page 43-40, is used to display ATM connection statistics for CSM and ATM access ports. And the **vcrs** command, which is described in *Viewing Connection Receive Error Statistics* on page 43-45, is used to display ATM receive connection statistics for CSM and ATM access ports.

### *Intelligent Multicast Replication*

An overview of intelligent multicast replication is provided in *Intelligent Multicast Replication* on page 43-47. Descriptions of UI commands to enable, disable, display performance gain, and to display the intelligent multicast replication tree begin on page 43-50.

**♦ Note ♦**

For basic UI commands to configure CSM ports and to create and modify PVCs, see Chapter 42, "Managing Cell Switching Modules (CSMs)."

# Soft PVCs

The OmniSwitch supports "soft PVCs." Soft PVCs must be configured like standard PVCs, but they are brought up on-the-fly and use PNNI signaling like SVCs. Configuration data for soft PVCs is stored in flash memory; if the OmniSwitch is restarted, data for the soft PVCs still exists.

## Creating a Soft PVC

The **scvc** command allows you to create a soft PVC for a physical port and logical VPI or VPI/VCI that you specify. The **scvc** command contains several suboptions for configuring multi-cast virtual circuits and traffic contract parameters. Many of the options in the **scvc** command are the same as those used in the **cvc** command. For example, traffic parameters, priority, and statistics control are configured the same in both commands. The central difference between configuring a PVC and a soft PVC is that a soft PVC requires destination port information.

To begin setting up a soft PVC, enter **scvc** followed by the slot number, a slash (/), and the port number where you want to set up the soft PVC. After the slot and port number, leave a space, then specify the Virtual Path Identifier (VPI), a slash (/), and then the Virtual Channel Identifier (VCI). (You do not have to include the VCI if you are setting up a Virtual Path only.) For example, the following command specifies a soft PVC with a VCI of 200, and VPI of 1 on the first port on the module in slot 5:

```
scvc 5/1 1/200
```

Note that these values indicate the *input* port and *input* VPI/VCI for the soft PVC on this OmniSwitch. Output parameters are specified later through **scvc** screen options.

The following message displays for a moment

```
creating csm connection, please wait .....
```

This initial message will be followed by a screen of options similar to the following:

```
Slot 5 Port 1 Connection VPI 1 VCI 200 Configuration

    Available bandwidth: Tx=353209 Rx=353209

1)  Description (30 chars max          : Connection 200
2)  End point Id (1..65535)            : 1
3)  Terminating ATM Address            : 000000000000000000000000000000000000000000
4)  Other End VPI (0..4095)            : 1
5)  Other End VCI (0..65535)           : 1
6)  Channel Type { vc-nni(3), vc-uni(4) }                    : VC-UNI
7)  Transport Priority {CBR(1), CBR_PRS(2), VBR_RT(3),       : UBR
                        VBR_NRT(4), ABR(5), UBR(6) }
8)  Point to Multipoint { disable(0), enable(1)}             :disabled
9)  Channel Redirect { not allowed(0), allowed(1) }          : not allowed
10) AAL5 Discard Continue { disable(0), enable(1) }          : enable

11) Traffic Parameters
13) Advanced Parameters
14) Target Selector Type {required(1), any(2) }              : required
15) SoftPvc Retry parameters
16) Broadband Bearer Capability Parameters

Enter (option=value/save/cancel) :
```

You make changes by entering the line number for the option you want to change, an equal sign (=), and then the value for the new parameter. When you are done entering all new values, type **save** at the colon prompt (:) and all new parameters will be saved. The following sections describe the options you can alter through this menu.

### Description

A textual description of this virtual circuit. You can use up to 30 characters to describe a virtual circuit. For example, if this soft PVC will be used primarily to carry traffic for multimedia workstations, you may want to describe the circuit as "Multimedia VC."

### End point Id

An identification number used to keep track of the endpoints within a single soft PVC. This number is used for identification purposes only and does not affect VPI/VCI numbering.

### Terminating ATM Address

The ATM address of the output port of the ATM switch at the other end of this soft PVC.

### Other End VPI

The Virtual Path Identifier (VPI) used for this circuit on the ATM switch at the other end of this soft PVC connection. This VPI is not the same one you specified in the **scvc** command line; the VPI specified in the **scvc** command line is the input VPI used on this OmniSwitch. The **Other End VPI** is the VPI used at the destination end of this soft PVC. This field will not display if the **Target Selector Type** field is set to **Any**.

### Other End VCI

The Virtual Channel Identifier (VCI) used for this circuit on the ATM switch at the other end of this soft PVC connection. This VCI is not the same one you specified in the **scvc** command line. The VCI specified in the **scvc** command line is the input VCI used on this OmniSwitch. The **Other End VCI** is the VCI used at the destination end of this soft PVC. This field will not display if you are not setting up a Virtual Channel Connection (VCC) or if the **Target Selector Type** field is set to **Any**.

### Channel Type

The type of connection supported by this channel. Normally, this circuit will connect to a user device, such as an ATM workstation, or to another network switch, such as an OmniSwitch. When connected directly to a user device, this connection would be considered a UNI connection (option 4). When connected to another ATM switch, this connection would be considered an NNI connection (option 3).

### Transport Priority

Indicates the type of traffic and its priority on this connection. Some traffic types require higher priority than others because any disruption in the connection will cause unacceptable results. For example, a circuit emulating a private digital line requires a continuous flow of traffic. Circuit emulation requires Continuous Bit Rate (CBR) transport and is given a higher priority than other less sensitive traffic. On the other hand, data connections can tolerate some delay in the connection. Data traffic usually requires Available Bit Rate (ABR) transport.

When you set this option, the Class of Service and priority level of the circuit are automatically selected in **scvc** submenus. The following options are available:

| | |
|---|---|
| **CBR** | Continuous Bit Rate |
| **CBR_PRS** | Continuous Bit Rate with Primary Reference Source |
| **VBR_RT** | Variable Bit Rate, Real Time |

| | |
|---|---|
| **VBR_NRT** | Variable Bit Rate, Non-Real Time |
| **ABR** | Available Bit Rate |
| **UBR** | Unspecified Bit Rate |

Screen numbering for **Transport Priority** indicates the priority level of traffic except in the case of the two CBR traffic types: CBR_PRS (option 2) is given a higher priority than standard CBR traffic (option 1).

### Point to Multipoint

Enables multicast, or point-to-multipoint, soft PVCs on this primary virtual circuit. If you enable multicast support, you will receive additional prompts to indicate additional information for the multicast virtual circuits. Multicast virtual circuits are leaves of the primary, or root, virtual circuit. In addition, multicast virtual circuits inherit QoS and traffic parameters from the root virtual circuit. See Chapter 42, "Managing Cell Switching Modules (CSMs)," for more information on multicast circuits. The steps for setting up individual point-to-multipoint virtual circuits for soft PVCs are described later in *Configuring Point-to-Multipoint Soft PVCs* on page 43-12.

### Channel Redirect

Indicates whether data in this channel will be redirected to another channel if this channel goes down.

### AAL5 Discard Continue

Indicates whether or not to discard AAL5 PDU cells during times of congestion. Enabling AAL5 Discard, which enables "Partial Packet Discard," increases overall frame throughput for AAL5 traffic during times of congestion. The default for this value is disabled.

### Traffic Parameters

This option enters a screen of suboptions for configuring traffic descriptors and Quality of Service parameters. This screen and its options are described later in *Configuring Traffic Parameters* on page 43-6.

### Advanced Parameters

This option enters a screen of suboptions for configuring the priority level for this circuit and for controlling statistics output. This screen and its options are described later in *Configuring Statistics and Priority Parameters* on page 43-11.

### Target Selector Type

Indicates whether you want the destination ATM switch to choose the VPI and VPI/VCI values or if you want to specify these values manually. **Required** means that you must specify **Other End VPI** and/or **Other End VCI** values. **Any** means the destination switch will select the VPI and VPI/VCI values; when **Any** is selected, the **Other End VPI** and **Other End VCI** fields will not display.

### SoftPvc Retry parameters

This option displays a screen of sub-options for soft PVC retry parameters, such as Retry Interval and Retry Threshold. This screen and its options are described later in *Configuring Soft PVC Retry Parameters* on page 43-15.

### Broadband Bearer Capability Parameters

This option displays a screen of suboptions for additional soft PVCs parameters. This screen's options are described in *Configuring Broadband Bearer Capability Parameters* on page 43-15.

## Configuring Traffic Parameters

The **scvc** command contains a sub-option for configuring traffic parameters, such as traffic descriptors and Quality of Service (QoS) parameters. Option 11 on the main **scvc** screen provides the link to this submenu. Enter **11** at the **Enter** prompt at the bottom of the main s**cvc** screen and you will see the following screen of sub-options:

```
Slot 5 Port 1 Connection VPI 2 VCI 200 Configuration

     Available bandwidth: Tx=353210 Rx=353210


1)  Requested Tx QoS Class { Unspecified(0),              : Class 3
       Class1(1), Class2(2), Class3(3), Class4(4)}
2)  Requested TX Best Effort { False (1), True (2) }      : False
3)  Requested Tx Traffic Descriptor Type { None(1),       : CLP Tag SCR
       NoCLPNoSCR(2), CLPNoTagNoSCR(3), CLPTagNoSCR(4),
       NoCLPSCR(5), CLPNoTagSCR(6), CLPTagSCR(7) }
     20)  Peak Cell Rate (cells/sec) for CLP=0+1          : 3
     21)  Sustaining Cell Rate (cells/sec) for CLP=0      : 2
     22)  Maximum Burst Rate (cells) for CLP=0            : 1

4)  Requested Rx QoS Class                               : Class 3
5)  Requested RX Best Effort { False (1), True (2) }     : False
6)  Requested Rx Traffic Descriptor Type                 : CLP Tag SCR
     30)  Peak Cell Rate (cells/sec) for CLP=0+1          : 3
     31)  Sustaining Cell Rate (cells/sec) for CLP=0      : 2
     32)  Maximum Burst Rate (cells) for CLP=0            : 1

7)   Bi-directional Traffic Params { Off (1), On (2) }    : On


Enter (option=value/save/cancel) :
```

The following sections describe the options on this screen.

### 1) Requested Tx QoS Class

The Quality of Service (QoS) for cells transmitted (from source to destination) on this VPI or VPI/VCI. The QoS can be Unspecified (**0**), Class 1 (**1**), Class 2 (**2**), Class 3 (**3**), or Class 4 (**4**). Each of these five classes is described in Chapter 42, "Managing Cell Switch Modules (CSMs)," and they are listed below. The QoS Class that you select affects the priority of this Virtual Circuit and the Generic Cell Rate Algorithm (GCRA) used to police traffic. See Chapter 42, "Managing Cell Switch Modules (CSMs)," for more information on the interaction of QoS and GCRAs.

| | |
|---|---|
| **Unspecified** | Best Effort for data traffic (UBR) |
| **Class 1** | Circuit Emulation, Constant Bit Rate Traffic (CBR) |
| **Class 2** | Variable Bit Rate for Real Time Audio and Video Traffic (rt-VBR) |
| **Class 3** | VBR for Connection-Oriented Protocols Such as Frame Relay (nrt-VBR) |
| **Class 4** | Available Bit Rate for Connectionless Data Protocols Such as IP (ABR) |

### 2) Requested Tx Best Effort

Indicates whether to use the Peak Cell Rate (PCR) setting—specified later in this procedure—to determine the amount of bandwidth allocated or to use all available bandwidth. Setting this field to **True** specifies this circuit to use all available bandwidth. Setting this field to **False** specifies the circuit to use the PCR to determine the amount of bandwidth; if bandwidth is not available to support the PCR then this connection will be disabled.

### 3) Requested Tx Traffic Descriptor Type

The traffic descriptor bundle to be used with this Class of Service. The traffic descriptor bundle you choose here determines which traffic parameters you will specify. The traffic parameters will include the Peak Cell Rate (PCR) and may also include the Sustained Cell Rate (SCR) and Maximum Burst Size (MBS). Each traffic descriptor bundle available is described in Chapter 42, "Managing Cell Switch Modules (CSMs)."

The traffic descriptor along with the Class of Service you choose determines the Generic Cell Rate Algorithm (GCRA), or "leaky bucket," that will be used to police this connection. See Chapter 42, "Managing Cell Switch Modules (CSMs)," for more information on the relationship between Class of Service, traffic descriptors, and GCRA. The following traffic descriptor bundles and prompts are available:

**None** No traffic enforcement imposed. No prompts for any traffic parameters.

**NoCLPNoSCR** Prompts for the Peak Cell Rate (PCR). Option 20 will display as follows:

```
3) Requested Tx Traffic Descriptor Type { None (1),          : NoCLP NoSCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
 20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 traffic. Both the minimum and default setting for PCR is 3 cells per second.

**CLPNoTagNoSCR** Prompts for the Peak Cell Rate (PCR). Options 20 and 21 will display as follows:

```
3) Requested Tx Traffic Descriptor Type { None (1),          : CLP NoTag NoSCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
 20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
 21) Peak Cell Rate (cells/sec) for CLP=0            : 3
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 (CLP=0+1) traffic and separately on CLP=0 traffic. The default setting for PCR on CLP=0+1 traffic is 3 cells per second. The default setting for PCR on CLP=0 traffic is 3 cells per second.

**CLPTagNoSCR** Prompts for the Peak Cell Rate (PCR). Options 20 and 21 will display as follows:

```
3) Requested Tx Traffic Descriptor Type { None (1),          : CLP_Tag_NoSCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
 20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
 21) Peak Cell Rate (cells/sec) for CLP=0            : 3
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 (CLP=0+1) traffic and separately on CLP=0 traffic. The default setting for PCR on CLP=0+1 traffic is 3 cells per second. The default setting for PCR on CLP=0 traffic is 3 cells per second.

**NoCLPSCR** Prompts for the Peak Cell Rate (PCR), Sustained Cell Rate (SCR), and Maximum Burst Size (MBS). Options 20, 21, and 22 displays as follows:

```
3) Requested Tx Traffic Descriptor Type { None (1),          : NoCLP SCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
  20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
  21) Sustaining Cell Rate (cells/sec) for CLP+0+1    : 2
  22) Maximum Burst Size                              : 1
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 (CLP=0+1) traffic. The default setting for PCR is 3 cells per second. The SCR will be checked on the aggregate of CLP=0 and CLP=1 traffic. Both the minimum value and the default setting for SCR is 2 cells per second. SCR must be less than PCR. The MBS will be checked on the aggregate of CLP=0+1 traffic. The MBS default setting is 1 cell.

**CLPNoTagSCR** Prompts for the Peak Cell Rate (PCR), Sustained Cell Rate (SCR), and Maximum Burst Size (MBS). Options 20, 21, and 22 will display as follows:

```
3) Requested Tx Traffic Descriptor Type { None (1),          : CLP NoTag SCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
  20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
  21) Sustaining Cell Rate (cells/sec) for CLP=0      : 2
  22) Maximum Burst Size (cells) for CLP=0            : 1
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 (CLP=0+1) traffic. The default setting for PCR is 3 cells per second. The SCR will be checked on CLP=0 traffic. The default setting for SCR is 2 cells per second. The MBS will be checked on CLP=0 traffic; the MBS default setting is 1 cell.

**CLPTagSCR** Prompts for the Peak Cell Rate (PCR), Sustained Cell Rate (SCR), and Maximum Burst Size (MBS).

```
3) Requested Tx Traffic Descriptor Type { None (1),          : CLP Tag SCR
    NoCLPNoSCR (2), CLPNoTagNoSCR (3) CLPTagNoSCR (4),
    NoCLPSCR (5), CLPNo tagSCR (6), CLPTagSCR (7) }
  20) Peak Cell Rate (cells/sec) for CLP=0+1          : 3
  21) Sustaining Cell Rate (cells/sec) for CLP=0      : 2
  22) Maximum Burst Size (cells) for CLP=0            : 1
```

The PCR will be checked on the aggregate of CLP=0 and CLP=1 (CLP=0+1) traffic. The default setting for PCR is 3 cells per second. The SCR will be checked on CLP=0 traffic. The default setting for SCR is 2 cells per second. The MBS will be checked on CLP=0 traffic The MBS default setting is 1 cell.

The following sections describe the traffic parameter prompts that display after you select a traffic descriptor bundle.

### *Peak Cell Rate*

The following is a sample prompt display:

```
20) Peak Cell Rate (cells/sec) for CLP=0+1      : 3
```

In this field, you specify the Peak Cell Rate (PCR), in cells per second allowed on this VPI or VPI/VCI. The PCR is the fastest cell rate allowed on the connection. The switch will use this parameter as part of the traffic contract for this virtual circuit. A cell rate above the rate you indicate here will denote a violation of the traffic contract and the leaky bucket algorithm will determine which enforcement action take. Note that the PCR will be enforced on CLP=0+1 or CLP=0 cell flows; this prompt will indicate which cell flow is checked.

### *Sustaining Cell Rate*

The following is a sample prompt display:

```
21) Sustaining Cell Rate (cells/sec) for CLP=0+1    : 2
```

In this field, you specify the Sustaining Cell Rate (SCR), in cells per second allowed on this VPI or VPI/VCI. The SCR is highest average cell rate allowed on the circuit. The switch will use the parameter as part of the traffic contract for this virtual circuit. An average cell rate above the rate you indicate here will denote a violation of the traffic contract and the leaky bucket algorithm will determine which enforcement action take. Note that the SCR will be enforced on CLP=0+1 or CLP=0 cell flows; this prompt indicates which cell flow is checked.

### *Maximum Burst Size*

The following is a sample prompt display:

```
22) Maximum Burst Rate (cells) for CLP=0+1      : 1
```

In this field, you specify the Maximum Burst Size (MBS), in cells allowed on this VPI or VPI/VCI. The MBS is the largest single burst of cells allowed on the connection. The switch will use this parameter as part of the traffic contract for this virtual circuit. A burst size above the value you indicate here will denote a violation of the traffic contract and the leaky bucket algorithm will determine which enforcement action to take. Note that the MBS will be enforced on CLP=0+1 or CLP=0 cell flows; this prompt indicates which cell flow is checked.

### 4) Requested Rx QoS Class

The Quality of Service (QoS) for cells received from the destination at the source on this VPI or VPI/VCI. The QoS can be Unspecified (**0**), Class 1 (**1**), Class 2 (**2**), Class 3 (**3**), or Class 4 (**4**). Each of these five classes is described in Chapter 42, "Managing Cell Switch Modules (CSMs)," and they are listed below. The QoS Class that you select affects the priority of this Virtual Circuit and the Generic Cell Rate Algorithm (GCRA) used to police traffic. See Chapter 42, "Managing Cell Switch Modules (CSMs)," for more information on the interaction of QoS and GCRAs.

| | |
|---|---|
| **Unspecified** | Best Effort for data traffic (UBR) |
| **Class 1** | Circuit Emulation, Constant Bit Rate Traffic (CBR) |
| **Class 2** | Variable Bit Rate for Audio and Video Traffic (rt-VBR) |
| **Class 3** | VBR for Connection-Oriented Protocols Such as Frame Relay (nrt-VBR) |
| **Class 4** | Available Bit Rate for Connectionless Data Protocols Such as IP (ABR) |

### 5) Requested Rx Best Effort

Indicates whether to use the Peak Cell Rate (PCR) setting—specified later in this procedure—to determine the amount of bandwidth allocated or to use all available bandwidth. Setting this field to **True** specifies this circuit to use all available bandwidth. Setting this field to **False** specifies the circuit to use the PCR to determine the amount of bandwidth; if bandwidth is not available to support the PCR then this connection will be disabled.

### 6) Requested Rx Traffic Descriptor Type

The traffic descriptor bundle to be used with this Class of Service. The traffic descriptor bundle you choose here determines which traffic parameters you will specify. The traffic parameters will include the Peak Cell Rate (PCR) and may also include the Sustained Cell Rate (SCR) and Maximum Burst Size (MBS). Each traffic descriptor bundle available is described in Chapter 42, "Managing Cell Switch Modules (CSMs)." In addition, please refer to *3) Requested Tx Traffic Descriptor Type* on page 43-7 for information on the traffic descriptor options included in this software option.

### 7) Bi-directional Traffic Params

Indicates whether you want to use the same traffic parameters for the transmit and receive sides of this virtual circuit. If you enter a **Yes** in this field then the Tx traffic parameters (fields 1 to 3) will match the Rx traffic parameters (fields 4 to 6).

## Configuring Statistics and Priority Parameters

The **scvc** command contains a sub-option for configuring the Priority level and the statistics that display for this connection. Option 12 on the main **scvc** screen provides the link to this submenu. Enter **12** at the **Enter** prompt at the bottom of the main **scvc** screen and you will see the following screen of sub-options:

```
Slot 5 Port 1 Connection VPI 2 VCI 200 Configuration

     Available bandwidth: Tx=353209 Rx=353209

1)  User Priority (0-15)                          : 4
2)  CDV (10us-10000us)                            : 1000


Enter (option=value/save/cancel) :
```

The options in this screen are described below.

### User Priority

The priority level assigned to this virtual circuit. This priority is used to decide which virtual circuit's traffic is discarded first in a situation where congestion occurs. The priority level for a virtual circuit can range from 0 to 15, with 0 being the highest priority and 15 being the lowest. A default value is supplied for User Priority based on the type of traffic you specified under the **Traffic Priority** option on the main **scvc** screen (Option 7). The following defaults are supplied for each traffic type:

**Traffic Type and Priority**

| Traffic Type | Default Priority Level |
|---|---|
| CBR | 4 |
| VBR | 8 |
| ABR | 8 |
| UBR | 15 |

You can fine tune these priorities through this option. For example, some CBR circuits can be given higher priority than other CBR circuits by assigning a User Priority of 1, 2, or 3 rather than CBR default of 4.

### CDV

Cell Delay Variation in microseconds. Also referred to as "jitter," this value is the change that occurs in cell spacing from the time cells leave one node and arrive at another node.

## Configuring Point-to-Multipoint Soft PVCs

While configuring a soft PVC through the **scvc** command, you can configure multicast circuits to be associated with the primary soft PVC. Multicast circuits are leaves of the root soft PVC and inherit its traffic properties. Cells on the root circuit are copied to all leaf circuits you specify. See Chapter 42, "Managing Cell Switching Modules (CSMs)," for more information on point-to-multipoint connections. Option 8 in the **scvc** command allows you to set up point-to-multipoint soft PVCs. Follow these steps:

1. At the bottom of the main **scvc** screen, you will find the following prompt.

```
Enter (option=value/save/cancel) :
```

   Enter **8=1** at this prompt to enable multicast support on this soft PVC. The **scvc** screen re-displays with an additional option under the **Point to Multipoint** option, as follows.

```
Slot 5 Port 1 Connection VPI 1 VCI 300 Configuration

    Available bandwidth: Tx=353209 Rx=353209

1)  Description (30 chars max)        : Connection 300
2)  End point Id (1..65535)           : 1
3)  Terminating ATM Address           : 00000000000000000000000000000000000000000000
4)  Other End VPI (0..4095)           : 1
5)  Other End VCI (0..65535)          : 1
6)  Channel Type { vc-nni(3), vc-uni(4) } : VC-UNI
7)  Transport Priority {CBR(1), CBR_PRS(2), VBR_RT(3),    : UBR
                        VBR_NRT(4), ABR(5), UBR(6) }
8)  Point to Multipoint { disable(0), enable(1)}          :enabled
     20) Add/Delete Point to Multipoint{ add(1), delete(2) }
9)  Channel Redirect { not allowed(0), allowed(1) }       : not allow
10) AAL5 Discard Continue { disable(0), enable(1) }       : disable

11) Traffic Parameters
13) Advanced Parameters
14) Target Selector Type {required(1), any(2)             : any
15) Advanced SoftPvc parameters
16) Broadband Bearer Capability Parameters

Enter (option=value/save/cancel) :
```

2. Enter **20=1** at the **Enter** prompt to add a point-to-multipoint soft PVC.

3. The following prompt displays:

```
Enter Terminating atm Address:
```

   Enter the ATM address for the output port of the ATM switch at the end of this soft PVC. You could also specify the ATM address for the end device on this soft PVC.

4. The following prompt displays:

```
Enter EndPoint Id (1..65535) :
```

   Enter the endpoint identification. This identification number is used to keep track of the endpoints within the soft PVC. This number is used for identification purposes only and does not affect VPI/VCI numbering.

**5.** The following prompt displays:

**Enter Selector Type {required(1), any(2)} :**

This prompt indicates whether or not you want the destination ATM switch to choose the VPI and VPI/VCI values or if you want to specify these values manually. **Required** means that you must specify **Other End VPI** and/or **Other End VCI** values manually. **Any** means the destination switch will select the VPI and VCI values.

**6.** If you select **Required** after the **Selector Type** field, the following prompt displays:

**Enter Other End VPI:**

Enter the Virtual Path Identifier (VPI) used for this circuit on the ATM switch at the other end of this soft PVC connection. This prompt will not display if you selected **Any** as the **Selector Type** in Step 5.

**7.** If you select **Required** after the **Selector Type** field, the following prompt displays:

**Enter Other End VCI:**

Enter the Virtual Channel Identifier (VCI) used for this circuit on the ATM switch at the other end of this soft PVC connection. This field will not display if you are not setting up a Virtual Channel Connection (VCC) or if you selected **Any** as the **Selector Type** in Step 5.

**8.** The following prompt displays:

**Enter Retry Interval (0..3600) :**

Enter the period to wait, in seconds, before attempting to establish another soft PVC connection after the first failed call attempt. A value of zero (0) indicates that no retries will be attempted.

**9.** The following prompt displays:

**Enter Retry Threshold (0..65535) :**

Enter the number of call setup attempts that will be made to establish the same soft PVC connection before an alarm is generated. After this threshold is reached an alarm will be generated. A value of zero (0) indicates that an infinite number of retries will be attempted before an alarm is generated.

**10.** The following prompt displays:

**Enter Retry Limit (0..65535) :**

Enter the maximum number of consecutive unsuccessful call setup attempts that will be made before stopping any further attempts to set up the connection. A value of zero (0) indicates that an infinite number of attempts will be made to establish the connection.

**11.** After you finish entering parameters, the main **scvc** screen re-displays with the point-to-multipoint connection you just entered. A sample is provided below:

```
8) Point to Multipoint { disable(0), enable(1)} :
    20) Add/Delete Point to Multipoint { add(1), delete(2) }

EndptId          Terminating Atm Address                          OtherEnd
                                                                  Vpi  Vci
-------------------------------------------------------------------------------------------------------------
   2      11220000000000000000000000000000000000000000 2    2
   33     22330000000000000000000000000000000000000000 1    1
   44     44440000000000000000000000000000000000000000 33   44
```

You might also note that an additional option displays at the bottom of the main **scvc** screen for modifying multipoint soft PVCs (Option 16) after you configure a multipoint soft PVC.

**12.** Continue adding multicast connections by repeating steps 2 through 11.

## Modifying a Point-to-Multipoint Soft PVC

After you create a point-to-multipoint soft PVC, an additional option displays at the bottom of the **scvc** screen. Option 17 on the main **scvc** screen provides the link to this soft PVC modification submenu. (You can also modify a point-to-multipoint soft PVC through the **mvc** command.) Follow these steps to modify a point-to-multipoint soft PVC:

**1.** Enter **17** at the **Enter** prompt at the bottom of the main **scvc** screen and the following prompt displays:

```
Enter Endpoint Id of the ptomp connection :
```

**2.** Specify the endpoint ID for this soft PVC. This endpoint ID was entered when the soft PVC was initially configured. A table of multipoint soft PVCs displays below Option 8 in the main **scvc** screen. The endpoint IDs are listed in the first column of this table.

**3.** After you enter the endpoint ID, a screen similar to the following displays:

```
Endpoint Id = 4

1)  Selector {required(1), any(2)}     : Required
2)  Other End Vpi (0..4096)            : 4
3)  Other End Vci (1..65535)           : 4
4)  Terminating Address                : 12345678909876543212345678909876543212345
5)  Retry Interval (0..3600)           : 4
6)  Retry Threshold (0..65535)         : 4
7)  Retry Limit (0..65535)             : 4

Enter (option=value/save/cancel) :
```

Make changes by entering the line number for the option you want to change, an equal sign (=), and then the value for the new parameter. When you are done entering all new values, type **save** at the colon prompt (:) and all new parameters will be saved. The options in this screen are described in the section, *Configuring Point-to-Multipoint Soft PVCs* on page 43-12.

## Configuring Soft PVC Retry Parameters

The **scvc** command contains a sub-option for configuring Retry parameters for a soft PVC connection. Option 15 on the main **scvc** screen provides the link to this submenu. Enter **15** at the **Enter** prompt at the bottom of the main **scvc** screen and you will see the following:

```
1)  Retry Interval                  : 10
2)  Retry Threshold                 : 1
3)  Retry Limit                     : 0
```

### Retry Interval

The period to wait, in seconds, before attempting to establish another soft PVC connection after the first failed call attempt. A value of zero (0) indicates that no retries will be attempted.

### Retry Threshold

Indicates the number of call setup attempts that will be made to establish a soft PVC connection before an alarm is generated. After this threshold is reached an alarm will be generated. A value of zero (0) indicates that an infinite number of retries will be attempted before an alarm is generated.

### Retry Limit

The maximum number of consecutive unsuccessful call setup attempts that will be made before stopping any further attempts to set up the connection. A value of zero (0) indicates that an infinite number of attempts will be made to establish the connection.

## Configuring Broadband Bearer Capability Parameters

The **scvc** command contains a sub-option for configuring broadband bearer capability parameters for this soft PVC connection. Option 16 on the main **scvc** screen provides the link to this submenu. Enter **16** at the **Enter** prompt at the bottom of the main **scvc** screen and you will see the following screen of sub-options:

```
1)  Class { bcobA(1), bcobC(2), bcobX(3) }                    : bcobA
2)  Traffic Type { noIndictn(1), CBR(2), VBR(3) }             : NoIndication
3)  Timing Requirements { NoIndication(1), End2EndReqd(2)
                          End2EndNotReqd(3)              }    : No Indication
4)  Susceptibility to Clipping { True(1), False(2) }          : True
5)  User Plane Connection Config { pt2pt(1), ptomp(2) }       : Point to Point
```

### Class

The broadband bearer capability class of service. The Class of Service will either be Class A (**bcobA**), Class C (**bcobC**), or Unspecified (**bcobX**). Class A corresponds to Class 1 level of service typically used for CBR traffic types, providing zero cell loss and no transit delay. Class C corresponds to Class 3 level of service typically reserved for VBR non-real-time traffic, providing guaranteed delivery and some transit delay. Unspecified does not guarantee bandwidth to the circuit and cell traffic is delivered on a “best effort” basis.

### Traffic Type

The broadband bearer traffic type. The traffic type will be either Constant Bit Rate (**CBR**) or Variable Bit Rate (**VBR**). You can also specify no traffic type (**NoIndictn**).

### Timing Requirements

Indicates whether end-to-end timing over the broadband link is necessary. End-to-end timing for traffic types sensitive to transit delay, such as CBR traffic, typically require end-to-end timing. Indicate whether you want to require end-to-end timing in this field.

### Susceptibility to Clipping

Indicates whether or not cells on this link can be discarded under congestion conditions. If you want cells to be discarded when congestion occurs, then select the **True** option. If you do not want cells to be discarded under congestion, then select the **False** option.

### User Plane Connection Configuration

Select whether this soft PVC is a standard point-to-point connection or whether it is a point-to-multipoint connection. Point-to-multipoint connections are configured through Option 8; the procedure for configuring multipoint connections is described in *Configuring Point-to-Multipoint Soft PVCs* on page 43-12.

## Viewing Soft PVCs

The **svvc** command allows you to view information on the soft PVCs set up in this OmniSwitch. The following is sample of the output from this command:

```
+ ==> PVC Connections
* ==> SVC Connections which cannot be modified by the user
@ ==> Soft PVC Connections
& ==> Control Connections

                                CSM Connections

        Incoming                        Outgoing
-------------------------       -------------------------       Connection              Chan  Transport
Slot  Port VPI  VCI     Slot  Port VPI  VCI     Description             Type  Priority
===== ==== ===== ===== ===== ==== ===== ===== ======================= ======= =========
5     5    1     1     5     5    1     1     Connection 1            VC UNI  UBR    @

Slot  Port VPI  VCI   EndPt           Terminating Atm Address                                 OtherEnd
                      Id                                                                      Vpi      Vci
==== ==== ======== ===== ========================================== ====     =====
5     5    1     1     1     00000000000000000000000000000000000000000000   1        1
                      2     11220000000000000000000000000000000000000000   2        2
                      33    22330000000000000000000000000000000000000000   1        1
                      44    44440000000000000000000000000000000000000000   33       44

Slot  Port VPI  VCI   EndPt Release     Oper        Release
                      Id    Cause       Status      Diagnostic
==== ==== ==== ==== ===== ======= =========== ===========
5     5    1     1     1     0       Other       00000000
                      2     0       Other       00000000
                      33    0       Other       00000000
                      44    0       Other       00000000

                Retry Information

Slot  Port VPI  VCI   EndPt Retry   Retry   Retry   Retry       Retry
                      Id    Intvl   Timer   T'hold  Failures    Limit
==== ==== === ==== ===== ======= ======= ======= ========= ========
5     5    1     1     1     2       0       1       0           0
                      2     2200    0       2300    0           25
                      33    25      0       25      0           25
                      44    24      0       24      0           24
```

— Output continues on next page —

```
                    Broadband Bearer Capability Parameters

Slot  Port VPI  VCI   Class  Traffic          Timing          Suscept  User Plane
                           Type             Requirement     To Clip  Config
==== ==== ==== ==== ===== ============  ============== ======= ===========
5     5    1    1     C     noIndication   noIndication     True     pt2pt

                                 User
Slot  Port VPI  VCI          Up Time                Down Time          Pri.  Statistics Mode
==== ==== ==== ==== ==================== ==================== ==== ===============
5     5    1    1    MON FEB 03 13:30:08  MON FEB 03 13:30:08  15    CntGcra, PsCell

                        Tx Traffic Information

                          Tx Traffic          Peak     Sustain    Maximum  Tx    Best
Slot  Port VPI  VCI       Descrip Type     Cell Rate  Cell Rate  Burst Sz  QoS  Effort
==== ==== ==== ==== ============== ========== ========= ========= ===  ======
5     5    1    1     NoCLP NoSCR    1                                  Uns  True

                        Rx Traffic Information

                          Rx Traffic          Peak     Sustain    Maximum  Rx    Best
Slot  Port VPI  VCI       Descrip Type     Cell Rate  Cell Rate  Burst Sz  QoS  Effort
==== ==== ==== ==== ============== ========== ========= ========= ===  ======
5     5    1    1     NoCLP NoSCR    1                                  Uns  True

                                                                  Multicast
                                                                 ----------------------------------
Slot  Port VPI  VCI   gcra a enf mode   gcra b enf mode   grp id   enable   ingrs/egrss
==== ==== ==== ==== ================ ================ ====== ======= ===========
5     5    1    1     no cong dx clp1   no cong dx clp1   0        disable  ingress
```

The legend at the top of the display indicates the symbols used to differentiate the virtual circuit types. A symbol is placed after the **Transport Priority** column to indicate the circuit type. The **svvc** command displays only soft PVCs, shown by the **@** symbol.

**Incoming Port**, **Outgoing Port**, **Connection Description**, **Chan Type**, and **Transport Priority**. These variables are described earlier in *Creating a Soft PVC* on page 43-3.

**EndPt Id**, **Terminating Atm Address**, **Other End Vpi/Vci**. These variables are described in *Creating a Soft PVC* on page 43-3.

**Release Cause**. Indicates an internal code that gives information on why this connection was released.

**Oper Status**. Indicates the current operational status of this soft PVC.

**Release Diagnostic**. Indicates an internal diagnostic code used for releasing this connection.

**Retry Intvl**, **Retry T'hold**, **Retry Limit**. These variables are described earlier in *Configuring Soft PVC Retry Parameters* on page 43-15.

**Retry Timer**. The current value, in seconds, for the retry timer on this soft PVC connection.

**Retry Failures**. The total number of retry failures experienced on this connection.

**Traffic Type**, **Timing Requirement**, **Suscept To Clip**, **User Plane Config**. These variables are described earlier in *Configuring Broadband Bearer Capability Parameters* on page 43-15.

**User Pri.**, **Statistics Mode**. These variables are described in *Configuring Statistics and Priority Parameters* on page 43-11.

**Tx Traffic Information**, **Rx Traffic Information**. These variables are described in *Configuring Traffic Parameters* on page 43-6.

**gcra a mode**, **gcra b mode**. The type of algorithm used for the Generic Cell Rate Algorithm (GCRA), or "leaky bucket," with this virtual circuit. By default, this column will read **no cong dx clp1**, meaning that only CLP=1 cells will be discarded.

**Multicast grp id**. The group identification number for this multicast virtual circuit. This number is not user-configurable and is used internally by the switch.

**Multicast enable**. Indicates whether multicast leaf virtual circuits are associated with this root virtual circuit.

**Multicast ingres/egress**. Indicates whether this is the ingress or egress point for this multicast virtual circuit.

# Virtual UNI/NNI Using Virtual Path (VP) Tunneling

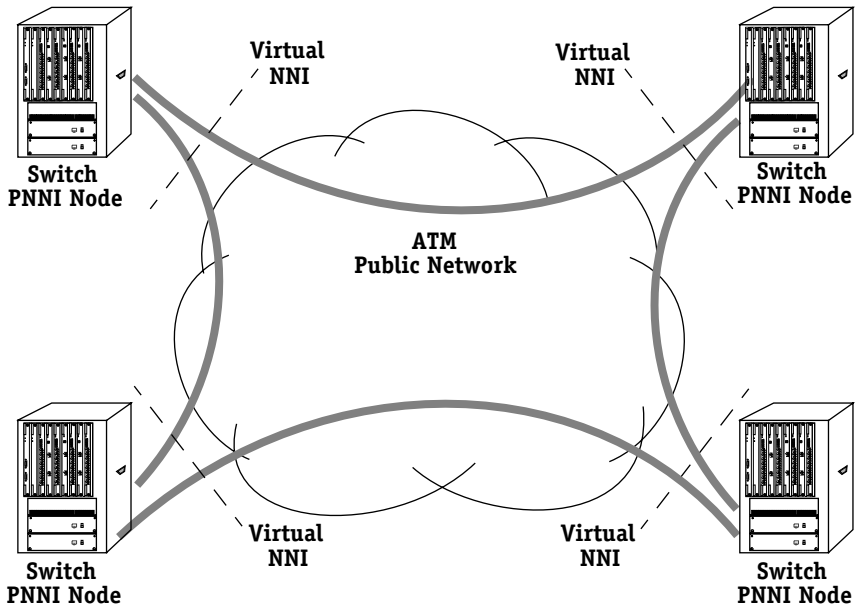
You can create multiple UNI or NNI instances on a CSM physical port through the use of virtual path (VP) tunneling. A single switch connected to a PVC-based ATM network, such as a public carrier network, can support up 255 UNI or NNI instances. You create these instances through the **cvpt** command, which allows you to configure signaling parameters on a per UNI or NNI basis. You can configure each instance to be a UNI (public or private), PNNI, or IISP connection.

The virtual UNI/NNI feature can be used in multiple applications. The following sections provide three examples in which this feature could be deployed.

## Extending PNNI Over Public Networks

The most common VP Tunneling application interconnects campus networks via public ATM bearer services. This application extends the PNNI network over the public network. PNNI nodes on each side of the public network are interconnected by Permanent Virtual Paths (PVPs). Although the nodes use the public network to communicate with each other, the nodes function as if they are part of the same small private network.

The Virtual Path that connects the OmniSwitch nodes in the following diagram is managed and policed by the ATM carrier service provider. PNNI nodes manage and police the virtual tunnels within the Virtual Path, but not the Virtual Path itself.

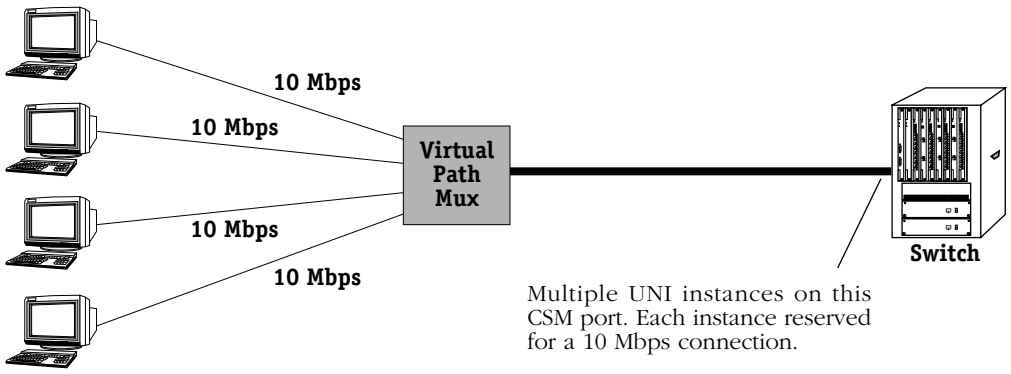



**Virtual NNI Instances Extend PNNI Over Public Network**

The Virtual Path Identifier (VPI) for all virtual paths piped across the public network will be the same in this example. When configuring virtual paths, it is important that the VPI used matches the VPI supplied by the service carrier. For example, if the service carrier assigns the network a VPI of 80, then all configured virtual paths must use 80 as their VPI.

## Virtual Path Mux

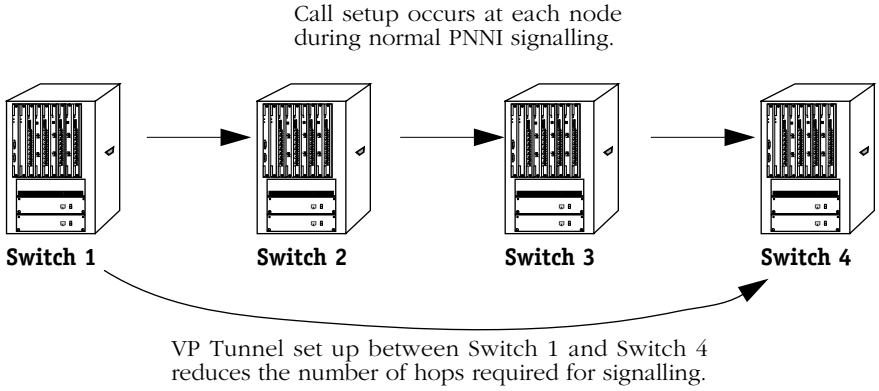
As a second application, you could assign a virtual UNI to each of several low-speed links that combine into a high-speed ATM link. The diagram below shows several 10 Mbps devices connecting into a VP mux, or cross-connect. Each 10 Mbps device could use a LAN Emulation (LANE) switched virtual circuit (SVC) to connect to the ATM network. Signaling messages on the user side would take VCI 5 within each virtual path and ILMI messages would take VCI 16. The user devices are muxed through the cross-connect and sent on an ATM link, such as an OC-3 link, to the OmniSwitch. On the OmniSwitch port connected to the VP mux you would assign unique UNI instances to distinguish the various 10 Mbps connections.




**Switch Distinguishes User Devices Through Virtual UNIs**

## Signaling Hop Reduction

A virtual path tunnel can also be used to reduce the number of signaling hops in a PNNI network. In a daisy-chain of ATM switches, call setups and other signaling messages are normally processed at each hop. Using a virtual NNI, a virtual path tunnel could be created between the first and last switches of the daisy-chain, reducing the amount of signaling that must take place to establish a call.




**VP Tunnel Reduces Signalling Overhead**

## Creating a VP Tunnel

You can use the **cvpt** command to configure Virtual Path (VP) Tunnels on a CSM port. To use this command, enter **cvpt** followed by the slot and port number of the CSM port on which you want to set up the VP tunnel. For example, to configure a virtual path for port 1 on the CSM module in slot 8, you would enter:

```
cvpt 8/1
```

A screen similar to the following displays:

```
                Slot 5 Port 3 VP Tunnel Configuration

1)  Description (30 chars max)        :
2)  Tunnel VPI                        : 1
3)  I/F Type {Pub UNI(1), Pri UNI(2),
        PNNI (3), IISP(4)}            : PNNI
4)  SIG Enable {False(1), True(2) }   : Enable
5)  Signaling Ver {3.0(1), 3.1(2)}    : 3.1
6)  ILMI Enable {False(1), True(2) }  : Disable
7)  Admin Status { disable (1)
                   enable (2) }       : Enable

Enter (option=value/save/cancel) :
```

You change a value in the field by entering the line number for the value, an equal sign (=), and then the new value for the variable. For example, to change the **Description** field variable to read "VP Tunnel 1," you would enter a 1 (the line number for **Description**), an equal sign, and then the new description as follows:

```
1=VP Tunnel 1
```

### Description

A textual description of this VP Tunnel. The description may be up to 30 characters long. This identifier will be used in displays for other software commands.

### Tunnel VPI

The Virtual Path Identifier (VPI) for the VP tunnel you are creating. If this VPI will be used over a public network, then it should match the VPI assigned by your carrier. You can configure traffic parameters for this VPI through the **cvc** command.

Note that the valid VPI range for this VP tunnel is determined by the **Max VPI Bits** value you specified through the **map** command. For example, if the value indicated for **Max VPI Bits** allows the CSM port to support VPIs in the range of 1 to 15, then make sure the VP tunnel VPI you specify here falls within that range.

**♦ Caution ♦**

When configuring a VP tunnel, you need to consider the range of VPIs supported by the CSM ports on each side of the tunnel connection. For example, if one CSM port supports VPIs 0 to 3 and the other CSM port supports VPIs 0 to 7, then you need to make sure that the VP tunnel between the two ports uses a VPI in the range of 0 to 3. Otherwise, if a VP tunnel were to use a VPI greater than 3, then the VPI on one CSM port would be truncated and data would appear to come in on the wrong VPI.

### I/F Type

Specifies the type of ATM interface that this VP tunnel supports. The options are described below:

**Pub UNI** Public UNI. This virtual path will be used for connections to public ATM service carrier switches, such as those used by Telcos.

**Priv UNI** Private UNI. The virtual path is used for private UNI uplinks. Such a VP would connect either directly to an ATM workstation, LAN switch, or ATM attached router.

**PNNI 1.0** Private Network-to-Network Interface (PNNI). The virtual path will support PNNI version 1.0 ATM routing, which includes support for a single peer group mapping.

**♦ Important Note ♦**

If your software version is prior to 4.1, then you *must* reboot the switch when you change the **I/F Type** from **PNNI 1.0** to **Pub UNI**.

**IISP** Interim Interswitch Signaling Protocol. Typically an IISP virtual path would be part of an intermediate ATM node that did not support the PNNI routing protocol. It is used primarily for establishing static routes using the IISP protocol. See Chapter 46, "Managing IISP and PNNI Routes" for further information.

### SIG Enable

Indicate whether you want to enable the Service-Specific Connection Oriented Protocol (SSCOP). SSCOP operates on the ATM control plane and is a peer-to-peer protocol that helps set up connections, detect errors in connections, and correct connection errors.

### Signaling Ver

The version of the User-to-Network Interface (UNI) used on this virtual path. The switch is compliant with ATM Forum UNI specifications versions 3.0, 3.1, and 4.0. You select which version your ATM network supports.

**♦ Important Note ♦**

If you change the **Signaling Ver**, then you *must* reboot the switch.

### ILMI Enable

Indicates whether or not you want to enable ILMI. Normally you will want to enable ILMI to allow the switch to discover attached ATM End Systems (ESs). If you disable ILMI, then you must configure a static route between this virtual path and all attached ESs.

### Admin Status

Indicates the administrative status for this VP tunnel. When first configuring your network, you may want to create a VP tunnel and disable it until it is ready for live operation. The VP tunnel will not be available for traffic flow until the **Admin Status** is set to **Enable**.

## Displaying VP Tunnel Information

The **lvpt** command allows you to display information on all configured VP tunnels in the switch. If you enter **lvpt** at any prompt a screen similar to the following displays:

```
                                CSM VP Tunnel(s)

                                                                  VP Tun
Index  Slot  Port  Inst  VP Tunnel Descriptor                    Number  VPI  Type
=====  ====  ====  ====  ========================================  ======  ====  ====
1      6     1     1     ATM Tunnel #2 on VP 1.                    2       1     PNNI
2      7     1     1     ATM Tunnel #1 on VP 1.                    1       1     PNNI
3      7     2     1     ATM Tunnel #3 on VP 1.                    3       1     PNNI


                                      Abs   Enable   Enable   Admin
Index  Slot  Port  Inst                Port  ILMI     SSCOP    Status
=====  ====  ====  ====                ====  =======  =======  =======
1      6     1     1                   702   Disabl   Enable   Enable
2      7     1     1                   701   Disabl   Enable   Enable
3      7     2     1                   703   Disabl   Enable   Enable

                                      Status
                                      =======

Slt  Prt  Inst  Sscop Up                  Sscop Down                Up  Dn  Status
===  ===  ====  ======================    ======================    ==  ==  ======
6    1    1     TUE FEB 23 15:34:41 1999  WED FEB 24 11:42:47 1999  4   5   Down
7    1    1     TUE FEB 23 10:09:57 1999  --------                  1   0   Up
7    2    1     TUE FEB 23 14:57:11 1999  TUE FEB 23 14:56:18 1999  10  10  Up

Slt  Prt  Inst  Ilmi Up                   Ilmi Down                 Up  Dn  Status
===  ===  ====  ======================    ======================    ==  ==  ======
6    1    1     TUE FEB 23 15:34:29 1999  WED FEB 24 11:42:47 1999  5   1   Down
7    1    1     TUE FEB 23 10:09:57 1999  --------                  1   0   Up
7    2    1     TUE FEB 23 14:57:11 1999  TUE FEB 23 11:04:26 1999  8   1   Up

Slt  Prt  Inst  Phy Up                    Phy Down                  Up  Dn  Status
===  ===  ====  ======================    ======================    ==  ==  ======
6    1    1     TUE FEB 24 11:45:21 1999  WED FEB 24 11:42:47 1999  2   2   En
7    1    1     TUE FEB 23 14:06:49 1999  --------                  2   0   En
7    2    1     TUE FEB 23 14:06:49 1999  TUE FEB 23 11:04:26 1999  3   1   Dis
```

**Index**. This value is a running total, or counter, of all VP tunnels set up in the switch. It is not related to the VPI value. You can use this value to help interpret displays. Since the **lvpt** display requires two sets of columns, the **Index** value can help you keep track of values between the top and bottom sets of columns.

**Slot**. The slot within the switch where this VP tunnel is set up.

**Port**. The port on the CSM module where this VP tunnel is set up.

**Inst**. The instance of this VP tunnel on this particular CSM module port. This value is not the same as the VPI. It is a counter of the number of VP tunnels set up on this CSM port, and can be used with the **mvpt** and **dvpt** commands. The physical CSM port has an instance of zero (0).

**VP Tunnel Descriptor**. The textual description of this VP tunnel entered through the **cvpt** command

**VP Tun Number**. This value is a number assigned by switch software to keep track of VP tunnels. It is not the same as the VPI and is used internally; it can also be used with the **mvpt** and **dvpt** commands.

**VPI**. The Virtual Path Identifier (VPI) assigned to this VP tunnel through the **cvpt** command. The VPI identifies a discrete path through the ATM network. Multiple virtual paths can be set up on the same CSM port; the VPI is used to identify each path on a CSM port.

**Type**. Specifies the type of ATM interface that this VP tunnel supports. Possible types are **PNNI**, **PrUNI** (Private UNI), **PuUNI** (Public UNI), and **IISP** (Interim Interswitch Signalling Protocol). Definitions for each of these types are provided in the section, *Creating a VP Tunnel* on page 43-22.

**Abs Port**. An internal port assignment used by PNNI software to identify specific VP tunnels. You might use this number for the sake of comparison when viewing displays for PNNI-specific commands, which are found in the PNNI sub-menu. Some PNNI commands use these port assignments to describe connections. The same number in this **lvpt** display will correspond to a port assignment in a PNNI display screen.

**ILMI Enable**. Indicates whether the Integrated Local Management Interface (ILMI) has been enabled on this virtual path through the **cvpt** command.

**Enable SSCOP**. Indicates whether the Service-Specific Connection Oriented Protocol (SSCOP) has been administratively enabled through the **cvpt** command.

**Admin Status**. Indicates whether this VP tunnel was administratively enabled or disabled through the **cvpt** command. The VP tunnel can not become operational until the **Admin Status** has been set to **Enable**.

The following column headings fall under the table heading labeled **Status**.

**SSCOP**. The current operational state of the Service-Specific Connection Oriented Protocol (SSCOP). SSCOP operates on the ATM control plane and is a peer-to-peer protocol that helps set up connections, detect errors in connections, and correct connection errors. The **Sscop Up** and **Sscop Down** columns will indicate the last time SSCOP last came up and went down, respectively. The **Up** and **Down** columns will indicate the number of times SSCOP came up and went down, respectively. The SSCOP **Status** column will indicate Up or Down.

**ILMI**. The current operational state of the Integrated Local Management Interface (ILMI), which is a standard ATM management protocol based on SNMP. By default, ILMI uses VPI 0 and VCI 16 for management signalling. The **Ilmi Up** and **Ilmi Down** columns will indicate the last time ILMI last came up and went down, respectively. The **Up** and **Down** columns will indicate the number of times ILMI came up and went down, respectively. The ILMI **Status** column will indicate Up or Down.

**PHY**. The Operational Status of this virtual path. This column indicates if the virtual path is **Enabled** or **Disabled**. The **Phy Up** and **Phy Down** columns will indicate the last time PHY last came up and went down, respectively. The **Up** and **Down** columns will indicate the number of times PHY came up and went down, respectively. The PHY **Status** column will indicate whether the port is **Enabled** or **Disabled**. The virtual path is enabled if the connection is good on this end and the far end. If there is a disconnection at either end, the operational status will be **Disabled**.

## Viewing SSCOP, ILMI, and PHY

You can view general and detailed SSCOP, ILMI, and PHY information on all configured VP tunnels in a switch, a single CSM board, and individual ports. The **lvpt** command is used to provide this information.

### Viewing SSCOP, ILMI, and PHY Information on All Ports

To view SSCOP, ILMI, and PHY information on all configured VP tunnels in a switch, you enter the **lvpt** command along with the following parameters:

**lvpt sip**

where **s** indicates SSCOP, **i** indicates ILMI, and **p** indicates PHY. This command displays a screen similar to the following:

```
                                CSM VP Tunnel(s)

                                  Status
                                 ========

Slt  Prt  Inst          Sscop Up                 Sscop Down              Up   Dn  Status
===  ===  ====  ========================  ========================  ====  ====  ======
6    1    1     TUE  FEB 23  15:34:41 1999  WED  FEB 24  11:42:47 1999  4     5    Down
7    1    1     TUE  FEB 23  10:09:57 1999            --------          1     0     Up
7    2    1     TUE  FEB 23  14:57:11 1999  TUE  FEB 23  14:56:18 1999  10    10    Up

Slt  Prt  Inst          Ilmi Up                  Ilmi Down               Up   Dn  Status
===  ===  ====  ========================  ========================  ====  ====  ======
6    1    1     TUE  FEB 23  15:34:29 1999  WED  FEB 24  11:42:47 1999  5     1    Down
7    1    1     TUE  FEB 23  10:09:57 1999            --------          1     0     Up
7    2    1     TUE  FEB 23  14:57:11 1999  TUE  FEB 23  11:04:26 1999  8     1     Up

Slt  Prt  Inst          Phy Up                   Phy Down                Up   Dn  Status
===  ===  ====  ========================  ========================  ====  ====  ======
6    1    1     TUE  FEB 24  11:45:21 1999  WED  FEB 24  11:42:47 1999  2     2     En
7    1    1     TUE  FEB 23  14:06:49 1999            --------          2     0     En
7    2    1     TUE  FEB 23  14:06:49 1999  TUE  FEB 23  11:04:26 1999  3     1     Dis
```

Additionally, you may enter the parameters for SSCOP, ILMI, and PHY in any order and combination. For example, if you wanted to view only the ILMI and PHY, you would enter the **lvpt** command along with the respective parameters as follows:

**lvpt ip**

or

**lvpt pi**

This command displays a screen similar to the following:

```
Slt  Prt  Inst          Ilmi Up                  Ilmi Down               Up   Dn  Status
===  ===  ====  ========================  ========================  ====  ====  ======
6    1    1     TUE  FEB 23  15:34:29 1999  WED  FEB 24  11:42:47 1999  5     1    Down
7    1    1     TUE  FEB 23  10:09:57 1999            --------          1     0     Up
7    2    1     TUE  FEB 23  14:57:11 1999  TUE  FEB 23  11:04:26 1999  8     1     Up

Slt  Prt  Inst          Phy Up                   Phy Down                Up   Dn  Status
===  ===  ====  ========================  ========================  ====  ====  ======
6    1    1     TUE  FEB 24  11:45:21 1999  WED  FEB 24  11:42:47 1999  2     2     En
7    1    1     TUE  FEB 23  14:06:49 1999            --------          2     0     En
7    2    1     TUE  FEB 23  14:06:49 1999  TUE  FEB 23  11:04:26 1999  3     1     Dis
```

Descriptions of the columns included in the two displays above are described earlier in *Displaying VP Tunnel Information* on page 43-24.

### Viewing SSCOP, ILMI, and PHY Information on One CSM Board

To view SSCOP, ILMI, and PHY information on a single CSM board, you enter the **lvpt** command along with the slot number for the CSM board and the following parameters:

**lvpt <slot> sip**

where **<slot>** is the slot number where the CSM board is installed, **s** indicates SSCOP, **i** indicates ILMI, and **p** indicates PHY. For example, if you wanted to view SSCOP, ILMI, and PHY information for the board in slot 7, you would enter:

**lvpt 7 sip**

This command displays a screen similar to the following:

```
                                CSM VP Tunnel(s)
                                                                  VP Tun
Index  Slot  Port  Inst  VP Tunnel Descriptor                    Number  VPI  Type
=====  ====  ====  ====  ========================  ======  ====  ====
2      7     1     1     ATM Tunnel #1 on VP 1.                  1       1    PNNI
3      7     2     1     ATM Tunnel #3 on VP 1.                  3       1    PNNI


                                  Abs   Enable   Enable   Admin
Index  Slot  Port  Inst          Port  ILMI     SSCOP    Status
=====  ====  ====  ====          ====  =======  =======  =======
2      7     1     1             701   Disabl   Enable   Enable
3      7     2     1             703   Disabl   Enable   Enable

                                                Status
                                                =======

Slt  Prt  Inst          Sscop Up                 Sscop Down                Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    1    1     TUE  FEB 23  10:09:57 1999              --------          1    0     Up
7    2    1     TUE  FEB 23  14:57:11 1999   TUE  FEB 23  14:56:18 1999  10   10    Up

Slt  Prt  Inst          Ilmi Up                  Ilmi Down                 Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    1    1     TUE  FEB 23  10:09:57 1999              --------          1    0     Up
7    2    1     TUE  FEB 23  14:57:11 1999   TUE  FEB 23  11:04:26 1999  8    1     Up

Slt  Prt  Inst          Phy Up                   Phy Down                  Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    1    1     TUE  FEB 23  14:06:49 1999              --------          2    0     En
7    2    1     TUE  FEB 23  14:06:49 1999   TUE  FEB 23  11:04:26 1999  3    1     Dis
```

Additionally, you may enter the parameters for SSCOP, ILMI, and PHY in any order and combination. For example, if you wanted to view the statistics for only SSCOP and ILMI for a single board, you would enter the lvpt command along with the slot number and the respective parameters as follows:

**lvpt <slot> si**

or

**vap <slot> is**

Descriptions of the columns included in the display above are described earlier in *Displaying VP Tunnel Information* on page 43-24.

### Viewing SSCOP, ILMI, and PHY Information on One Port

To view SSCOP, ILMI, and PHY information on a single CSM port, you enter the **lvpt** command along with the slot number for the CSM board, the port number for which you want to receive information, and the following parameters:

**lvpt <slot>/<port> sip**

where **<slot>** is the slot number where the CSM board is installed, **<port>** is the port number on the CSM board, **s** indicates SSCOP, **i** indicates ILMI, and **p** indicates PHY. For example, if you wanted to view SSCOP, ILMI, and PHY information for port 2 on the CSM module in slot 7, you would enter:

**lvpt 7/2 sip**

This command displays a screen similar to the following:

```
                                CSM VP Tunnel(s)
                                                                 VP Tun
Index  Slot  Port  Inst  VP Tunnel Descriptor                    Number  VPI  Type
=====  ====  ====  ====  ======================== ======  ====  ====
3      7     2     1     ATM Tunnel #3 on VP 1.                  3       1    PNNI

                                                  Abs   Enable   Enable   Admin
Index  Slot  Port  Inst                            Port  ILMI     SSCOP    Status
=====  ====  ====  ====                            ====  =======  =======  =======
3      7     2     1                               703   Disabl   Enable   Enable

                                                                    Status
                                                                    =======

Slt  Prt  Inst          Sscop Up                  Sscop Down                Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    2    1     TUE FEB 23 14:57:11 1999  TUE FEB 23 14:56:18 1999  10    10     Up

Slt  Prt  Inst          Ilmi Up                   Ilmi Down                 Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    2    1     TUE FEB 23 14:57:11 1999  TUE FEB 23 11:04:26 1999  8     1      Up

Slt  Prt  Inst          Phy Up                    Phy Down                  Up   Dn   Status
===  ===  ====  ========================  ========================  ====  ====  ======
7    2    1     TUE FEB 23 14:06:49 1999  TUE FEB 23 11:04:26 1999  3     1      Dis
```

Additionally, you may enter the parameters for SSCOP, ILMI, and PHY in any order and combination. For example, if you wanted to view the statistics for only SSCOP and PHY for a single CSM port, you would enter the **lvpt** command along with the slot number, the port number for which you want to receive information, and the respective parameters as follows:

**lvpt <slot>/<port> sp**

or

**lvpt <slot>/<port> ps**

Descriptions of the columns included in the display above are described earlier in *Displaying VP Tunnel Information* on page 43-24.

## Modifying a VP Tunnel

The **mvpt** command enables you to modify a VP tunnel. It uses the same screens and allows you to change the same parameters as the **cvpt** command. To begin modifying a VP tunnel, enter **mvpt** followed by the slot number, a slash (/), and the port number where the VP tunnel currently exists. Enter a space and then the instance number for the VP tunnel. You can find the instance number through the **lvpt** display. For example, to modify a VP tunnel with an instance number of 3 on Port 1 of the CSM module in slot 4, you would enter:

```
mvpt 4/1 3
```

Alternatively, you can enter **mvpt** followed simply by the VP tunnel number. Each VP tunnel on the switch has a unique VP tunnel number, which you can find through an **lvpt** command display. Using this method, you could delete a VP tunnel with a number of 7 by entering:

```
mvpt 7
```

For more information on the **mvpt** screens and parameters, see *Virtual UNI/NNI Using Virtual Path (VP) Tunneling* on page 43-20.

## Deleting a VP Tunnel

You can use the **dvpt** command to delete VP tunnels previously created through **cvpt**. To delete a VP tunnel, enter **dvpt** followed by the slot number, a slash (/), and the port number where the VP tunnel currently exists. Enter a space and then the instance number for the VP tunnel. Find the instance number through an **lvpt** display. For example, to delete a VP tunnel with an instance number of 3 on Port 1 of the CSM module in slot 4, you would enter:

```
dvpt 4/1 3
```

Alternatively, you can enter **dvpt** followed simply by the VP tunnel number. Each VP tunnel on the switch has a unique VP tunnel number, which you can find through an **lvpt** command display. Using this method, you could delete a VP tunnel with a number of 7 by entering:

```
dvpt 7
```

A prompt displays to confirm the deletion. After you answer that prompt a message displays to indicate whether the VP tunnel was deleted.

# Configuring a LECS ATM Address

The **masrt** command configures LANE Configuration Server (LECS) ATM addresses on an ATM cell switch. This command modifies the service registry table in the Integrated Local Management Interface (ILMI) database. ILMI is responsible for the LECS ATM address as this address is configured on the network side of a user-to-network (UNI) connection.

LANE clients find a LECS address by going directly to the ILMI service registry table or by using the ATM Well-Known Address (WKA) for a LECS. The LANE client will typically use the well-known address to locate the LECS. This well-known ATM address for a LECS is as follows:

**47007900000000000000000000A03E00000100**

However if you want to configure multiple LECSs (e.g., redundant configurations) or if your LANE client bypasses the LECS well-known address and goes straight to the ILMI service registry table for the LECS address, then you will have to use **masrt** .

Multiple LECS can be helpful. LANE clients (LECs) use the LECS to locate LANE servers. If the LECS is unavailable and you have not configured another LECS in ILMI, then no new clients will be able to locate the LANE server. You can configure up to 16 LECS addresses in the service registry table of an ATM switch.

Instructions for using **masrt** are provided as follows:

1. Enter **masrt** and press **<Enter>**. A screen similar to the following displays:

```
ATM Service Registry Table configuration:

 ATM Service Registration Table is empty!

(add/save/quit/cancel/help)
  :
```

2. Enter **add** at the colon prompt (:) and press **<Enter>**. The following prompt displays:

```
Enter 20 byte ATM address:
```

3. Enter the ATM address that you want to configure and press **<Enter>**. The following prompt displays:

```
Type of Service ([L]ecs/[A]ns): (L)
```

4. Indicate whether the ATM address is for a LECS or an ATM Name Server (ANS). The ANS is also part of the ILMI database. By default this prompt will select LECS. If this address is for an ANS, then you must specifically select **A**. Press **<Enter>** after making your selection.

5. If the ATM address you set up is for a LECS, then the following prompt displays:

   **Map WKA to this LECS address:**

   Indicate whether you want the LECS Well-known Address (WKA) to be mapped to this new address. Enter a **Y** for Yes or an **N** for No. In most cases, you will want to indicate Yes at this prompt. If you enter **Y** here, then a LANE client that cannot reach the LECS by well-known address may query (if configured to perform such queries) the service registry table for the address. If you indicate **N**, then the LANE client will not be able to see this address when searching for the LECS by well-known address.

   The standard **masrt** prompt re-displays:

   ```
   (add/save/quit/cancel/help)
     :
   ```

6. Enter **save** to save the settings you just configured. You can now enter **quit** to exit the command.

## Mapping Service Registry Table Addresses to the Well-Known Address

When you map a new LECS address to the well-known address through **masrt** (Step 5 in the above instructions) LANE clients will be able to access the address in the event the well-known address is not available. If the well-known address is not accessible, LANE clients may query (when they are configured to make such queries) the LECS addresses in the service registry table until they find one that is available.

**♦ Note ♦**

Mapping an ATM address to the well-known address does *not* change the well-known address. It just makes the additional LECS address accessible to LANE clients.

You can find out if a LECS address has been mapped to the well-known address by entering the **masrt** command. If any addresses have been configured, they will display. For example, the following **masrt** display shows two configured LECS addresses.

```
ATM Service Registry Table configuration:

1) LECS address - 3902689001bc900001017e2b200020da00004000   WKA
2) LECS address - 3902691001bc900001017e2b200020da00004000   WKA

(add/save/quit/cancel/help)
:
```

Note the **WKA** after the LECS addresses. The WKA (Well-Known Address) indicates that both addresses are accessible to LANE clients. The order of the addresses is important. Once a LANE client starts to query the service registry table, it will start with the first address and then work its way through the addresses in order until it finds an address that is reachable.

## Modifying Existing Addresses in the Service Registry Table

Once you add ATM addresses to the service registry table, you can modify or delete them. The following **masrt** display shows two configured LECS addresses:

```
ATM Service Registry Table configuration:

1) LECS address - 3902689001bc900001017e2b200020da00004000   WKA
2) LECS address - 3902691001bc900001017e2b200020da00004000   WKA

(add/save/quit/cancel/help)
:
```

To modify an address, type the index number of the address (1 or 2 in the above example), an equal sign, then the new ATM address. For example, to change the second ATM address to **3902841001bc900001017e2b200020da00004000**, you would enter the following at the colon prompt:

```
2=3902841001bc900001017e2b200020da00004000
```

To delete an address, type the index number of the address, an equal sign, then a period (.). For example, to delete the second ATM address in the sample shown above, you would enter:

```
2=.
```

# Viewing ATM Layer Statistics

The **vls** command displays the ATM layer statistics table. This table provides a summary of transmit and receive activity on all ports of a given CSM, FCSM, or ASM module. The following screen is a sample of the output from the **vls** command:

```
                                ATM Layer Statistics

Slot  Port  Rx SDUs     Tx SDUs     Rx Cells    Tx Cells    Rx Octets   Tx Octets
====  ====  ==========  ==========  ==========  ==========  ==========  ==========
3     1     0           302458      0           978672      0           46976256
3     2     0           236         0           236         0           11328


                              CSM ATM Layer Statistics

Slot  Port  Received Cells          Received CLP=0 Cells   Received CLP=1 Cells
====  ====  ====================   ====================   ====================
3     1                  978672                 978672                      0
3     2                     236                    236                      0
5     1                       0                      0                      0
5     2                       0                      0                      0
5     3                       0                      0                      0
5     4                     432                    432                      0
5     5                       0                      0                      0
5     6                       0                      0                      0
5     7                       0                      0                      0
5     8                       0                      0                      0


                              CSM ATM Layer Statistics

Slot  Port  Transmitted Cells       Mark EFCI Cells        Marked GCRA Cells
====  ====  ====================   ====================   ====================
3     1                       0                      0                      0
3     2                      92                      0                      0
5     1                       0                      0                      0
5     2                       0                      0                      0
5     3                       0                      0                      0
5     4                     236                      0                      0
5     5                       0                      0                      0
5     6                       0                      0                      0
5     7                       0                      0                      0
5     8                       0                      0                      0
```

The first part of the display, which is labelled **ATM Layer Statistics**, provides information on the FCSM module ports and ASM module ports (if applicable). In the sample above, information is provided only on the two FCSM internal ports. Descriptions of the columns in this table are provided in Chapter 35, "Managing ATM Access Modules."

Descriptions of the second part of the display, which is labelled **CSM ATM Layer Statistics**, are provided below.

**Slot/Port**. Indicates the CSM module and the port number for which statistical information is provided. Each row in the table gives information for a single CSM port.

**Received Cells**. The total number of ATM cells received on this port since that last initialization of the OmniSwitch. This count includes all cells (data, management, and discarded), regardless of their CLP bit setting.

**Received CLP=0 Cells**. The number of cells received on this port with the CLP bit set to 0. CLP=0 cells have a higher priority than cells with their CLP bit set to 1.

**Received CLP=1 Cells**. The number of ATM cells received on this port with the CLP bit set to 1. CLP=1 cells have a lower priority than cells with their CLP bit set to 0. Under the OmniSwitch policing algorithms, there is a higher probability of CLP=1 cells being discarded than CLP=0 cells being discarded.

**Transmitted Cells**. The total number of cells transmitted from this CSM port. This count includes all cells (data, management, and discarded), regardless of their CLP bit setting.

**Mark EFCI Cells**. The number of ATM cells for which this OmniSwitch set the Explicit Forward Congestion Indication (EFCI) bit. The switch sets the EFCI bit to 1 on cells that experience congestion. See Chapter 42, "Managing Cell Switching Modules (CSMs)," for further information.

**Marked GCRA Cells**. The number of ATM cells this OmniSwitch tagged (i.e., set the CLP bit to 1) during the enforcement of traffic contract parameters. Depending on the Class of Service and traffic descriptors chosen for a virtual connection, an ATM cell may be tagged when it violates one of the traffic contract parameters (i.e., PCR, SCR, or MBS). See Chapter 42, "Managing Cell Switching Modules (CSMs)," for further information on enforcement methods employed by the OmniSwitch.

# Viewing ATM Layer Receive Error Statistics

The **vlrs** command displays the ATM Layer receive error statistics table. This table provides a summary of receive activity on all ports of a given CSM, FCSM, or ASM module. The following screen is a sample of the output from the **vlrs** command:

**ATM Layer Rx SDU Error Statistics**

| Slot | Port | Discards | Errors | Invalid Sz | No Buffers | Trash | CRC Errors |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |

**ATM Layer Rx Cell Error Statistics**

| Slot | Port | Discards | Errors | No Buffers | Trash | CRC Errors |
|---|---|---|---|---|---|---|
| 3 | 1 | 0 | 0 | 0 | 0 | 0 |
| 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 0 | 0 | 0 | 0 | 0 |
| 3 | 2 | 0 | 0 | 0 | 0 | 0 |

**CSM ATM Layer Rx Error Statistics**

| Slot | Port | Total Discard Cells | Dx Congestion/CLP=0 | Dx Congestion/CLP=1 |
|---|---|---|---|---|
| 4 | 1 | 0 | 0 | 0 |
| 4 | 2 | 0 | 0 | 0 |
| 4 | 3 | 0 | 0 | 0 |
| 4 | 4 | 0 | 0 | 0 |
| 4 | 5 | 0 | 0 | 0 |
| 4 | 6 | 0 | 0 | 0 |
| 4 | 7 | 0 | 0 | 0 |
| 4 | 8 | 0 | 0 | 0 |
| 5 | 1 | 0 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 |
| 5 | 3 | 10 | 0 | 0 |
| 5 | 4 | 3 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 |
| 6 | 1 | 0 | 0 | 0 |
| 6 | 2 | 0 | 0 | 0 |
| 7 | 1 | 3 | 0 | 0 |
| 7 | 2 | 9 | 0 | 0 |

— Output continues on next page —

CSM ATM Layer Rx Error Statistics

| Slot | Port | Dx Cells GRCAA CLP=0 | Dx Cells GCRAA CLP=1 | Dx Cells GCRAB CLP=0 |
|---|---|---|---|---|
| 4 | 1 | 0 | 0 | 0 |
| 4 | 2 | 0 | 0 | 0 |
| 4 | 3 | 0 | 0 | 0 |
| 4 | 4 | 0 | 0 | 0 |
| 4 | 5 | 0 | 0 | 0 |
| 4 | 6 | 0 | 0 | 0 |
| 4 | 7 | 0 | 0 | 0 |
| 4 | 8 | 0 | 0 | 0 |
| 5 | 1 | 0 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 |
| 5 | 3 | 0 | 0 | 0 |
| 5 | 4 | 0 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 |
| 6 | 1 | 0 | 0 | 0 |
| 6 | 2 | 0 | 0 | 0 |
| 7 | 1 | 0 | 0 | 0 |
| 7 | 2 | 0 | 0 | 0 |

CSM ATM Layer Rx Error Statistics

| Slot | Port | Dx Cells GRCAA CLP=1 | Unknown VP/VC Cells | Unknown VPI | Unknown VCI |
|---|---|---|---|---|---|
| 4 | 1 | 0 | 0 | 0 | 0 |
| 4 | 2 | 0 | 0 | 0 | 0 |
| 4 | 3 | 0 | 0 | 0 | 0 |
| 4 | 4 | 0 | 0 | 0 | 0 |
| 4 | 5 | 0 | 0 | 0 | 0 |
| 4 | 6 | 0 | 0 | 0 | 0 |
| 4 | 7 | 0 | 0 | 0 | 0 |
| 4 | 8 | 0 | 0 | 0 | 0 |
| 5 | 1 | 0 | 8 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 | 0 |
| 5 | 3 | 0 | 10 | 0 | 0 |
| 5 | 4 | 0 | 3 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 | 0 |
| 6 | 1 | 0 | 0 | 0 | 0 |
| 6 | 2 | 0 | 0 | 0 | 0 |
| 7 | 1 | 0 | 3 | 0 | 0 |
| 7 | 2 | 0 | 9 | 0 | 0 |

The first part of the display, which is labelled **ATM Layer Rx SDU Error Statistics**, provides information on the FCSM module ports and ASM module ports (if applicable). In the sample above, information is provided only on the two FCSM internal ports. Descriptions of the columns in this table are provided in Chapter 35, "Managing ATM Access Modules."

Descriptions of the second part of the display, which is labelled **CSM ATM Layer Rx Error Statistics**, are provided on the next page.

**Slot/Port**. Indicates the CSM module and the port number for which statistical information is provided. Each row in the table gives information for a single CSM port.

**Total Discard Cells**. The total number of cells that were discarded by this OmniSwitch due to congestion and/or traffic contract violations.

**Dx Congestion/CLP=0**. The total number of CLP=0 (high priority) cells that were discarded during a congestive state.

**Dx Congestion/CLP=1**. The total number of CLP=1 (low priority) cells that were discarded during a congestive state.

**Dx Cells GCRAA CLP=0**. The total number of CLP=0 (high priority) cells that were discarded because they violated traffic parameters policed by the first Generic Cell Rate Algorithm (GCRA), or "leaky bucket." For more information on GCRAs, see Chapter 42, "Managing Cell Switching Modules (CSMs)," .

**Dx Cells GCRAA CLP=1**.The total number of CLP=1 (low priority) cells that were discarded because they violated traffic parameters policed by the first Generic Cell Rate Algorithm (GCRA), or "leaky bucket." For more information on GCRAs, see Chapter 42, "Managing Cell Switching Modules (CSMs)."

**Dx Cells GCRAB CLP=0**. The total number of CLP=0 (high priority) cells that were discarded because they violated traffic parameters policed by the *second* Generic Cell Rate Algorithm (GCRA), or "leaky bucket." For more information on GCRAs, see Chapter 42, "Managing Cell Switching Modules (CSMs)."

**Dx Cells GCRAB CLP=1**. The total number of CLP=1 (low priority) cells that were discarded because they violated traffic parameters policed by the *second* Generic Cell Rate Algorithm (GCRA), or "leaky bucket." For more information on GCRAs, see Chapter 42, "Managing Cell Switching Modules (CSMs)."

**Unknown VP/VC Cells**. The number of cells received on this port that contained Virtual Path (VPI) and/or Virtual Channel (VCI) identifiers that this OmniSwitch did not recognize. When the OmniSwitch does not recognize the identifiers for a cell, it discards the cell.

## Information on the Ports for One CSM Board

To view the ATM Layer receive error statistics table on a single CSM board, you enter the **vlrs** command along with the slot number for the CSM board as follows:

**vlrs <slot>**

where **<slot>** is the slot number where the CSM board is installed. For example, if you wanted to obtain status information for the board in slot 5, you would enter:

**vlrs 5**

This command displays a screen similar to the following:

**CSM ATM Layer Rx Error Statistics**

| Slot | Port | Total Discard Cells | Dx Congestion/CLP=0 | Dx Congestion/CLP=1 |
|---|---|---|---|---|
| 5 | 1 | 0 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 |
| 5 | 3 | 10 | 0 | 0 |
| 5 | 4 | 3 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 |

**CSM ATM Layer Rx Error Statistics**

| Slot | Port | Dx Cells GRCAA CLP=0 | Dx Cells GCRAA CLP=1 | Dx Cells GCRAB CLP=0 |
|---|---|---|---|---|
| 5 | 1 | 0 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 |
| 5 | 3 | 0 | 0 | 0 |
| 5 | 4 | 0 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 |

**CSM ATM Layer Rx Error Statistics**

| Slot | Port | Dx Cells GRCAA CLP=1 | Unknown VP/VC Cells | Unknown VPI | Unknown VCI |
|---|---|---|---|---|---|
| 5 | 1 | 0 | 8 | 0 | 0 |
| 5 | 2 | 0 | 0 | 0 | 0 |
| 5 | 3 | 0 | 10 | 0 | 0 |
| 5 | 4 | 0 | 3 | 0 | 0 |
| 5 | 5 | 0 | 0 | 0 | 0 |
| 5 | 6 | 0 | 0 | 0 | 0 |
| 5 | 7 | 0 | 0 | 0 | 0 |
| 5 | 8 | 0 | 0 | 0 | 0 |

Descriptions of the columns included in this display are described earlier in *Viewing ATM Layer Receive Error Statistics* on page 43-35.

## Information on One Port

To view ATM Layer receive error statistics on a single CSM port, you enter the **vlrs** command along with the slot number for the CSM board and the port number for which you want to receive information, as follow:

**vlrs <slot>/<port>**

where **<slot>** is the slot number where the CSM board is installed and **<port>** is the port number on the CSM board. For example, if you wanted to view status information for Port 4 on the CSM module in slot 5, you would enter:

**vlrs 5/4**

This command displays a screen similar to the following:

```
                    CSM ATM Layer Rx Error Statistics

Slot  Port  Total Discard Cells      Dx Congestion/CLP=0   Dx Congestion/CLP=1
==== ==== ================== ================== ==================
5     4     3                     0                     0

                    CSM ATM Layer Rx Error Statistics

Slot  Port Dx Cells GRCAA CLP=0  Dx Cells GCRAA CLP=1  Dx Cells GCRAB CLP=0
==== ==== ================== ================== ==================
5     4     0                     0                     0

                    CSM ATM Layer Rx Error Statistics

Slot  Port Dx Cells GRCAA CLP=1  Unknown VP/VC Cells   Unknown VPI  Unknown VCI
==== ==== ================== ================== ============ ============
5     4     0                     3                     0            0
```

Descriptions of the columns included in this display are described earlier in *Viewing ATM Layer Receive Error Statistics* on page 43-35.

# Viewing ATM Connection Statistics Table

You can view ATM connection statistical information on all ATM boards in the switch, a single CSM board, individual ports, and individual virtual circuits. The **vcs** command, which displays the ATM connection statistics table, is used to provide this information. For CSM ports, this table provides a summary of the Cell Loss Priority (CLP) bit settings for all received and transmitted cells. In addition, the statistics are broken down by VPI and VCI.

## Information on All ATM Boards in a Switch

To view status information on all ATM boards in a switch, you enter the **vcs** command without any parameters as follows:

```
VCS
```

The command displays a screen similar to the following:

```
                                ATM Connection Statistics

Slot  Port  VCI   Rx SDUs   Tx SDUs   Rx Cells   Tx Cells   Rx Octets   Tx Octets
==== ==== ==== ========= ========= ========== ========== ========== =========
3     1     100   0         9647      0          28465      0          1366320


                                CSM Connection Statistics

Slot  Port  VPI   VCI   Received Cells/          Transmitted Cells/
                      Received CLP=0 Cells       Received CLP=1 Cells
==== ==== ==== ==== ==================== ====================
3     1     0     5                    0                    0
                                         0                    0
3     1     0     16                   0                    0
                                         0                    0
3     1     0     18                   0                    0
                                         0                    0
3     2     0     32                   0                    0
                                         0                    0
3     2     0     105                444                  444
                                       444                    0
3     2     0     296                  0                    0
                                         0                    0
3     2     0     369                180                  180
                                       180                    0
3     2     1     560                  0                    0
                                         0                    0
3     2     1     633                  0                    0
                                         0                    0
5     4     0     5                    0                    0
                                         0                    0
5     4     0     16                 182                  182
                                       182                    0
5     4     0     18                   0                    0
```

The first part of the display, which is labelled **ATM Connection Statistics**, provides information on the FCSM module ports and ASM module ports (if applicable). In the sample above, information is provided only on the two FCSM internal ports. Descriptions of the columns in this table are provided in Chapter 35, "Managing ATM Access Modules."

Descriptions of the second part of the display, which is labelled **CSM Connection Statistics**, are provided as follows.

**Slot/Port/VPI/VCI**. These columns identify the virtual circuit for which statistics are displayed. The Slot and Port indicate the physical interface, or CSM port, where this Virtual Circuit is configured. The VPI is the Virtual Path Identifier for the circuit and the VCI is the Virtual Channel Identifier for the circuit.

**Received Cells/Received CLP=0 Cells**. Statistics in this column are displayed as two values for each VPI/VCI row. The top value for each VPI/VCI row is the total number of cells received by this switch on this virtual circuit. The bottom value is the total number of cells with the CLP bit set to 0 received by this switch on this virtual circuit.

**Transmitted Cells/Received CLP=1 Cells**. Statistics in this column are displayed as two values for each VPI/VCI row. The top value for each VPI/VCI row is the total number of cells forwarded by this switch on this virtual circuit. The bottom value is the total number of cells with the CLP bit set to 1 received by this switch on this virtual circuit.

**♦ Note ♦**

If you add the number of received CLP=0 cells and CLP=1 cells (the bottom two values for each VPI/VCI row), the sum will equal the total received cells (the top value in the **Received Cells** column for each VPI/VCI row).

## Information on the Ports for one CSM Board

To obtain status information on a single CSM board, you enter the **vcs** command along with the slot number for the CSM board, as follows:

**vcs <slot>**

where the **<slot>** is the slot number where the CSM board is installed. For example, if you wanted to view status information for the CSM board in slot 3, you would enter:

**vcs 3**

This command displays a screen similar to the following:

**ATM Connection Statistics**

| Slot | Port | VCI | Rx SDUs | Tx SDUs | Rx Cells | Tx Cells | Rx Octets | Tx Octets |
|---|---|---|---|---|---|---|---|---|
| 3 | 1 | 100 | 0 | 9647 | 0 | 28465 | 0 | 1366320 |

**CSM Connection Statistics**

| Slot | Port | VPI | VCI | Received Cells/ Received CLP=0 Cells | Transmitted Cells/ Received CLP=1 Cells |
|---|---|---|---|---|---|
| 3 | 1 | 0 | 5 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 1 | 0 | 16 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 1 | 0 | 18 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 32 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 105 | 444 | 444 |
| | | | | 444 | 0 |
| 3 | 2 | 0 | 296 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 369 | 180 | 180 |
| | | | | 180 | 0 |
| 3 | 2 | 1 | 560 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 1 | 633 | 0 | 0 |

The first part of the display, which is labelled **ATM Connection Statistics**, provides information on the FCSM module ports and ASM module ports (if applicable). In the sample above, information is provided only on the two FCSM internal ports. Descriptions of the columns in this table are provided in Chapter 35, "Managing ATM Access Modules."

The second part of the display, which is labelled **CSM Connection Statistics**, provides information on the CSM module ports. Descriptions of the columns in this table are described earlier in *Viewing ATM Connection Statistics Table* on page 43-40.

## Information on One Port

To obtain status information on a single CSM port, you enter the **vcs** command along with the slot number for the CSM board and the port number for which you want to receive information, as follows:

**vcs <slot>/<port>**

where **<slot>** is the slot number where the CSM board is installed and **<port>** is the port number on the CSM board. For example, if you want to view status information for port 2 on the CSM module in slot 3, you would enter:

**vcs 3/2**

This command displays a screen similar to the following:

**CSM Connection Statistics**

| Slot | Port | VPI | VCI | Received Cells/ Received CLP=0 Cells | Transmitted Cells/ Received CLP=1 Cells |
|---|---|---|---|---|---|
| 3 | 2 | 0 | 32 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 105 | 444 | 444 |
| | | | | 444 | 0 |
| 3 | 2 | 0 | 296 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 369 | 180 | 180 |
| | | | | 180 | 0 |
| 3 | 2 | 1 | 560 | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 1 | 633 | 0 | 0 |

Descriptions of the columns included in this display are described earlier in *Viewing ATM Connection Statistics Table* on page 43-40.

## Information on One Virtual Path

To obtain status information on a single virtual path, you enter the **vcs** command along with the slot number for the CSM board, the port number, and the VPI number for the virtual path on which you want information, as follows:

**vcs <slot>/<port> <vpi>**

where **<slot>** is the slot number where the CSM board is installed, **<port>** is the port number on the CSM board, and **<vpi>** is the virtual path identifier. For example, if you wanted to obtain status information for the board in slot 3, port 2, and VPI 1, you would enter:

**vcs 3/2 1**

This command displays a screen similar to the following:

```
                              CSM Connection Statistics

Slot  Port  VPI   VCI      Received Cells/          Transmitted Cells/
                          Received CLP=0 Cells   Received CLP=1 Cells
==== ==== ==== ==== ==================== ====================
3     2     1     560                    0                      0
                                         0                      0
3     2     1     633                    0                      0
```

Descriptions of the columns included in this display are described earlier in *Viewing ATM Connection Statistics Table* on page 43-40.

## Information on One Virtual Channel

To obtain status information on a single virtual channel, you enter the **vcs** command along with the slot number for the CSM board, the port number, the VPI number, and the VCI number for the virtual channel on which you want information, as follows:

**vcs <slot>/<port> <vpi>/<vci>**

where slot is the **<slot>** number where the CSM board is installed, **<port>** is the port number on the CSM board, and **<vpi>** is the virtual path identifier, and **<vci>** is the virtual channel identifier. For example, if you wanted to obtain status information for the board in slot 3, port 2, VPI 1, and VCI 369, you would enter:

**vcs 3/2 1/633**

This command displays a screen similar to the following:

```
                              CSM Connection Statistics

Slot  Port  VPI   VCI      Received Cells/          Transmitted Cells/
                          Received CLP=0 Cells   Received CLP=1 Cells
==== ==== ==== ==== ==================== ====================
3     2     1     633                    0                      0
```

Descriptions of the columns included in this display are described earlier in *Viewing ATM Connection Statistics Table* on page 43-40.

# Viewing Connection Receive Error Statistics

The **vcrs** command displays the ATM receive error statistics table. This table provides a summary of receive activity on a virtual channel basis. The following screen is a sample of the output from the **vcrs** command:

**ATM Connection Rx SDU Error Statistics**

| Slot | Port | VCI | Discards | Errors | Invalid Sz | No Buffers | Trash | CRC Errors |
|---|---|---|---|---|---|---|---|---|
| 3 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |

**ATM Connection Rx Cell Error Statistics**

| Slot | Port | VCI | Discards | Errors | No Buffers | Trash | CRC Errors |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 100 | 0 | 0 | 0 | 0 | 0 |

**CSM Connection Rx Error Statistics**

| Slot | Port | VPI | VCI | Dx Congestion CLP=0/ Dx GCRA A for CLP=0/ Dx GCRA B for CLP=0 | Dx Congestion CLP=1/ Dx GCRA A for CLP=1/ Dx GCRA B for CLP=1 |
|---|---|---|---|---|---|
| 3 | 1 | 0 | 5 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 1 | 0 | 16 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 1 | 0 | 18 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 32 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 105 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 296 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 369 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 560 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 3 | 2 | 0 | 633 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 5 | 4 | 0 | 5 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 5 | 4 | 0 | 16 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |
| 5 | 4 | 0 | 18 | 0 | 0 |
| | | | | 0 | 0 |
| | | | | 0 | 0 |

The first part of the display, which is labelled **ATM Connection Rx SDU Error Statistics**, provides information on the FCSM module ports and ASM module ports (if applicable). In the sample above, information is provided only on the two FCSM internal ports. Descriptions of the columns in this table are provided in Chapter 35, “Managing ATM Access Modules.”

Descriptions of the second part of the display, which is labelled **CSM Connection Rx Error Statistics**, are provided as follows.

**Slot/Port/VPI/VCI**. These columns identify the virtual circuit for which statistics are displayed. The Slot and Port indicate the physical interface where this virtual circuit is configured. The VPI is the Virtual Path Identifier for the circuit and the VCI is the Virtual Channel Identifier for the circuit.

The next two columns provide information on the number of cells discarded under several conditions. The first column provides information on cells with the CLP bit set to 0; the second column describes cells with the CLP bit set to 1.

**Dx Congestion CLP=0**. This value displays as the top value in the first column for each virtual circuit. It is the number of CLP=0 cells that were discarded during a congestive state. It does *not* include cells discarded due to traffic contract violations. The cells counted here were discarded due to the priority level of their virtual channel (i.e., the QoS and/or User Priority levels were lower than other connections on this CSM port). Some virtual channels have higher priority than others. For example, a virtual channel with a QoS for CBR traffic has a higher priority than a channel with a QoS for ABR traffic. This statistic lists the cells discarded for these priority-based reasons.

**Dx GCRA A for CLP=0**. This value displays as the middle value in the first column for each virtual circuit. It is the number of CLP=0 cells that were discarded because they violated the traffic policing algorithm for the *first* leaky bucket. The policing algorithm describes what happens to traffic when it exceeds traffic contract parameters, such as PCR, SCR, and MBS. Depending on the Class of Service on the circuit and CLP bit setting of the cell, cells that violate the traffic contract will either be tagged or discarded. See Chapter 42, "Managing Cell Switching Modules (CSMs)," for more information on traffic policing and Class of Service.

**Note**

This statistic does not count CLP=0 cells that were discarded during a congestive state; it counts only CLP=0 cells that were discarded during a time of no congestion.

**Dx GCRA B for CLP=0**. This value displays as the bottom value in the first column for each virtual circuit. It is the number of CLP=0 cells that were discarded because they violated the policing algorithm for the *second* leaky bucket. It is technically the same as the **Dx GCRA A for CLP=0** statistic, except it counts only traffic in the second leaky bucket. See the above **Dx GCRA A for CLP=0** description for further information.

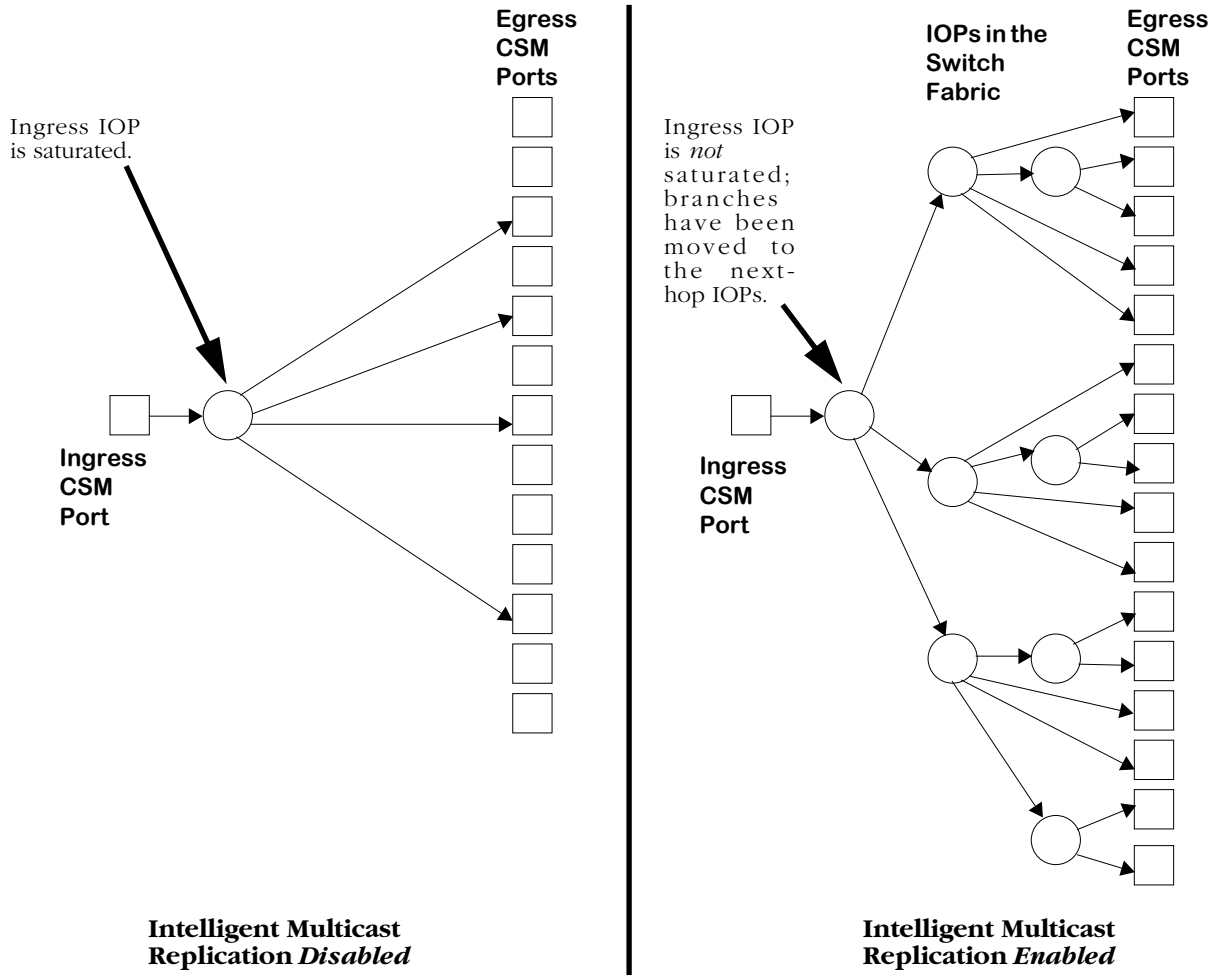
**Dx Congestion for CLP=1**. This value displays as the top value in the second column for each virtual circuit. It is the number of CLP=1 cells that were discarded during a congestive state. It does *not* include cells discarded due to traffic contract violations. The cells counted here were discarded due to the priority level of their virtual channel (i.e., the QoS and/or User Priority levels were lower than other connections on this CSM port). Some virtual channels have higher priority than others. For example, a virtual channel with a QoS for CBR traffic has a higher priority than a channel with a QoS for ABR traffic. This statistic lists the cells discarded for these priority-based reasons.

# Intelligent Multicast Replication

In point-to multipoint (PTOMP) connections, virtual channels are mapped from an ingress CSM port to two or more egress CSM ports. In this configuration, cells branch from an Alcatel-proprietary cell fabric ASIC, known as an Input-Output Processor (IOP), connected to the ingress port (i.e., an "ingress IOP") to egress CSM port(s). The number of branches at the ingress IOP effectively limits the cell input rate.

Intelligent multicast replication is a software algorithm that increases the input cell rate in PTOMP connections by reducing the number of branches at the ingress IOP. This algorithm uses existing branches from the ingress IOP instead of "blindly" branching from an ingress IOP. Instead, this algorithm creates branches at the loopback port of the next-hop IOP. In addition, idle IOPs in the switch are also used in the same manner. (See *Multicast Replication Trees* on page 43-49 for more information on replication trees.)

The figure below provides a side-by-side comparison between the cell fabric of a switch where intelligent multicast replication has not been enabled and a switch where it has been enabled. In the switch without intelligent multicast replication, the ingress IOP has been saturated — the cell input rate *cannot* increase. The switch with intelligent multicast replication enabled, on the other hand, has more egress ports and at the same time can still increase its effective cell input rate.




**Intelligent Multicast Replication Performance Gain**

Intelligent multicast replication is supported on all OC-3 CSM modules (CSM-155-8, CSM-155-8S, CSM-155C-8, FCSM I). It is *not* supported on OC-12 (CSM-622, FCSM II), CSM-A25, or CSM-U modules. However, these modules can join as a "leaf" (i.e., their CSM ports can be used as egress ports) in the intelligent multicast replication tree. In addition, the input cell rate will *not* improve for non OC-3 modules if you enable intelligent multicast replication.

**♦ Note ♦**

Intelligent multicast replication is *not* supported on OC-3 ATM access modules (i.e., ASM, ASM2, and ASX modules).

The following User Interface (UI) commands in the ATM menu are used to support intelligent multicast replication:

**imce**. This command enables intelligent multicast replication. It is described in *Enabling Intelligent Multicast Replication* on page 43-50.

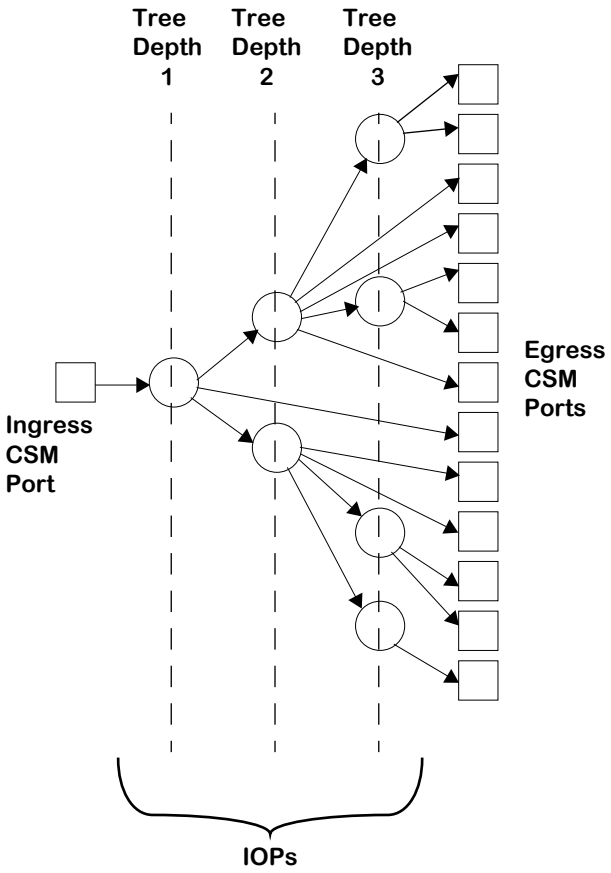
**imcr**. This command disables intelligent multicast replication. It is described in *Disabling Intelligent Multicast Replication* on page 43-50.

**imci**. This command displays the gain in performance from intelligent multicast replication. It is described in *Displaying Intelligent Multicast Replication Performance Gain* on page 43-51.

**imcd**. This command displays the intelligent multicast replication tree. It is described in *Displaying Intelligent Multicast Replication Trees* on page 43-52.

## Multicast Replication Trees

The figure below shows a diagram of the paths of cells in a point-to-multipoint connection. Cells entering the ingress CSM are processed by an IOP, which replicates them so they can be sent to other egress CSM ports and/or IOPs within the switch. These IOPs will, depending on the number of egress connections, also replicate cells. This process of replicating cells by IOPs is also known as a *replication tree*.




**Point-to-Multipoint Replication Tree**

In the figure above the ingress CSM port is at tree depth 1; subsequently, tree depth increases. There is a tree depth of three (3) since three levels of IOPs are involved between the ingress CSM port and the egress CSM ports. You can use the **imcd** command, which is described in *Displaying Intelligent Multicast Replication Trees* on page 43-52, to display the parameters for intelligent multicast replication trees.

## Enabling Intelligent Multicast Replication

To enable intelligent multicast replication on all OC-3 modules in your switch, you use the **imce** command. To use this command, enter

```
imce
```

at the system prompt. The following prompt will be displayed.

```
Do you want to enable Intelligent multicast Feature? (y) :
```

Enter **y** (the default) to enable intelligent multicast replication or **n** to exit the command. If you entered **y**, the following message will be displayed.

```
Intelligent multicast Feature will be enabled upon reboot.
```

You *must* reboot your switch for intelligent multicast replication to take effect.

## Disabling Intelligent Multicast Replication

To disable intelligent multicast replication on all OC-3 modules in your switch, you use the **imcr** command. To use this command, enter

```
imcr
```

at the system prompt. The following prompt will be displayed.

```
Do you want to disable Intelligent multicast Feature? (y) :
```

Enter **y** (the default) to disable intelligent multicast replication immediately or **n** to exit the command. If you entered **y**, the following message will be displayed.

```
Intelligent multicast Feature disabled.
```

Since this takes effect immediately you do not need to reboot your switch.

## Displaying Intelligent Multicast Replication Performance Gain

To display the gain in performance from intelligent multicast replication, you use the **imci** command. The syntax for this command is as follows.

**imci <slot>/<port> [<vpi>/<vci>]**

You can use the **<vpi>/<vci>** option to specify a specific virtual channel. If you do not use this option, then the performance gain for all virtual channels on the port you selected will be displayed.

For example, to display the intelligent multicast replication gain for all virtual channels on Port 1 in Slot 3, enter

**imci 3/1**

at the system prompt. A screen similar to the following will be displayed.

**CSM Intelligent Multicast Tree**

| Incoming | | | | No. of Branches with IMC | Max. BW in Mbps with IMC | Worst case Branches with IMC | Max. BW in Mbps with IMC | Gain in times |
|---|---|---|---|---|---|---|---|---|
| Slot | Port | VPI | VCI | Disabled | Disabled | Enabled | Enabled | |
| 3 | 1 | 0 | 453 | 20 | 16.5 | 3 | 110.0 | 6.66 |
| 3 | 1 | 0 | 455 | 2 | 115.0 | 2 | 115.0 | 1.0 |
| 3 | 1 | 0 | 458 | 20 | 16.5 | 3 | 110.0 | 6.66 |
| 3 | 1 | 0 | 461 | 2 | 115.0 | 2 | 115.0 | 1.0 |

The fields displayed by the **imci** command are described below.

**Incoming Slot**. The incoming slot number of the virtual channel.

**Incoming Port**. The incoming port number of the virtual channel.

**Incoming VPI**. The incoming virtual path identifier of the virtual channel.

**Incoming VCI**. The incoming virtual channel identifier of the virtual channel.

**No. of Branches with IMC Disabled**. The maximum number of branches at any node of the replication tree if intelligent multicast replication has *not* been enabled.

**Max. BW in Mbps with IMC Disabled**. The maximum bandwidth (in Megabits per second) for cells this virtual channel in PTOMP connections if intelligent multicast replication has *not* been enabled.

**Worst case Branches with IMC Enabled**. The maximum number of branches at any node of the replication tree if intelligent multicast replication *has* been enabled.

**Max. BW in Mbps with IMC Enabled**. The maximum bandwidth (in Megabits per second) for cells this virtual channel if intelligent multicast replication *has* been enabled.

**Gain in time**. The ratio between enabling and disabling intelligent multicast replication for this virtual channel. The higher the value in this field the greater the gain in maximum bandwidth will be for this virtual channel.

## Displaying Intelligent Multicast Replication Trees

To display all intelligent multicast replication trees on an ingress CSM port in point-to-multi-point (PTOMP) connections, you use the **imcd** command. The syntax for this command is as follows:

**imcd <slot>/<port> [<vpi>/<vci>]**

You can use the **<vpi>/<vci>** option to specify a specific virtual channel. If you do not use this option, then the intelligent multicast replication trees for all virtual channels on the port you selected will be displayed.

For example, to display the intelligent multicast replication trees for all virtual channels for Port 1 in Slot 3, enter

**imcd 3/1**

at the system prompt. The following prompt will be displayed.

**Do you want to verify conn records? (y) :**

Enter **y** to verify connection records or **n** to ignore this option. The following is a sample display of one (1) intelligent multicast replication tree on a port. A complete display produced by the **imcd** command consists of all intelligent multicast replication trees on an ingress CSM port in PTOMP connections.

**L ==> Loopback port of the IOP serving slot/port**
**P ==> Physical port**

**CSM Intelligent Multicast Tree**

| Tree Depth | Incoming | | | | | Outgoing | | | | | Port |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Slot | Port | VPI | VCI | IOP | Slot | Port | VPI | VCI | IOP | Type |
| 1 | 3 | 1 | 0 | 453 | 4 | 4 | L | 0 | 8192 | 9 | L |
| | | | | | | 4 | L | 0 | 8192 | 8 | L |
| | | | | | | 4 | 1 | 0 | 82 | 8 | P |
| 2 | 4 | L | 0 | 8192 | 9 | 4 | 3 | 0 | 86 | 9 | P |
| | | | | | | 5 | L | 0 | 8192 | 14 | L |
| | | | | | | 7 | 1 | 0 | 107 | 21 | P |
| | 4 | L | 0 | 8192 | 8 | 6 | L | 0 | 8192 | 16 | L |
| | | | | | | 3 | 1 | 0 | 454 | 4 | P |
| 3 | 5 | L | 0 | 8192 | 14 | 5 | L | 0 | 8192 | 13 | L |
| | | | | | | 6 | L | 0 | 8192 | 19 | L |
| | | | | | | 5 | 6 | 0 | 93 | 14 | P |
| | 6 | L | 0 | 8192 | 16 | 4 | L | 0 | 8192 | 10 | L |
| | | | | | | 6 | 2 | 0 | 84 | 16 | P |

— Output continues on next page —

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 5 | L | 0 | 8192 | 13 | 5 | 4 | 0 | 83 | 13 | P |
| | 6 | L | 0 | 8192 | 19 | 5 | L | 0 | 8192 | 12 | L |
| | | | | | | 6 | 8 | 0 | 92 | 19 | P |
| | 4 | L | 0 | 8192 | 10 | 7 | 2 | 0 | 700 | 22 | P |
| | | | | | | 4 | 5 | 0 | 82 | 10 | P |
| 5 | 5 | L | 0 | 8192 | 12 | 9 | L | 0 | 8192 | 31 | L |
| | | | | | | 5 | 2 | 0 | 423 | 12 | P |
| 6 | 9 | L | 0 | 8192 | 31 | 5 | L | 0 | 8192 | 15 | L |
| | | | | | | 9 | 7 | 0 | 122 | 31 | P |
| 7 | 5 | L | 0 | 8192 | 15 | 6 | L | 0 | 8192 | 18 | L |
| | | | | | | 5 | 8 | 0 | 124 | 15 | P |
| 8 | 6 | L | 0 | 8192 | 18 | 4 | L | 0 | 8192 | 11 | L |
| | | | | | | 6 | 6 | 0 | 129 | 18 | P |
| 9 | 4 | L | 0 | 8192 | 11 | 9 | L | 0 | 8192 | 30 | L |
| | | | | | | 4 | 7 | 0 | 125 | 11 | P |
| 10 | 9 | L | 0 | 8192 | 30 | 6 | L | 0 | 8192 | 17 | L |
| | | | | | | 9 | 5 | 0 | 78 | 30 | P |
| 11 | 6 | L | 0 | 8192 | 17 | 9 | L | 0 | 8192 | 28 | L |
| | | | | | | 6 | 4 | 0 | 86 | 17 | P |
| 12 | 9 | L | 0 | 8192 | 28 | 9 | L | 0 | 8192 | 29 | L |
| | | | | | | 9 | 1 | 0 | 74 | 28 | P |
| 13 | 9 | L | 0 | 8192 | 29 | 8 | 2 | 0 | 80 | 26 | P |
| | | | | | | 9 | 3 | 0 | 80 | 29 | P |

**Multicast tree displayed above is successfully validated with the information stored in IOP SRAM.**

The legend at the top of the display provides a definition of non numeric values in the **Incoming Port**, **Outgoing Port**, and **Port Type** fields. A **P** in these fields indicates that port is a physical port in the switch whereas an **L** indicates that the port is a loopback port on an IOP.

If you selected the option to verify the connection records (as shown on the previous page), then a message will be printed after each display for a replication tree that will state if the multicast replication tree has been verified against the data stored in the Static RAM (SRAM) of the CSMs.

The fields displayed by the **imcd** command are described below.

**Tree Depth**. The tree depth indicates one (1) plus the number of hops between the incoming IOP (displayed in the **Incoming IOP** field described below) and the ingress IOP.

**Incoming Slot**. The incoming slot number of the virtual channel.

**Incoming Port**. The incoming port number of the virtual channel.

**Incoming VPI**. The incoming virtual path identifier of the virtual channel.

**Incoming VCI**. The incoming virtual channel identifier of the virtual channel.

**Incoming IOP**. The IOP number (which is assigned by the switch) for the incoming IOP for this tree depth.

**Outgoing Slot**. The outgoing slot number of the virtual channel.

**Outgoing Port**. The outgoing port number of the virtual channel.

**Outgoing VPI**. The outgoing slot virtual path identifier of the virtual channel.

**Outgoing VCI**. The outgoing slot virtual channel identifier of the virtual channel.

**Outgoing IOP**. The IOP number (which is assigned by the switch) for the outgoing IOP for this tree depth.

**Port Type**. This field will display an **L** if the next hop from the outgoing IOP is a loopback port on another IOP, or a **P** if the next hop is a physical port on a CSM.