CONFIGURING FRAME RELAY SERVICE OVER DSL

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PRELIMINARY DRAFT

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About This Guide

Document Purpose and Intended Audience

This manual describes the deployment of a wholesale frame relay service using DSL. It is intended for DSL access providers who provide wholesale frame relay access to frame relay network service providers (NSPs).

Document Summary

Section	Description
Chapter 1	*Network Views.* Provides an overview of the roles and concerns of the DSL provider and the frame relay NSP.
Chapter 2	*Provisioning Procedures.* Describes the steps required to deploy a frame relay service over DSL.
Appendix A	*Frame Relay to ATM Conversion for nrt-VBR Service*. Contains information necessary to provision an ATM channel to support frame relay using FRF.8.
Appendix B	*Port Mapping Table.* Shows the VPI/VCI default values assigned to circuits on the line card and the SCM for user data and user voice service.
Glossary	Defines acronymns and terms used in this document.
Index	Lists key terms, acronymns, concepts, and sections in alphabetical order.

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Product-Related Documents

Document Number	Document Title
7800-A2-GZ41	*OpenLane 5.x Service Level Management for UNIX Quick Start Installation Instructions*
7800-A2-GZ42	*OpenLane 5.x Service Level Management for Windows NT Quick Start Installation Instructions*
8000-A2-GB22	*Hotwire MCC Card, IP Conservative, User's Guide*
8000-A2-GB25	*Hotwire 8100/8200 Interworking Packet Concentrator (IPC) Network Configuration Guide*
8000-A2-GZ40	*Hotwire MCC Card, IP Conservative, Installation Instructions*
8021-A2-GB20	*Hotwire Shelf Concentration Module (SCM) Card User's Guide*
8021-A2-GZ40	*Hotwire Shelf Concentration Module (SCM) Card Installation Instructions*
8335-A2-GB20	*Hotwire ATM Line Cards, Models 8335 and 8365, User's Guide*
8335-A2-GZ40	*Hotwire ATM Line Cards, Models 8335 and 8365, Installation Guide*
8820-A2-GN20	*Hotwire 8820 GranDSLAM Installation Guide*
9783-A2-GB20	*FrameSaver DSL 9783 User's Guide*
9783-A2-GN10	*FrameSaver DSL 9783 Installation Instructions*

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Network Views

1

Overview

This chapter describes the responsibilities and concerns of the Digital Subscriber Line (DSL) provider and the frame relay network service provider (NSP).

Figure 1-1 reflects the perspective of the DSL provider.

- The DSL provider's customer is the frame relay NSP.
- The DSL provider knows what resources are dedicated to the frame relay NSP.
- The DSL provider has an endpoint-to-frame relay NSP focus (no end-to-end or end user focus).

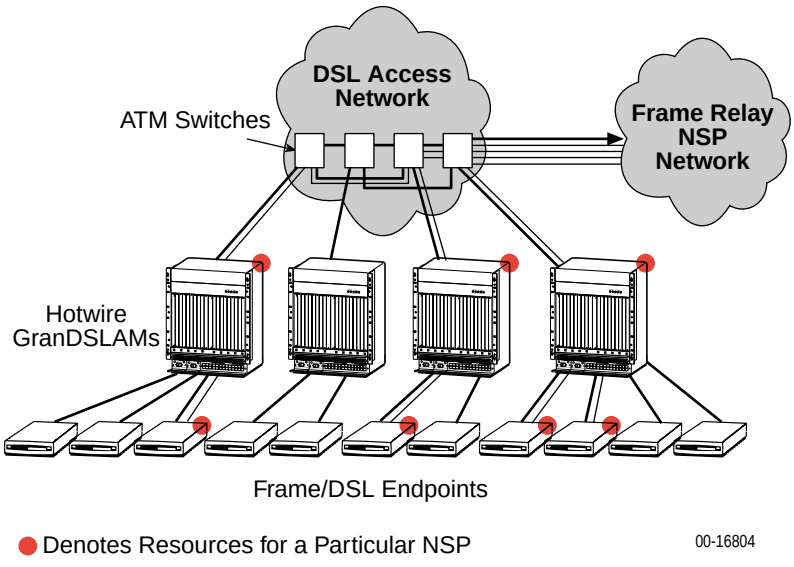


Figure 1-1. DSL Provider's Perspective: Wholesale Model

Figure 1-2 reflects the perspective of the frame relay NSP.

In general, the frame relay NSP wants to view the DSL provider's network exactly as they view a leased line access network. This desire poses special challenges both in the area of traffic management of the data and in management access and administration of the FrameSaver® DSL endpoints.

- The frame relay NSP's customer is the commercial end user.
- The frame relay NSP knows what resources are dedicated to each customer.
- The frame relay NSP has an end-to-end SLA and end user customer focus.

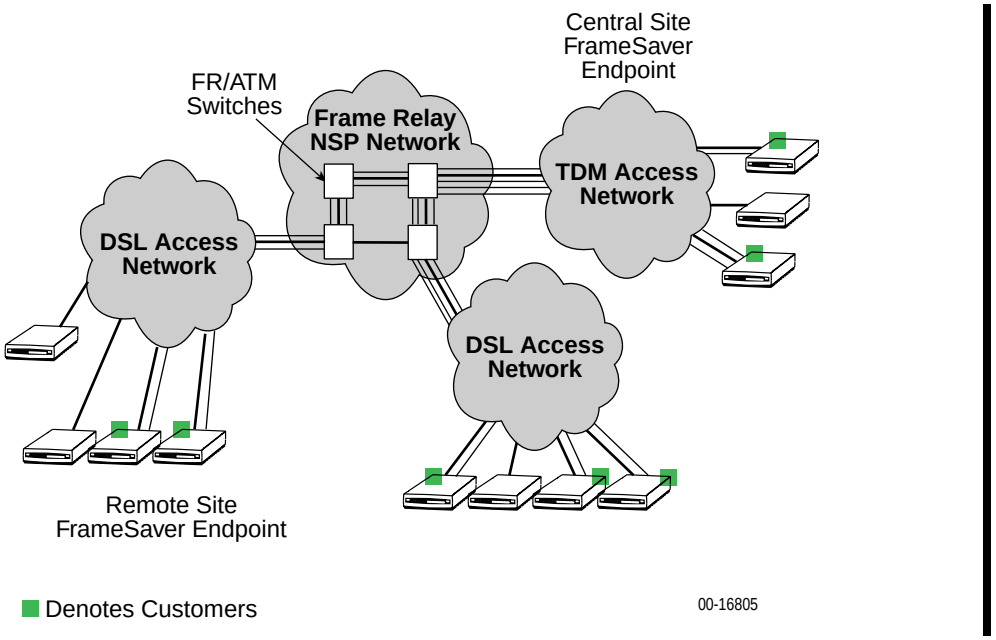


Figure 1-2. Frame Relay NSP's Perspective: End-to-End SLA Model

Entire Network Model

It is important to understand the entire network model and the components. The network in Figure 1-3 will be used to discuss various configurations and how they interact with each other.

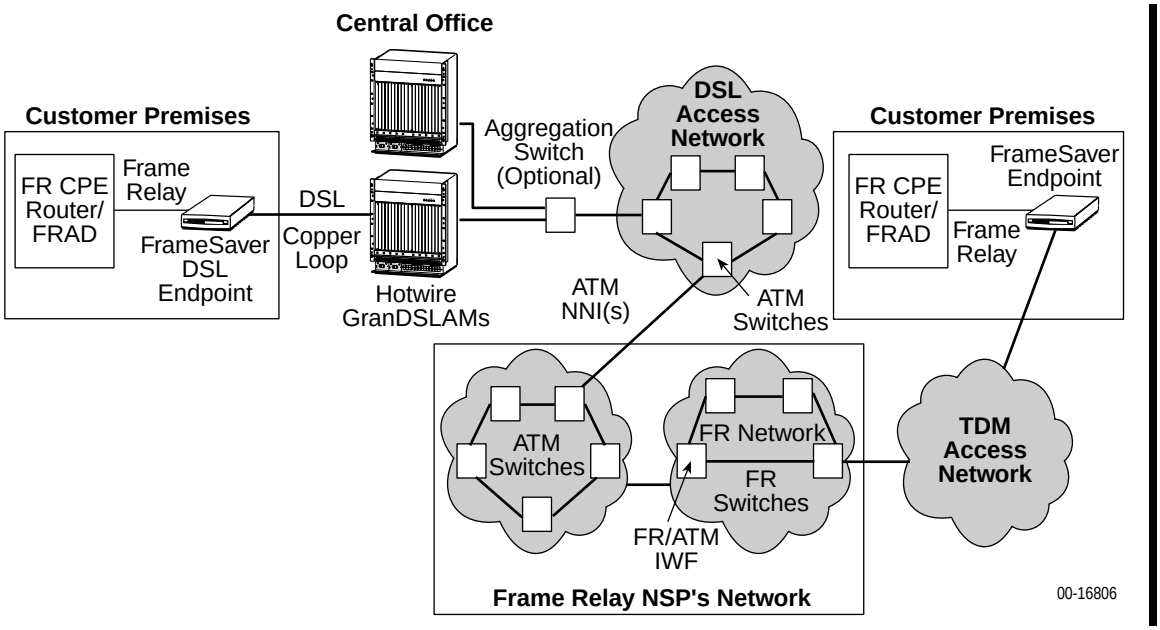


Figure 1-3. Entire Network View

One of the decisions that the DSL provider and frame relay service provider need to make is whether to design the network:

- To transfer data as soon as possible to the frame relay network (see Figure 1-4), or
- To back-haul the traffic to a small number of interface points between the networks (see Figure 1-5).

The DSL provider uses less bandwidth in the access network if the data is transferred as soon as possible to the frame relay service provider's network. However, more Network Node Interface (NNI) points between the two networks must be configured and administered. Back-hauling the traffic to a single NNI helps in administering the NNIs, but uses more circuits and trunk bandwidth. The following diagrams illustrate the two methods.

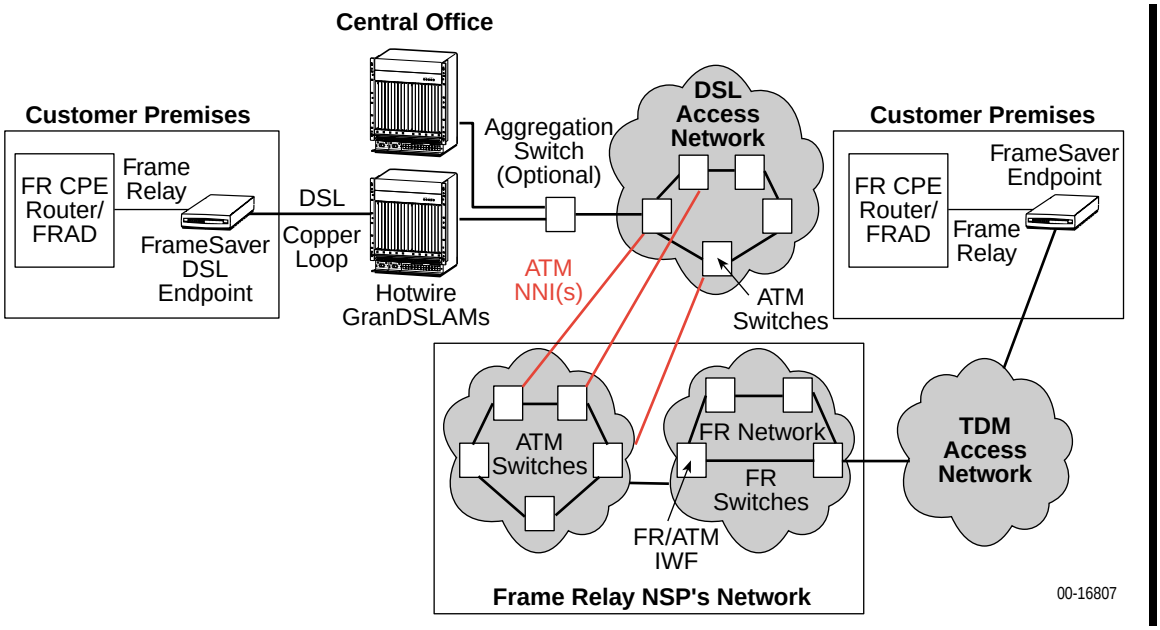


Figure 1-4. Short-Haul to Many NNIs

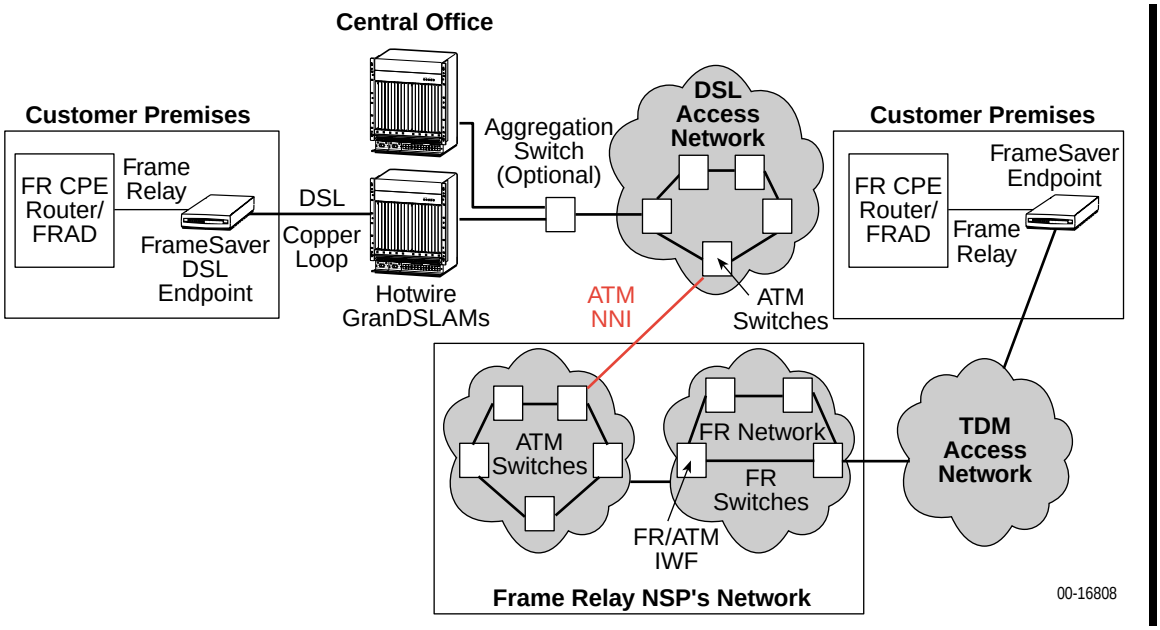


Figure 1-5. Back-Haul All Traffic to a Single NNI

Interworking Function Behavior and Protocol Encapsulation

A frame relay service provider typically performs the ATM-to-frame relay interworking inside their network.

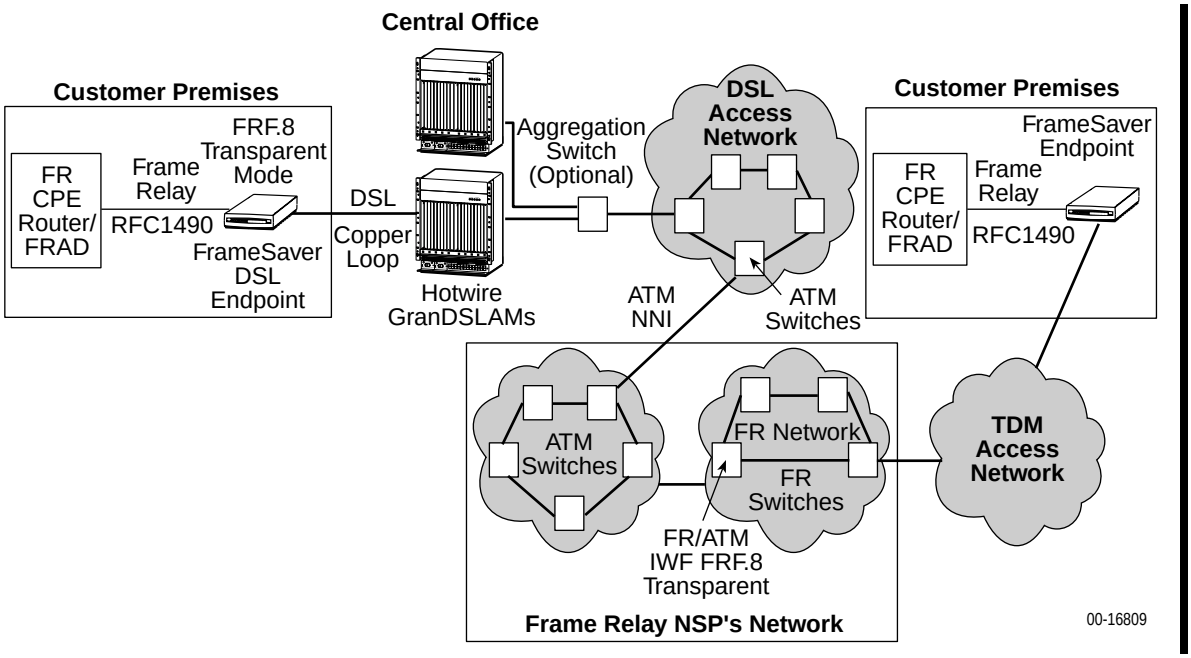


Figure 1-6. RFC 1490 Encapsulation and FRF.8 Transparent Mode

FRF.8

FRF.8 is a Frame Relay Forum implementation agreement, which is available from the Frame Relay Forum Web page (**www.frforum.com**). FRF.8 terminates the LMI and translates between ATM (OAM) and FR (LMI) messages and also the indicators in the frame and ATM headers. FRF.8 has two modes:

- Transparent mode

  FRF.8 Transparent mode is typically used in frame relay service deployments as no translation is needed. The data is carried transparently through the ATM network, maintaining its RFC 1490 format, which can be used to encapsulate any desired protocol. The FrameSaver DSL endpoint provides FRF.8 Transparent mode interworking.

- Translational mode

  FRF.8 Translational mode is typically used when an end-to-end frame relay Service is not being deployed and a mixture of CPE access link layer protocols is used.

Typically there is a single PVC from the DSL endpoint to each destination location, rather than multiple PVCs to each location or region. Therefore the FRF.8 is more efficient as the LMI is local (that is, there is no LMI overhead to the network interworking point) and there is no frame header overhead. Even if there were more than one PVC at an endpoint, and they all went to the same region, they still might not go through the same internetworking function. It depends on whether the DSL provider is back-hauling the data to a single NNI point for transfer to an Interexchange Carrier (IXC) network (adding latency and causing potential bottlenecks at the NNI) or the data is transferred as soon as possible to the IXC (implying regional NNIs and more internetworking points but also more administrative complexity).

In the FrameSaver DSL endpoint, as in most switches today, conversion is performed between ATM OAM F5 AIS/RDI and frame relay LMI DLCI active/inactive indications. This is specified as part of FRF.8 and ensures that VC active/inactive indicators are propagated through the interworking function and across both frame relay and ATM network segments properly. Thus, if an ATM VPI/VCI becomes inactive (due to internal network or local loop failure), the indication that the circuit is inactive will be propagated to the frame relay endpoint and vice versa.

Information Given to the DSL Provider by the Frame Relay Service Provider

Certain information must be communicated between the DSL provider and the NSP when providing network connection of a customer. It is recommended that when a frame relay service provider requests service from the DSL service provider on behalf of a customer, the following information is provided by the frame relay service provider as part of the request/work order.

- Customer Related Parameters:
  - — Location of Customer's equipment
  - — Number of PVCs
  - — End User Maximum Port Rate (must be greater than the sum of the CIRs of each VC on the DSL line)
- NSP Management Access Parameters for each NSP:
  - — Node IP address and subnet mask (frame relay NSP address space for frame realy NSP management)
  - — (Optional) SNMP Community Name for end-point device (use Community Name 2 for NSP access)
- General Circuit Parameters:
  - — Circuit Identifier
- Frame relay parameters for each PVC:
  - — CIR – Committed Information Rate
  - — B_c – Committed Burst Size
  - — B_e – Excess Burst Size
- ATM Traffic parameters (as needed) for each nrt-VBR PVC:
  - — PCR – Peak Cell Rate
  - — SCR – Sustained Cell Rate
  - — MBS – Maximum Burst Size
  - — CDVT – Cell Delay Variation Tolerance

Circuit Identifier

The circuit identifier must uniquely identify the circuit both to the DSL provider and to the frame relay service provider. It is a very powerful parameter as it is used to identify a particular circuit in all future administration of the circuit, such as configuration changes, troubleshooting, and communications between the DSL provider and the frame relay service provider. Maximum advantage is achieved if this circuit identifier is used throughout the DSL provider and frame relay service provider networks in all access equipment and switches, especially at NNI and interworking points. This allows for easier correlation of statistics and status for troubleshooting network problems and any SLA issues that may arise.

Frame Relay and ATM Parameters

The frame relay and ATM parameters specified for a particular PVC to be configured by the DSL provider should be those same values configured by the frame relay NSP at their FRF.8 Interworking function switch. Using the same values ensures consistency of the VC throughout the network. Although the frame relay service provider specifies these parameters, the DSL provider may want some knowledge about the relationship between the frame relay and ATM parameters, in case any issues arise. Information is provided in Appendix A, *Frame Relay to ATM Conversion*, regarding the relationship of the frame relay and ATM Traffic Parameters, some tradeoffs pointed out and recommendations made.

DSLAM Management Model

Generally, the DSL provider owns the Digital Subscriber Line Access Multiplexers (DSLAMs) and has exclusive management access to this equipment. Access can be provided inband via a management PVC from the Network Operations Center (NOC) to the Hotwire® GranDSLAM carried over the ATM uplink from the Hotwire GranDSLAM, or it can be provided out of band by an Ethernet connection to a local router.

All remote management functions in the Hotwire GranDSLAM are conducted over this management path including configuration, testing, alarm reporting, statistics collection and firmware download. SNMP, Telnet, FTP, and TFTP are the maintenance related applications supported by the Hotwire GranDSLAM's Management Communications Processor (MCP).

DSL Provider Management of the FrameSaver DSL Endpoints

There are two basic endpoint device management approaches:

- On-demand management, whose scope is limited to troubleshooting and downloading, and
- Persistent management, a proactive method.

Using either approach, the DSL provider needs to have access to:

- FTP Download, mainly for device software upgrades, using the OpenLane download feature.
- Telnet, for basic configuration and DSL and ATM layers status information.
- SNMP agent in the device, via the OpenLane™ NMS application. SNMP is primarily used for circuit provisioning, alarm monitoring and reporting, and performance statistics collection.

On-Demand Management of the FrameSaver DSL Endpoints by the DSL Provider

With on-demand management, SNMP access is used mainly for VC configuration, based on the information provided by the frame relay NSP at service initiation. However, with persistent management, SNMP is used not only for VC configuration, but also for alarm logging (Traps) and real-time performance monitoring.

A management VC needs to be configured for each endpoint device as shown in Figure 1-7.

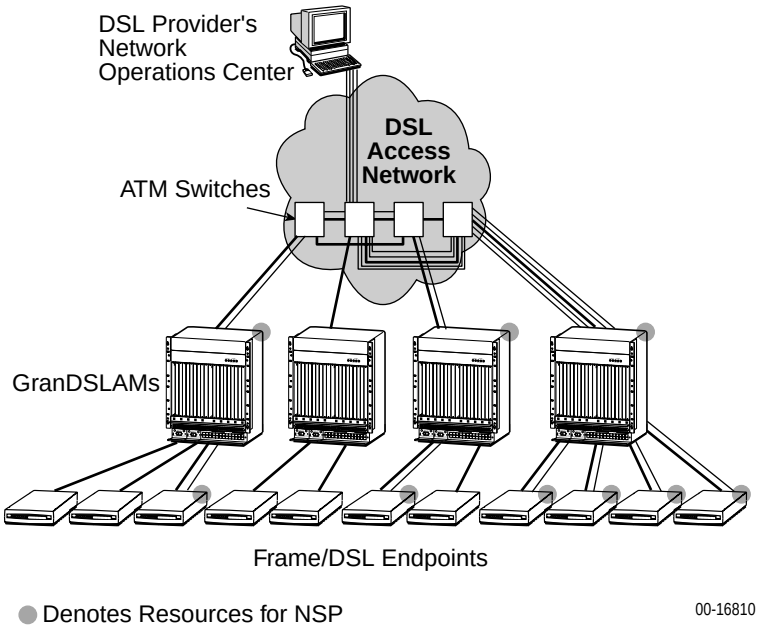


Figure 1-7. DSL Provider's Perspective: Wholesale Model Endpoint Management

In the on-demand management approach, the device's management interface uses a temporary IP address. After installation, the management VCs from the NOC to the Hotwire GranDSLAM are torn down. They will be created again by the DSL provider when access to the device is required.

The TS Management VCs from the endpoints to the Hotwire GranDSLAM uplink interface are normally left in place as there is really no benefit in tearing them down.

Persistent Management of the FrameSaver DSL Endpoints by the DSL Provider

In the persistent management approach, each device's management interface receives a permanent IP address in the DSL provider's IP address space, and a dedicated management VC is created. All dedicated management VCs from the NOC to the end-point devices are indefinitely left in place, for real-time performance monitoring and alarm logging.

Frame Relay NSP Management of the FrameSaver DSL Endpoints

The frame relay service provider performs persistent management of the FrameSaver DSL endpoints when the frame relay service is governed by a Service Level Agreement (SLA). Other minimal frame relay services may only require ad hoc management of the endpoints for diagnostic purposes. It is important for the DSL provider to have some understanding of how the frame relay NSP will manage the FrameSaver DSL endpoints.

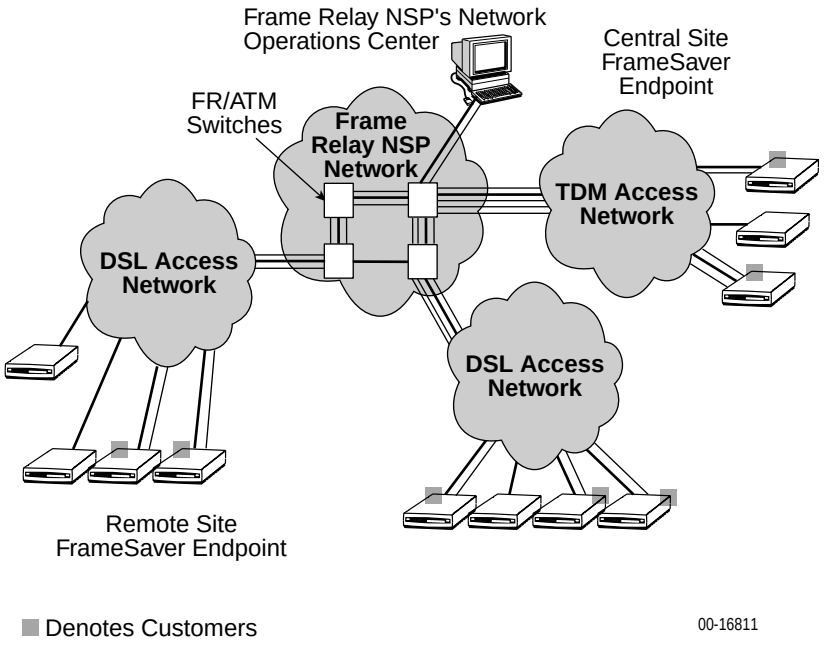


Figure 1-8. Frame Relay NSP's Perspective: End-to-End Management

Persistent Management of the FrameSaver DSL Endpoints by the Frame Relay NSP

The frame relay NSP is responsible for several aspects of managing the endpoints. The frame relay service provider is responsible for the complete end-to-end circuits for their customers. The DSL provider should ensure that the frame relay NSP has access to the endpoint. The frame relay NSP may want to access the endpoint for the following purposes:

- Telnet and SNMP access to perform end-to-end PVC diagnostics
- FTP and SNMP access to upload information to produce SLA reports
- Telnet access to configure the endpoint to send traps to their NOC NMS
- SNMP access to configure the endpoint to send RMON1 Alarms when SLA parameters are exceeded
- SNMP access to configure the endpoint for collection of RMON2 User History data in support of the SLA
- FTP and Telnet access to diagnose customer router and LMI problems

To enable such access, additional endpoint provisioning by the NSP can be done using the IP address the DSL provider configured for them during initial configuration (Node IP Address). The additional provisioning done by the frame relay NSP may include configuring their NMS IP address to receive traps, configuring RMON alarm thresholds, enabling RMON Traps and configuring RMON2 bucket collection information in support of their SLA reports.

Due to the multiplexing capability of all FrameSaver units, the NSP typically only creates a dedicated management PVC to their customer's central site unit. The central site FrameSaver unit routes management traffic in-band to remote units using existing customer data PVCs.

On-Demand Management by the Frame Relay NSP

The frame relay NSP may need ad hoc access to the FrameSaver DSL endpoint. This access may be necessary for troubleshooting even in a managed service, because often the group responsible for troubleshooting will perform troubleshooting for both managed and non-managed services.

Ad hoc management access to the FrameSaver DSL endpoints by the NSP is not recommended.

Endpoint Management Models Summary

<table>
<tr><th colspan="2">DSL Provider</th><th colspan="2">Frame Relay NSP</th></tr>
<tr><th>On-Demand Management</th><th>Persistent Management</th><th>On-Demand Management</th><th>Persistent Management</th></tr>
<tr><td colspan="2">Requires a management VC from the NOC to each endpoint device.</td><td rowspan="3">(Not recommended)</td><td>Uses permanent Node IP address (in frame relay NSP's address space).</td></tr>
<tr><td>Uses temporary IP address assigned to the TS Management Link.</td><td>Uses permanent IP address assigned to Dedicated Management Link.</td><td rowspan="2">Uses management EDLCIs from the central site unit to remote sites, and single management PVC from the frame relay NOC to the central site unit.</td></tr>
<tr><td>Tears down management VC when no longer needed.</td><td>Management VCs are left in place indefinitely.</td></tr>
</table>

Provisioning Procedures

2

Basic Hotwire GranDSLAM Configuration as Performed from the NOC

It is assumed that the following has occurred:

- Basic installation of the Hotwire GranDSLAM in the Central Office (CO), following the steps in the Hotwire GranDSLAM installation manuals for installing the chassis and connecting the interfaces for power, DSL, and management
- Basic installation of the IPC, if required
- Installation of OpenLane in the NOC
- Configuration of the management channel's connectivity parameters including the MCP's IP address and choice of internal (in-band) vs. external (out of band) management path:
  - — For an external path, an external Ethernet cable has been connected from the chassis to an Ethernet hub, switch, or concentrator (IPC)
  - — For an internal path, the diagnostic VPI/VCI for use by the management channel has been chosen on the SCM

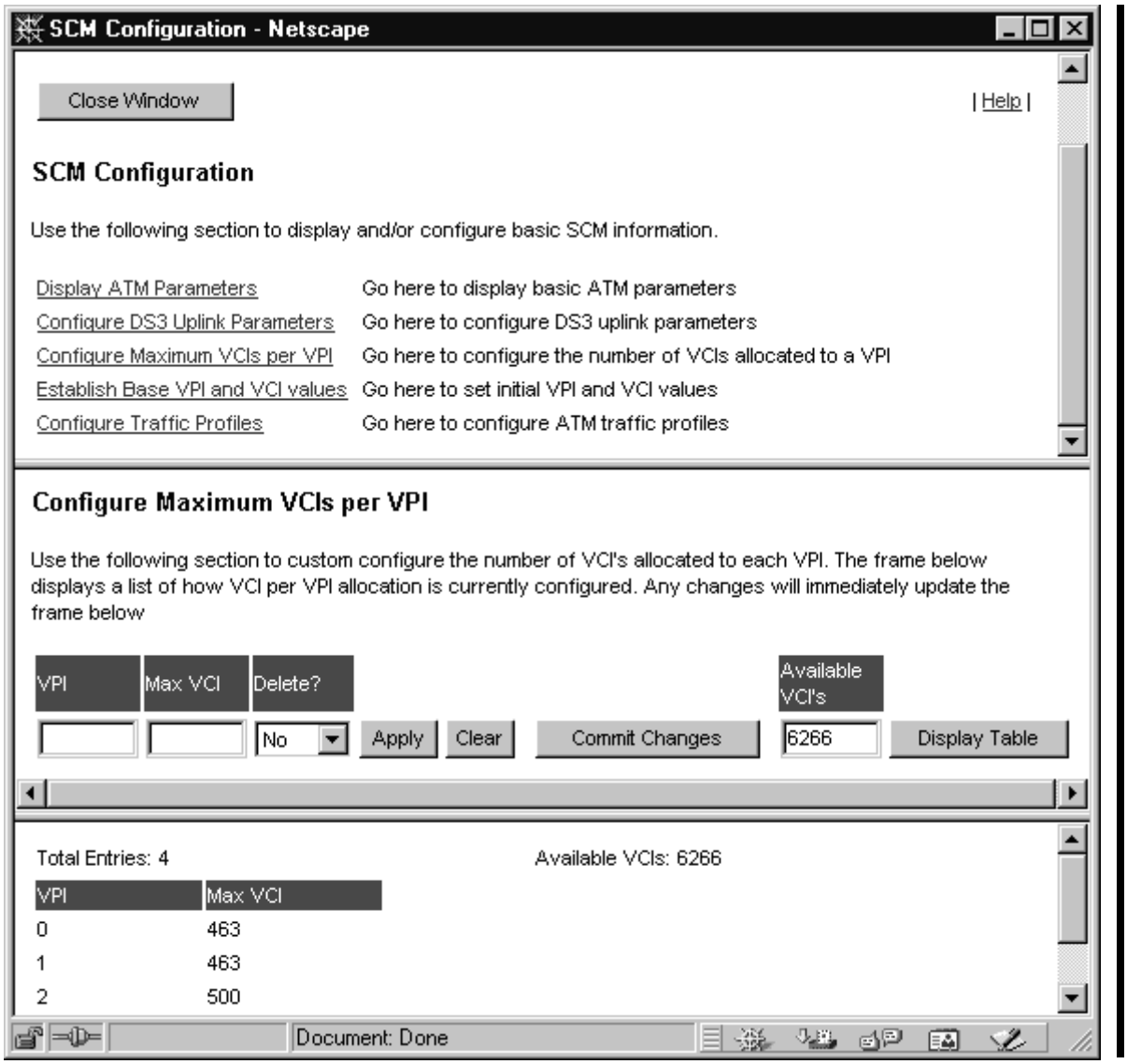
After the initial physical installation of the Hotwire GranDSLAM, MCP, SCM, and associated cabling has been completed, the following steps should be executed:

- Configure the SCM
- Allocate Bandwidth
- Set Up Automatic Cross Connections
- Install One or More Hotwire ATM Line Cards
- Create Traffic Profiles

Step 1: SCM Configuration

Determine how many VPs will be needed on the ATM uplink from each Hotwire GranDSLAM's Shelf Concentration Module (SCM). For each VP, estimate the number of VCs that will be assigned in each VP. Note that the total number of VCs supported by the SCM is 8192.

Using the OpenLane SCM Configuration screen, configure the Maximum VCIs per VPI for each VC.



After configuration, the SCM must be rebooted.

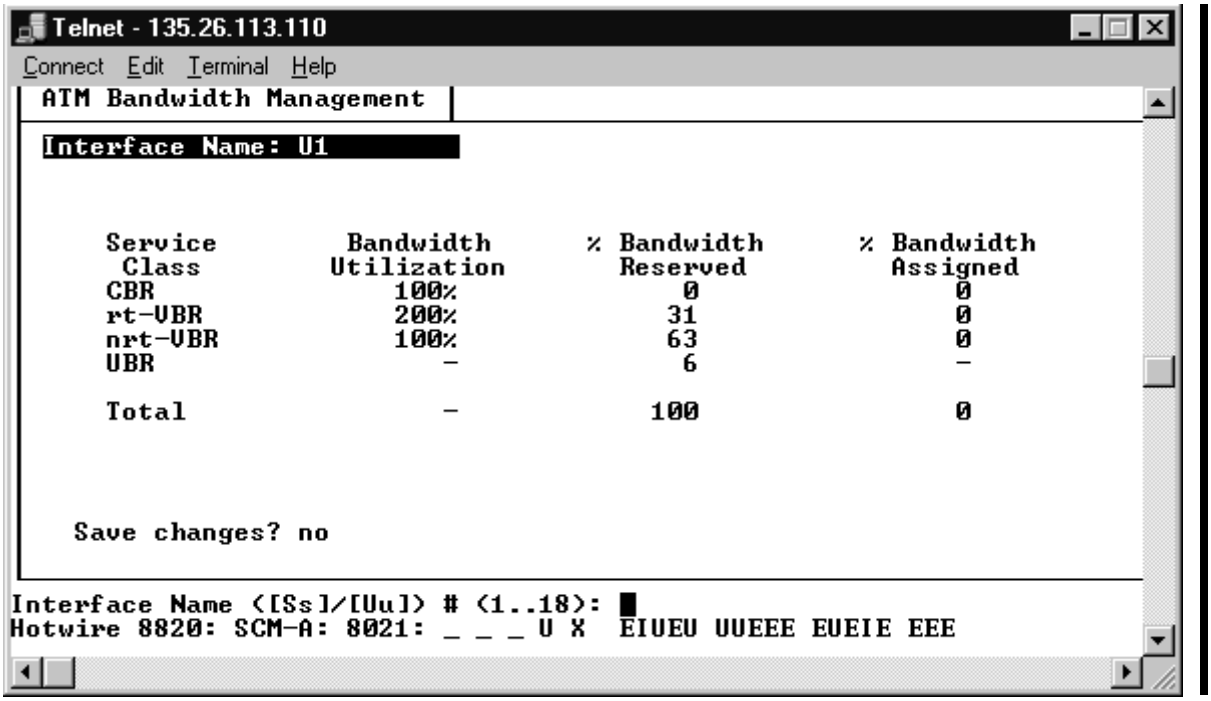
Step 2: Allocate Bandwidth

Allocate a percentage of the bandwidth on the uplink for the frame relay nrt-VBR traffic. Uplink bandwidth reservation is important when deploying multiple services using the same Hotwire GranDSLAM, such as voice over ATM (typically rt-VBR), best effort ISP data (UBR), and frame relay over DSL (nrt-VBR). It is important to allocate enough bandwidth on the uplink to support the necessary services. For deployment of frame relay over DSL, the bandwidth allocated on the uplink (nrt-VBR) must be at least the sum of the expected SCR values for the projected VCs to be deployed, with additional bandwidth as required for any other services using nrt-VBR. Frame relay over DSL (and any other services using nrt-VBR) should not be oversubscribed as SLA penalities may apply to the frame relay over DSL service if the CIR is not met.

The bandwidth allocation percentage for interface U1 (the SCM uplink) for the nrt-VBR class of service should equal the sum of the SCRs for each VC on the uplink in the nrt-VBR class divided by the uplink bandwidth.

The bandwidth allocation percentage for interface S(*n*) (the cell bus to slot *n*) for the nrt-VBR class of service should equal the sum of the SCRs for each VC on the cell bus to a line card in slot *n* of the Hotwire GranDSLAM in the nrt-VBR class divided by 28 Mbps. (28 Mbps is the cell bus bandwidth used when the chassis is fully loaded.)

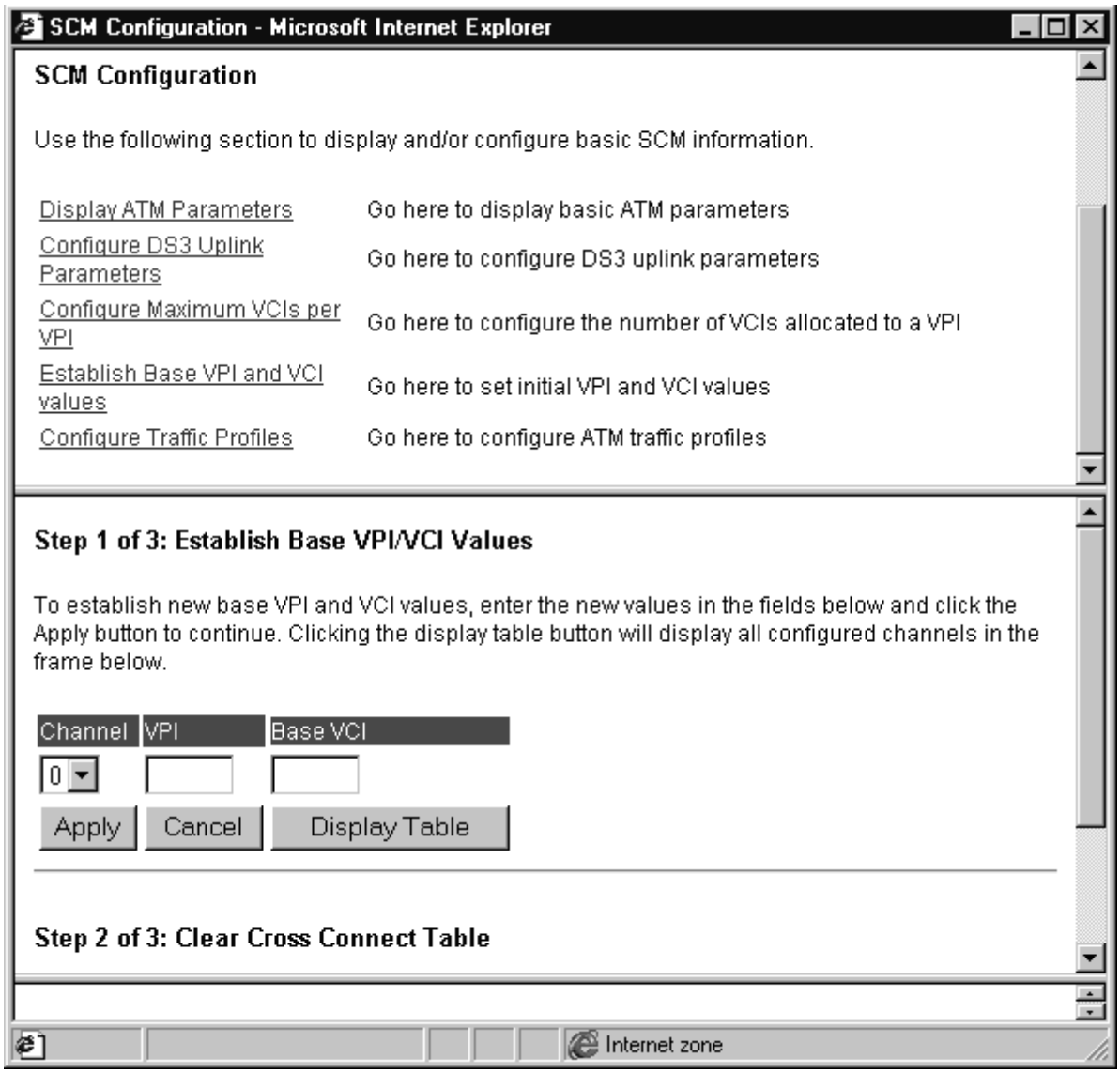
In the following example, the uplink bandwidth reservation for frame relay traffic (nrt-VBR) has been set to 63%, and the bandwidth utilization has been set to 100% (no oversubscription).



Step 3: Set Up Automatic Cross Connections

The Hotwire GranDSLAM has powerful default auto-configuration capabilities to minimize the amount of provisioning required. To take advantage of these features, the next planning and provisioning steps should be followed prior to activating services from the Hotwire GranDSLAM. Refer to Appendix A, *Frame Relay to ATM Conversion*, for additional information on items mentioned in these steps.

On the OpenLane SCM Configuration screen, configure the VPI and starting VCI number for each channel. A channel is a set of default connections. The default for the UBR management Channel 0 is VPI = 0, starting VCI = 32. The default for Channel 1 (the voice over ATM rt-VBR channel) is VPI = 1 and VC = 32. Channels 2 and 3 are not used unless valid VPI/VCIs are specified for them.



Note that if you want to configure two different channels on the same VPI, the starting number for the second channel must be at least 432 (24 x 18) higher than the first channel's starting number.

Verify that the Maximum VCIs per VPI is at least 432 for each VP used for default connections. This is done automatically for Channels 0 and 1, but must be set by the user for Channels 2 and 3 if these are to be used for additional default connections. Set the Maximum VCIs per VPI for the desired uplink VPIs for Channels 2 and 3 and apply the changes before specifying the channel's VPI and starting VCI numbers.

Execute the Clear Cross Connects command and reboot the SCM. This clears all existing cross connections and defines a new set of memory allocations for the default channels that have just been defined. Memory for 24 connections are reserved for each defined channel for each slot. However the actual cross connections are not actually set up until the cards are installed in the chassis.

Step 4: Install One or More Hotwire ATM Line Cards

After you install an ATM line card, the line card identifies itself and specifies how many default cross connections the SCM should activate for it. It also specifies which of four default traffic profiles to use for each channel. The MCP then passes this status message to the SCM, which activates the specified number and type of default cross connects for each port on the card. (Although not necessary, you may wish to check the SCM's cross connect screen after each line card has passed its self-test and has responded to the MCP's status poll to insure that the default auto configuration has been accomplished according to plan.)

For example, a Model 8335 ATM line card installed in Slot 5 will request that two default connections (with traffic profiles VOICE and DATA) be set up by the SCM for 16 ports on the SCM ATM bus to Slot 5.

These ports are defined in Appendix B, *Port Mapping Table*. Note that VPI/VCI 0/40 on the line card is set up as a rt-VBR and is intended for voice over DSL traffic. 0/35 is a UBR VC and will be used as the management path to the endpoint.

Step 5: Create Traffic Profiles

At this point you must create the traffic profiles stored on the Hotwire GranDSLAM (in the SCM and the ATM line cards) that define the different levels of service offered to the customer.

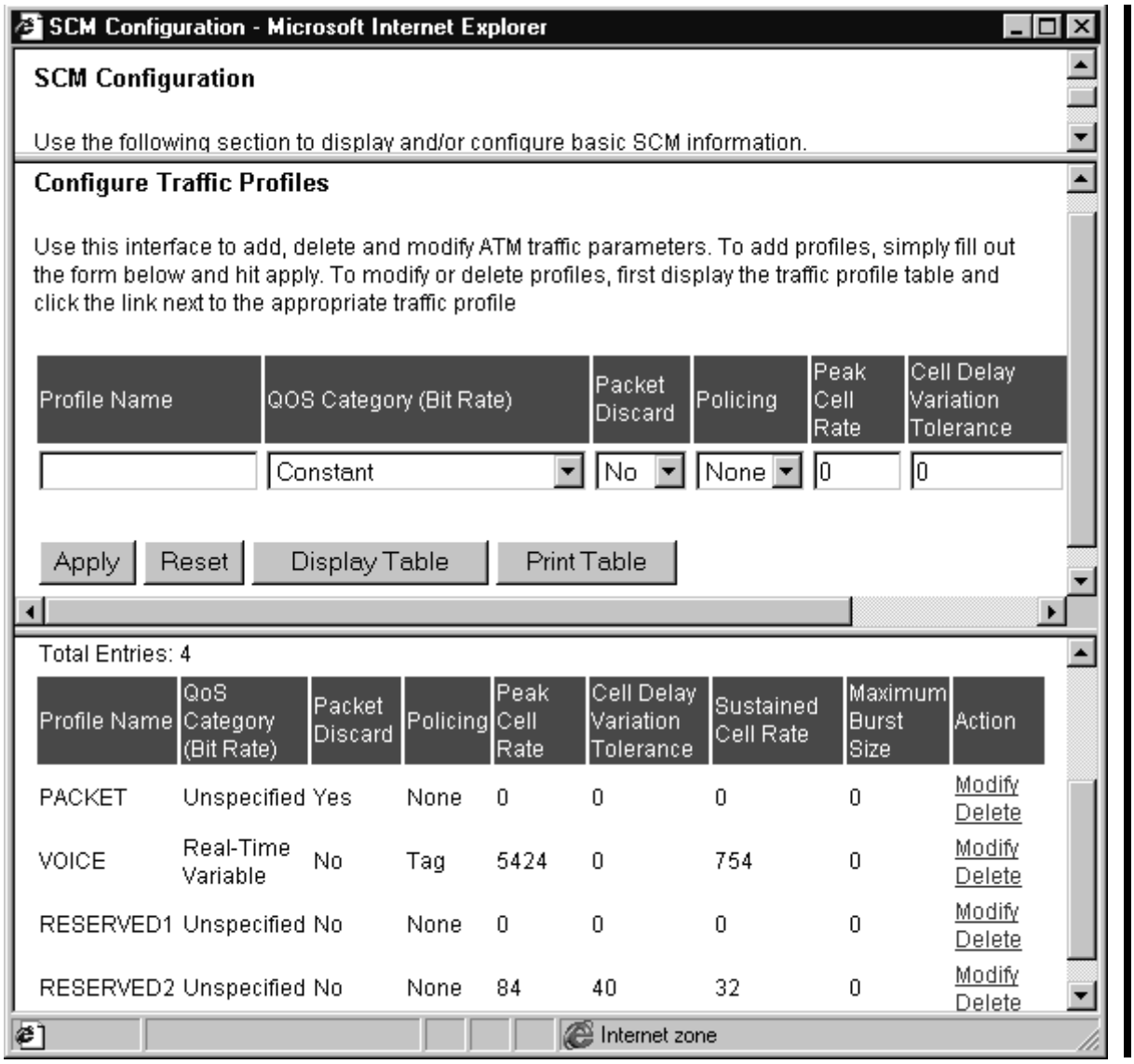
Traffic profiles are required for all connections to allow the SCM to perform its traffic management functions (CAC and policing). Up to 250 traffic profiles can be defined for the SCM. The traffic profiles specify the traffic class of the connection and the expected sustained and peak cell rates (SCR and PCR) as well as the burst rate which relates to delay between cells and can cause jitter in the data flow of real-time traffic resulting in discontinuities in the flow of a voice or video session. Traffic profiles should be based on the desired characteristics of a given service, not on the expected performance of a single connection.

For ease of administration, use the same traffic profiles on the SCM and the ATM line card. In fact, the same set of traffic profiles should be shared among all the cards in the Hotwire GranDSLAM, and the whole Hotwire GranDSLAM network if possible.

Note that traffic profiles that are being used by connections can not be edited, but those that are not in use can. This has two implications:

- If you wish to edit a traffic profile that several custom VCs are using, it is easier and less disruptive to customer data to make a new profile with the parameters you want and then swap the traffic profile names for each affected cross connection than it is to delete the cross connects, edit the traffic profile and rebuild the cross connections.
- The default traffic profiles are editable on the SCM, but only before any line cards have been installed in the Hotwire GranDSLAM and the automatic provisioning of the default connections has begun. If you need to change the default profiles of a running Hotwire GranDSLAM, you will have to first clear all existing cross connections (a disruptive process), edit the default traffic profiles, restart the SCM, then restart each line card to start the automatic assignment process for each card.

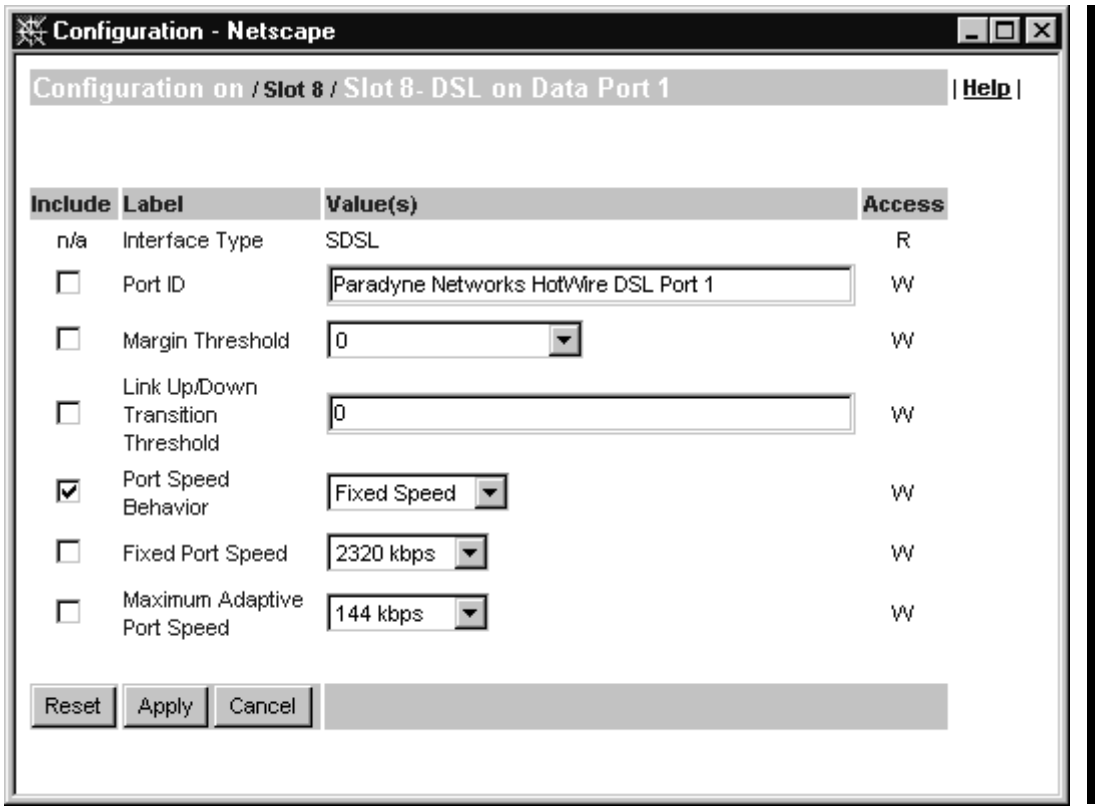
The OpenLane Traffic Profile Configurator supports complete traffic profile management, allowing you to create, edit, and delete profiles. Using OpenLane for this ensures that the same traffic profiles exist on the SCM and all the line cards in the GranDSLAM.


SCM Configuration - Microsoft Internet Explorer
SCM Configuration
Use the following section to display and/or configure basic SCM information.
Configure Traffic Profiles
Use this interface to add, delete and modify ATM traffic parameters. To add profiles, simply fill out the form below and hit apply. To modify or delete profiles, first display the traffic profile table and click the link next to the appropriate traffic profile
Profile Name
QOS Category (Bit Rate)
Packet Discard
Policing
Peak Cell Rate
Cell Delay Variation Tolerance
Constant
No
None
0
0
Apply
Reset
Display Table
Print Table
Total Entries: 4
Profile Name
QoS Category (Bit Rate)
Packet Discard
Policing
Peak Cell Rate
Cell Delay Variation Tolerance
Sustained Cell Rate
Maximum Burst Size
Action
PACKET Unspecified Yes None 0 0 0 0 Modify Delete
VOICE Real-Time Variable No Tag 5424 0 754 0 Modify Delete
RESERVED1 Unspecified No None 0 0 0 0 Modify Delete
RESERVED2 Unspecified No None 84 40 32 0 Modify Delete
Internet zone

Preparing for Service

▶ Procedure

1. Verify that the customer location is within the DSL service provider's network access area, and locate the CO closest to the customer location.
2. Verify that there is a copper pair available.
3. Check loop quality from the CO to the customer premises. If the loop is satisfactory, cross connect the loop to an available port on the ATM line card.
4. Verify that the Hotwire GranDSLAM has resources to support the requested port rate. CAC error messages indicate a lack of resources. Insert a new line card or install a new Hotwire GranDSLAM if necessary.
5. On the ATM line card, configure the following DSL port parameters for the DSL port assigned to the customer:
   - — Link Up/Down Transition Threshold (Should be set to 0 so that every link down occurence can be determined)
   - — Port Speed Behavior (Fixed is recommended, because dynamically changing line speeds may affect the SLAs that the customer expects to receive)
   - — Fixed Port Speed (Must be greater than the sum of the CIRs of each VC on the DSL line)



6. Build the path through the DSL Provider's network to the NOC for the appropriate VC on the uplink to be used for endpoint management. (Refer to Appendix B, *Port Mapping Table*.)
7. If using the Interworking Packet Concentrator (IPC), follow the procedure under *Preparing the IPC*.

Preparing the IPC

▶ Procedure

If using the Interworking Packet Concentrator (IPC), follow these steps:

1. Provision the T3/OC3 link on the IPC connected to the Hotwire GranDSLAM.
2. Create a management PVC on the CSM-U module using the **cvc** command. For example: **cvc 5/2 0/300**

```
Slot 5 Port 2 Connection VPI 0 VCI 300 Configuration
Available bandwidth: Tx=116877 Rx=116877Available
bandwidth: Tx=116877 Rx=116877
1) Description (30 chars max) : Connection 3001)
Description (30 chars max) : Connection 300
2) Outgoing Slot (1-9)     : 52) Outgoing Slot (1-9)
: 5
3) Outgoing Port (1-06)    : 23) Outgoing Port (1-06)
: 2
4) Outgoing VPI (0-0003)    : 04) Outgoing VPI (0-0003)
 : 0
5) Outgoing VCI (32-1022)   : 3005) Outgoing VCI
(32-1022)   : 300
6) Channel Type { vc-nni(3), vc-uni(4) }       : VC-UNI6)
Channel Type { vc-nni(3), vc-uni(4) }       : VC-UNI
7) Transport Priority {CBR(1), CBR_PRS(2), VBR_RT(3), :
UBR7) Transport Priority {CBR(1), CBR_PRS(2), VBR_RT(3),
: UBR
    VBR_NRT(4), ABR(5), UBR(6) }    VBR_NRT(4), ABR(5),
UBR(6) }
8) Multicast Enable { disable(0), enable(1) }     :
Disabled8) Multicast Enable { disable(0), enable(1) }
: Disabled
10) AAL5 Discard Continue { disable(0), enable(1) }  :
Disabled10) AAL5 Discard Continue { disable(0), enable(1)
}  : Disabled
11) Traffic Parameters11) Traffic Parameters
13) Advanced Parameters13) Advanced Parameters
Enter (option=value/save/cancel) Enter
(option=value/save/cancel)
```

3. Choose option 11 (Traffic Parameters) in order to modify the traffic descriptors of the transmit and receive PVC:

```
Slot 5 Port 2 Connection VPI 0 VCI 300 Configuration
Available bandwidth: Tx=116877 Rx=116877
1) Requested Tx QoS Class { Unspecified(0),     :
Unspecified
    Class1(1), Class2(2), Class3(3), Class4(4)}
2) Requested TX Best Effort { False (1), True (2) } :
True
```

```
3) Requested Tx Traffic Descriptor Type { None(1), :
NoCLP NoSCR
    NoCLPNoSCR(2), CLPNoTagNoSCR(3), CLPTagNoSCR(4),
    NoCLPSCR(5), CLPNoTagSCR(6), CLPTagSCR(7) }
    20) Peak Cell Rate (cells/sec) for CLP=0+1    : 3
4) Requested Rx QoS Class              : Unspecified
5) Requested RX Best Effort { False (1), True (2) } :
True
6) Requested Rx Traffic Descriptor Type     : NoCLP NoSCR
    30) Peak Cell Rate (cells/sec) for CLP=0+1    : 3
7) Bi-directional Traffic Params { Off (1), On (2) } : On
Enter (option=value/save/cancel) :
```

Installing the Endpoint

▶ Procedure

1. Connect the FrameSaver DSL endpoint device to the DSL loop at the customer premises as described in the *FrameSaver DSL 9783 Installation Instructions*.
2. Check the front panel LEDs to be sure the DSL line is trained.

   In the Network group of the front panel LEDs, both the ATM LED and the DSL LED should be solid green. If the DSL LED is flashing, the network interface is in the process of training. If the ATM LED is yellow, the ATM layer has lost cell delineation.

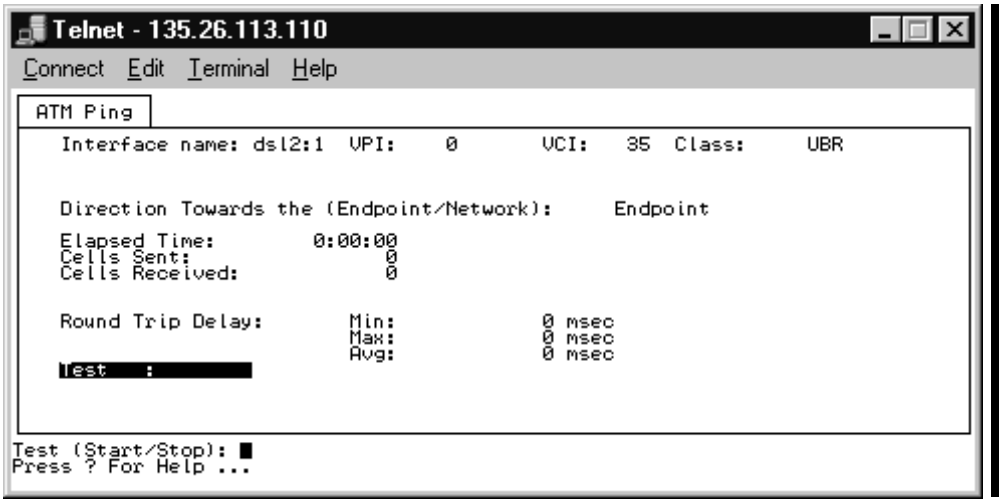
Configuring and Validating Endpoint Management

The endpoint mangement path configuration is performed from NOC using the management path to the Hotwire GranDSLAM.

▶ Procedure

1. From the NOC, command the ATM line card to send the endpoint an end-to-end OAM loopback cell on VPI 0, VCI 35. If successful, command the ATM line card to send an end-to-end F5 OAM loopback cell towards the network. This will terminate in the NOC at the edge of the ATM network (probably in a NOC router). If successful, the VC has been tested from the endpoint to the NOC.

   The following screen is used to support the OAM loopback initiation.



2. Configure the NOC router to add a route to the endpoint over the appropriate VC.

3. To assign the IP address to the endpoint, ping the endpoint five times from the NOC router or a workstation, PC, or NMS behind the router. Since the route has been added to the NOC router, the ping will be routed over the management VC to the endpoint. The endpoint will accept the IP address used as the destination of the pings as its temporary IP address for use on the management VC interface. This is a temporary IP address in that it is not maintained across endpoint power cycles. The device will assume a new IP address when it is again pinged five times.

Configuring the Endpoint from the NOC

The actual configuration of the endpoint device depends on the device management approach that the DSL provider intends to deploy in its network.

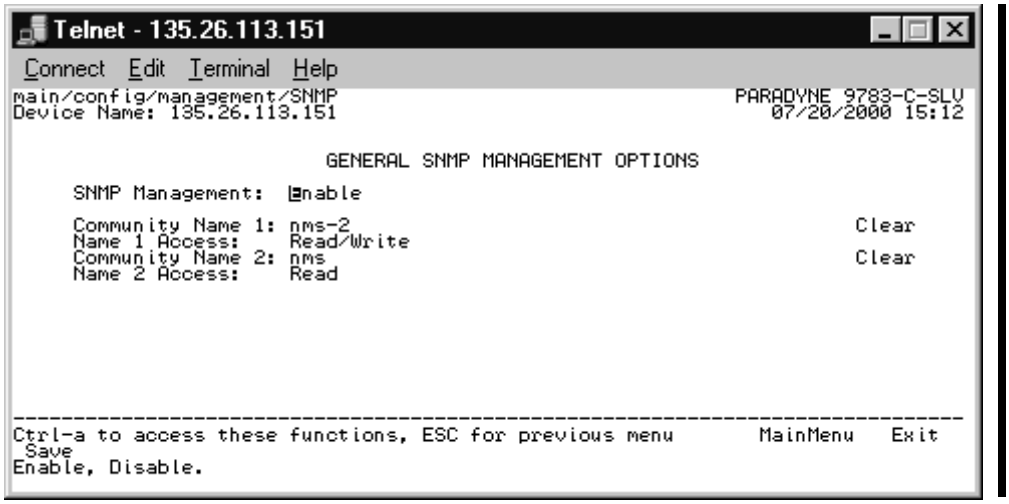
To enable access to it, the endpoint device needs to be configured from the DSL Provider's NOC, in a Telnet session to the user interface. Note that:

- The temporary IP address in the DSL Provider's domain is assigned to the temporary Management VC interface (referred to in the user interface as the TS Management Link) by pinging the endpoint five times.
- Telnet Session, FTP Session, and SNMP Management are enabled by default.

Configuring DSL Provider Management Parameters

To insure a level of security to SNMP management, Community Name 1 should be changed from the default value **public** to a string unique to the DSL provider. From the Management and Communication Options branch of the Configuration menu, the General SNMP Management Options screen allows configuring the community name.

The default value for Name 1 Access is Read/Write and does not require change. It is recommended that the Community Name 2 be reserved for the frame relay NSP SNMP access. If provided by the frame relay NSP, Community Name 2 string can be entered at this time. Name 2 Access needs to be changed to Read/Write. (The default is Read.)

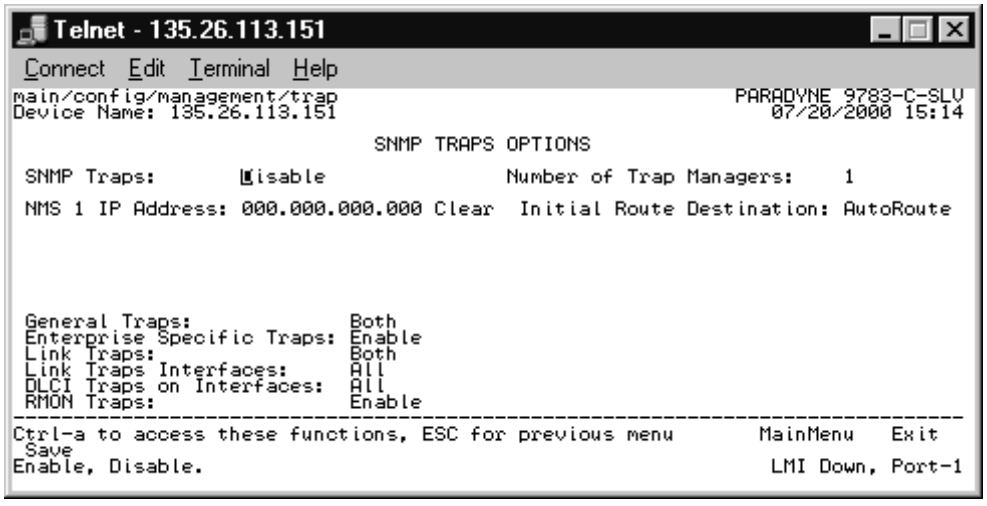


For on-demand management, no additional configuration of the FrameSaver DSL endpoint device is required.

For persistent management, the following additional configuration steps need to be performed.

▶ Procedure

1. Using OpenLane, create a Dedicated Management VC (as a separate entity from the Temporary Management VC), with VPI=0 and VCI= 50 at the device's end, and cross connect it through the Hotwire GranDSLAM to the DSL provider's NOC. Assign to this interface a permanent IP Address (in the DSL provider's address space).
2. Set SNMP Traps types and destination. From the Management and Communication Options branch in the FrameSaver DSL unit's Configuration menu, select the SNMP Traps Options screen:
   - — Enable SNMP Traps
   - — Set the number of Trap Managers desired (one, at least, corresponding to the NMS station at the DSL Provider's NOC)
   - — Configure the IP Addresses of the Trap Managers (for example, the NMS stations at the NOC)
   - — Configure the Initial Route Destination for the Traps (choose the name of the dedicated Management VC configured in Step 1)
   - — Set the types and the interfaces for the traps that the NOC plans to monitor (typically the General, Enterprise Specific, Link and DLCI traps on all interfaces)

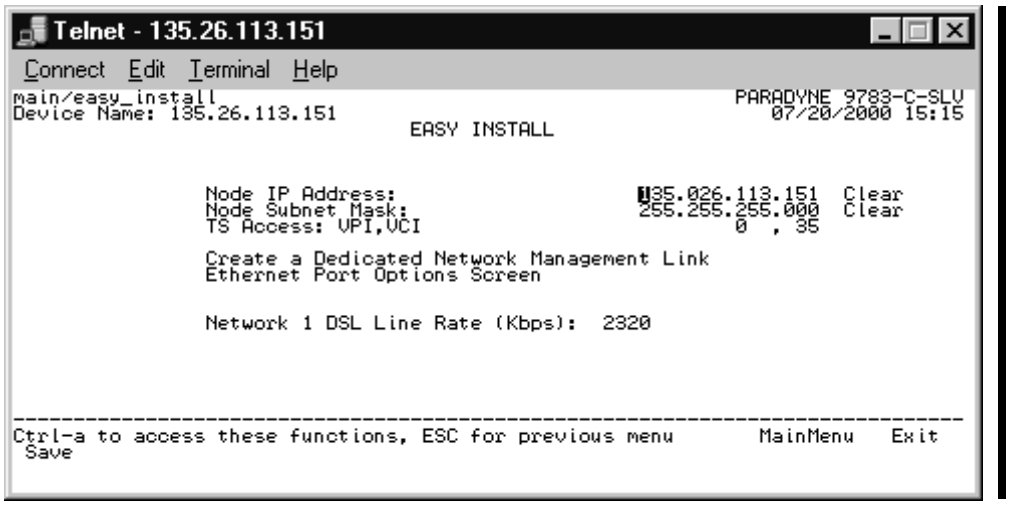


Configuring Frame Relay NSP Management Parameters

The following information should be minimally configured on the Easy Install screen to allow the frame relay NSP management access to the unit.

Using the IP Address provided by the frame relay NSP, enter the Node IP Address and Subnet Mask for the device.

At this point in the installation it should not be necessary to set any other configuration options.



Provisioning the Circuit in the Hotwire GranDSLAM and Endpoint

By using the OpenLane Provision Circuit screen the NOC administrator can add new circuits that start at the endpoint and traverse the ATM line card and SCM. In addition to the default VC sets (from 1 to 4), there is a group of 250 VCs allocated to each line card that can be assigned to any port on the card. These custom connections will be used to carry the frame relay over DSL traffic.

Note that before the custom cross connections are configured, the Maximum VCI number for the uplink VP to be used by these custom connections must be specified on the Configure Maximum VCIs per VPI screen in the SCM Configuration tool of OpenLane. See *Step 1: SCM Configuration* on page 2-2.

For ATM line cards, custom connections can be used to expand the number of VCs connected to the card. Each of the 250 VCs can be cross connected from any VC on the up link to any port on the line card.

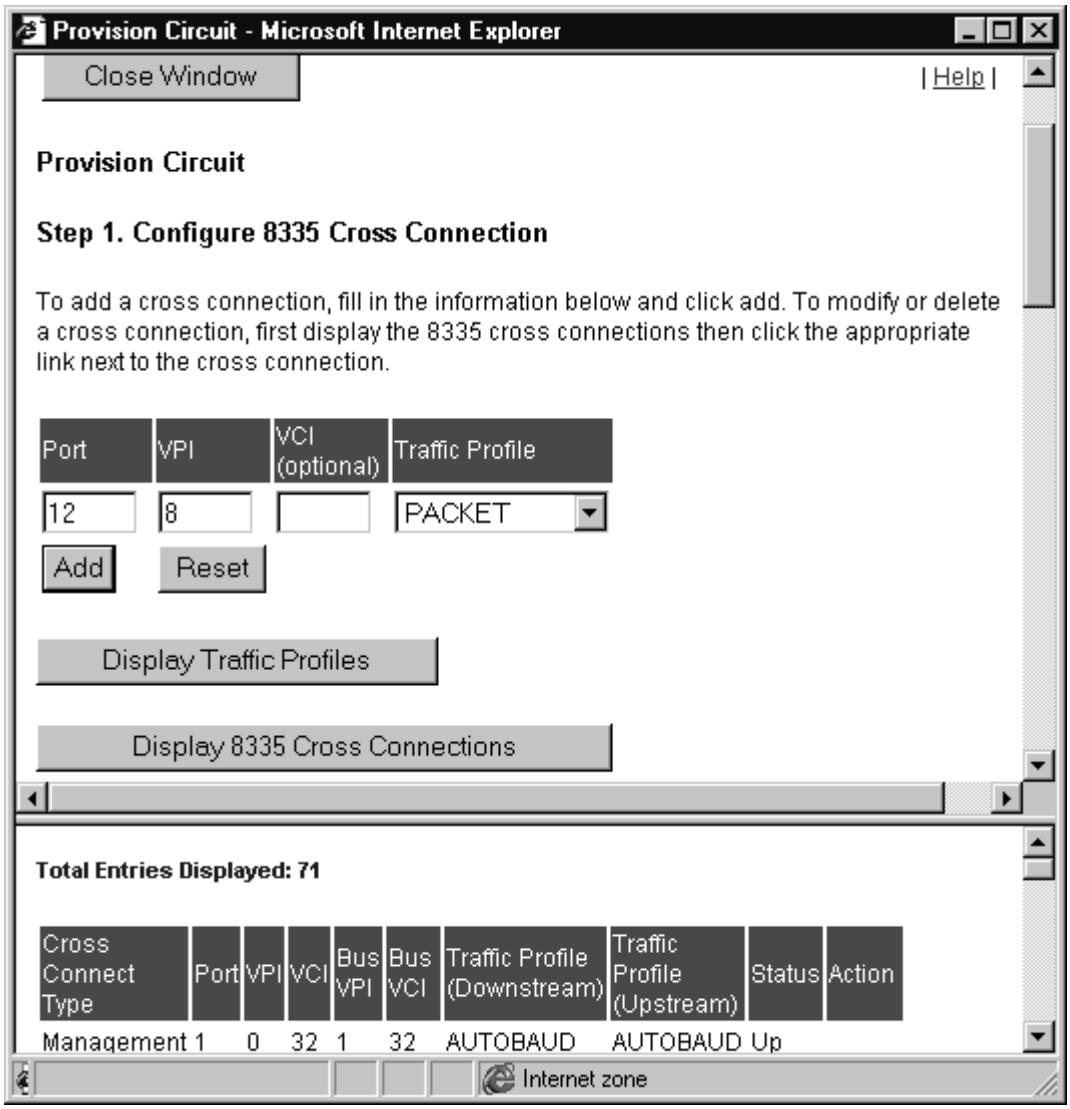
To provision a circuit using OpenLane, the following information is required:

- Port number of the DSL connection
- DSL link VPI/VCI
- Traffic Profile (the NSP provides input to the DSL provider, but the DSL provider determines which profile to use; nrt-VBR should be used for frame relay traffic)
- Virtual Network Identifier (VNID)
- Uplink VPI/VCI
- Endpoint IP address
- Endpoint SNMP write community string
- Frame relay DLCI (provided by the NSP)
- Frame relay CIR, B_c, and B_e (provided by the NSP)

▶ Procedure

1. From the Device Browser, left-click on an ATM line card. From the ensuing drop-down menu, select Configuration, then Provision Circuit.

   The Provision Circuit screen is displayed.



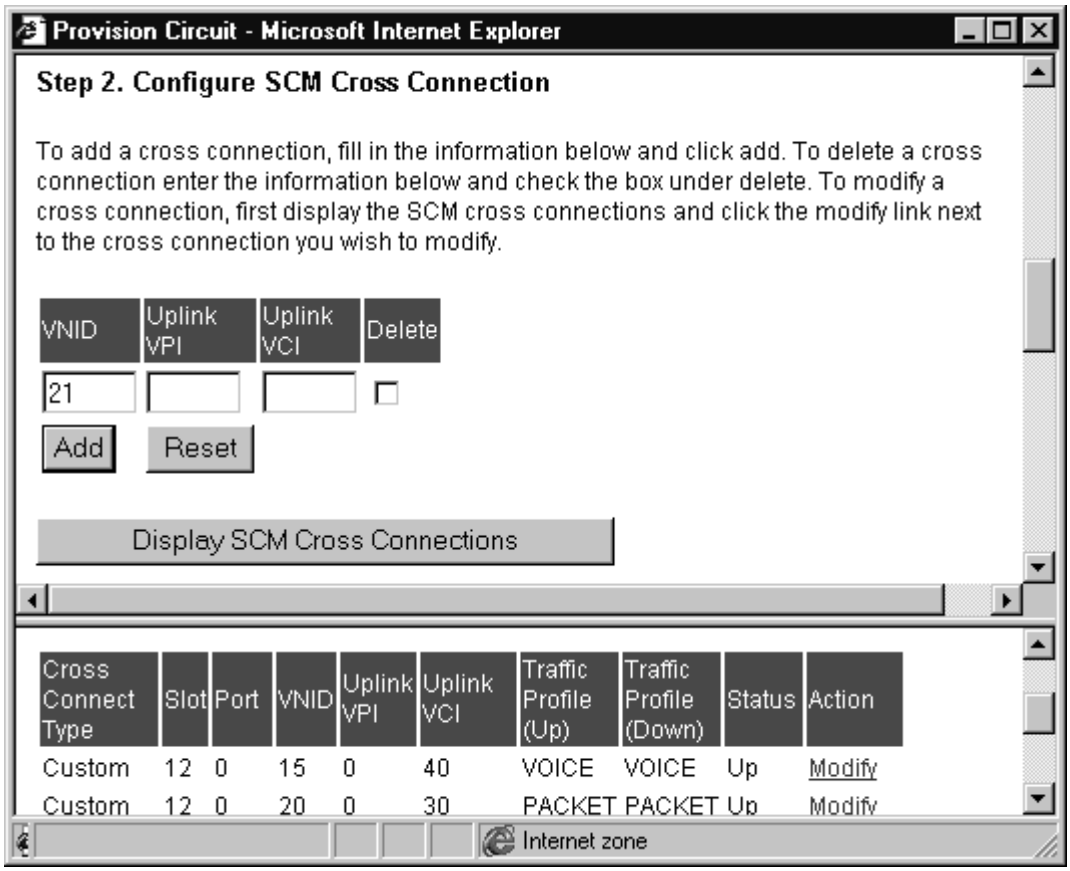
2. Enter the Port, VPI, and optionally the VCI.

   Select a Traffic Profile from the drop-down list. You can display existing traffic profile definitions in the lower frame by clicking on the Display Traffic Profiles button. If you need a new traffic profile, you can create one through the SCM Configuration screen. See *Step 5: Create Traffic Profiles* on page 2-6.

3. Click on Add to add the cross connection. A confirmation window is displayed and the entry fields are cleared.

   You can verify that your cross connection is added by clicking on the Display Cross Connections button. Cross connections are displayed in the lower frame.

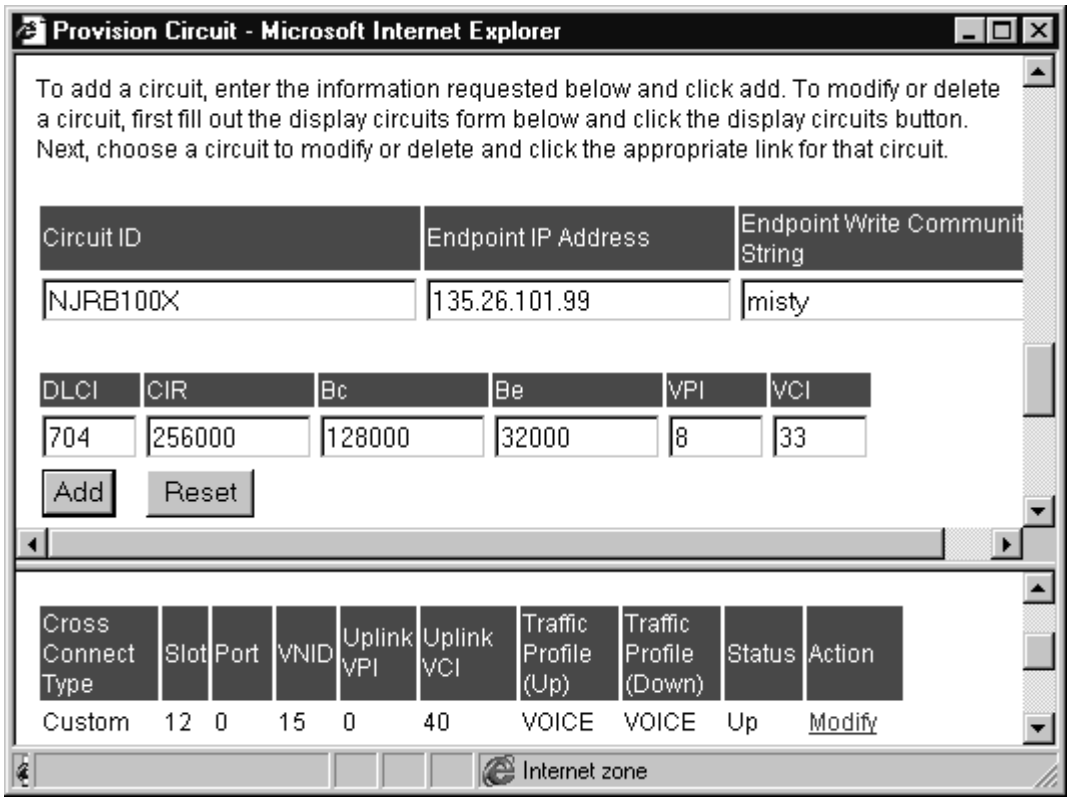
4. Scroll down to **Step 2. Configure SCM Cross Connection**.



5. Enter the VNID, VPI, and VCI.
6. Click on Add to configure the SCM cross connection. A confirmation window is displayed and the entry fields are cleared.

   You can verify that your SCM cross connection is establsihed by clicking on the Display SCM Cross Connections button. Cross connections are displayed in the lower frame.

7. Scroll down to **Step 3. Configure Circuit Information on Endpoint**.



8. Enter the circuit information for the endpoint.
9. Click on Add to configure the endpoint.

   The Circuit ID is applied to the newly defined circuit, and stored in both the FrameSaver DSL endpoint and in OpenLane.

   You can verify that your circuit is established by clicking on the Display Circuits button. Circuits are displayed in the lower frame.

Provisioning the Circuit in the IPC

If using the Interworking Packet Concentrator (IPC), modify the user priority and CDV for data PVCs using option 13 (Advanced Parameters):

```
  Slot 5 Port 3 Connection VPI 0 VCI 300 Configuration

  Available bandwidth: Tx=733754 Rx=734751

1) User Priority (0-15)              : 15

2) CDV (10us-10000us)               : 1000

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

Frame Relay to ATM Conversion

A

Selection of an ATM Channel In Support of Frame Relay Using FRF.8

Table A-1 contains suggested frame relay to ATM Parameter conversions to be used with a specific DSL line rate for nrt-VBR service. The frame relay service is characterized by CIR, with T_c=1 second. Assumptions are:

- Maximum frame size of 8192 bytes
- Average frame size of 256 bytes
- T_c of 1 second
- EIR equal to the DSL line rate

With those assumptions, values in Table A-1 are correct for FRF.8 interworking. For other conditions, refer to the formulas in *Detailed Formulas for an ATM Channel in Support of Frame Relay Using FRF.8.*

Table A-1. Frame Relay to ATM Conversion (1 of 2)

DSL Line Rate (kbps)	CIR (kbps)	PCR	SCR	MBS
2320	64	5471	188	175
	128	5471	375	327
	256	5471	750	569
	512	5471	1500	854
	768	5471	2250	939
	1024	5471	3000	875
	1280	5471	3750	700
	1536	5471	4500	439
	1792	5471	5250	109

Table A-1. Frame Relay to ATM Conversion (2 of 2)

DSL Line Rate (kbps)	CIR (kbps)	PCR	SCR	MBS
1552	64	3659	188	169
	128	3659	375	305
	256	3659	750	495
	512	3659	1500	628
	768	3659	2250	537
	1024	3659	3000	297
1168	64	2754	188	163
	128	2754	375	285
	256	2754	750	429
	512	2754	1500	442
	768	2754	2250	227
784	64	1848	188	153
	128	1848	375	248
	256	1848	750	317
	512	1848	1500	156
528	64	1244	188	138
	128	1244	375	201
	256	1244	750	186
400	64	942	188	125
	128	942	375	162
	256	942	750	85
272	64	641	188	103
	128	641	375	98
144	64	339	188	54

Detailed Formulas for an ATM Channel in Support of Frame Relay Using FRF.8

Example 2 of Appendix II of the ATM Forum Traffic Management Specification, version 4.1, suggests the following:

"The values of PCR and SCRs should be chosen to include the extra margin required to accommodate the overhead introduced in transferring the FRS frames via an ATM network. When the PCR is chosen to emulate the FRS access line rate, the EIR that is allowed in the difference between the access line rate and the CIR. Therefore, the EIR that is allowed possibly exceeds the EIR negotiated for the FRS. However, using traffic shaping, the PCR may be chosen to be the higher of either the required value to achieve the Transfer Delay objective, or the required value to achieve the sum of CIR and EIR to the user. The BT_0 should be set to allow the maximum committed burst accepted in FRS to be passed to the PCR."

With this in mind, the following method is suggested.

1. Utilize the VBR.3 Conformance Definition (Section 4.5.2.3 of the Traffic Management Specification), with tagging supported.
2. The PCR value should be set for the aggregate $(B_c + B_e)/Tc$ rate, adjusted for overhead.
3. The SCR value should be set for the (B_c/T_c) rate, adjusted for overhead.
4. MBS should be set to at least 8 times the frame size in cells for TCP/IP traffic, or, in situations when longer bursts are required, use the values in Table A-1. Those values were generated by formulas Bt_0 and MBS_0 below.

Since average frame size affects some of the following calculations, it is important to select the appropriate value. Smaller frame sizes generally require more overhead (unused bytes per cell) than larger frame sizes (in which the 1 to 47 unused bytes represent a smaller portion of the cell). Although 256 bytes should be appropriate for most applications, if many small cells are sent a lower value may be required.

If an unacceptable number of frames is dropped, it may be necessary to set the MBS value to the maximum size allowed by the frame relay network. This could be 4096 bytes or 8192 bytes.

The following diagram shows the formulas used for this approach.

Given Frame Traffic Management Parameters:

$$CIR = \frac{Bc}{Tc}\ (Bits/Sec) \qquad EIR = \frac{Bc+Be}{Tc}\ (Bits/Sec) \qquad n = \text{Average Frame Size in bytes}$$

Calculate ATM Traffic Parameters, using VBR.3:

$$FrameSize_{Cells} = \left\lceil \frac{n+8}{48} \right\rceil\ (Cells/AAL5\ Frame)$$

$\lceil X \rceil$ = Smallest Integer greater or equal to X (i.e. round up)

$$OH(n) = \frac{\left\lceil \frac{n+8}{48} \right\rceil}{n}\ (Cells/Byte)$$

Overhead Factor

$\lfloor X \rfloor$ = Largest Integer less than or equal to X (i.e. round down)

$$PCR_{0+1} = \frac{Bc+Be}{Tc \times 8} \times \left(OH(n) \right)\ (Cells/Sec)$$

$$SCR_0 = \frac{Bc}{Tc \times 8} \times \left(OH(n) \right)\ (Cells/Sec)$$

$$MBS_0 = FrameSize \times 8\ (Cells)$$

(For TCP/IP Traffic with window of 8)

$$BT_0 = Tc - \left(\frac{SCR_0 - 1}{PCR_{0+1}} \right) - \left(\frac{1}{SCR_0} \right)$$

$$MBS_0 = \left\lfloor 1 + \left(\frac{BT_0}{1/SCR_0 + 1/PCR_{0+1}} \right) \right\rfloor$$

(For Conservative channels where it is desired to send the complete CIR allocation in one burst)

Port Mapping Table

B

The following table shows the VPI/VCI default values assigned to circuits on the line card and the SCM for user data (UBR) and user voice (rt-VBR) service.

The table lists all 24 possible ports. The actual number of ports depends on the line card used.

NOTE:

The line card data VPI/VCI is always 0,35. Voice VPI/VCI is always 0,40.

Table B-1. Line Card and SCM Mapping for Chassis Slots 1–9 (1 of 2)

Ports	VC Type	Chassis Slot Number								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Data Voice	0,32 1,32	0,56 1,56	0,80 1,80	0,104 1,104	0,128 1,128	0,152 1,152	0,176 1,176	0,200 1,200	0,224 1,224
2	Data Voice	0,33 1,33	0,57 1,57	0,81 0,40	0,105 1,105	0,129 1,129	0,153 1,153	0,177 1,177	0,201 1,201	0,225 1,225
3	Data Voice	0,34 1,34	0,58 1,58	0,82 1,82	0,106 1,106	0,132 1,132	0,154 1,154	0,178 1,178	0,202 1,202	0,226 1,226
4	Data Voice	0,35 1,35	0,59 1,59	0,83 1,93	0,107 1,107	0,131 1,131	0,155 1,155	0,179 1,179	0,203 1,203	0,227 1,227
5	Data Voice	0,36 1,36	0,60 1,60	0,84 1,84	0,108 1,108	0,132 1,132	0,156 1,156	0,180 1,180	0,204 1,204	0,228 1,228
6	Data Voice	0,37 1,37	0,61 1,61	0,85 1,85	0,109 1,109	0,133 1,133	0,157 1,157	0,181 1,181	0,205 1,205	0,229 1,229
7	Data Voice	0,38 1,38	0,62 1,62	0,86 1,86	0,110 1,110	0,134 1,134	0,158 1,158	0,182 1,182	0,206 1,206	0,230 1,230
8	Data Voice	0,39 1,39	0,63 1,63	0,87 1,87	0,111 1,111	0,135 1,135	0,159 1,159	0,183 1,183	0,207 1,207	0,231 1,231
9	Data Voice	0,40 1,40	0,64 1,64	0,88 1,88	0,112 1,112	0,136 1,136	0,160 1,160	0,184 1,184	0,208 1,208	0,232 1,232
10	Data Voice	0,41 1,41	0,65 1,65	0,89 1,89	0,113 1,113	0,137 1,137	0,161 1,161	0,185 1,185	0,209 1,209	0,233 1,233
11	Data Voice	0,42 1,42	0,66 1,66	0,90 1,90	0,114 1,114	0,138 1,138	0,162 1,162	0,186 1,186	0,210 1,210	0,234 1,234
12	Data Voice	0,43 1,43	0,67 1,67	0,91 1,91	0,115 1,115	0,139 1,139	0,163 1,163	0,187 1,187	0,211 1,211	0,235 1,235

Table B-1. Line Card and SCM Mapping for Chassis Slots 1–9 (2 of 2)

Ports	VC Type	Chassis Slot Number								
		1	2	3	4	5	6	7	8	9
13	Data	0,44	0,68	0,92	0,116	0,140	0,164	0,188	0,212	0,236
	Voice	1,44	1,68	1,92	1,116	1,140	1,164	1,188	1,212	1,236
14	Data	0,45	0,69	0,93	0,117	0,141	0,165	0,189	0,213	0,237
	Voice	1,45	1,69	1,93	1,117	1,141	1,165	1,189	1,213	1,237
15	Data	0,46	0,70	0,94	0,118	0,142	0,166	0,190	0,214	0,238
	Voice	1,46	1,70	1,94	1,118	1,142	1,166	1,190	1,214	1,238
16	Data	0,47	0,71	0,95	0,119	0,143	0,167	0,191	0,215	0,239
	Voice	1,47	1,71	1,95	1,119	1,143	1,167	1,191	1,215	1,239
17	Data	0,48	0,72	0,96	0,120	0,144	0,168	0,192	0,216	0,240
	Voice	1,48	1,72	1,96	1,120	1,144	1,168	1,192	1,216	1,240
18	Data	0,49	0,73	0,97	0,121	0,145	0,169	0,193	0,217	0,241
	Voice	1,49	1,73	1,97	1,121	1,145	1,169	1,193	1,217	1,241
19	Data	0,50	0,74	0,98	0,122	0,146	0,170	0,194	0,218	0,242
	Voice	1,50	1,74	1,98	1,122	1,146	1,170	1,194	1,218	1,242
20	Data	0,51	0,75	0,99	0,123	0,147	0,171	0,195	0,219	0,243
	Voice	1,51	1,75	1,99	1,123	1,147	1,171	1,195	1,219	1,243
21	Data	0,52	0,76	0,100	0,124	0,148	0,172	0,196	0,220	0,244
	Voice	1.52	1,76	1,100	1,124	1,148	1,172	1.196	1,220	1,244
22	Data	0,53	0,77	0,101	0,125	0,149	0,173	0,197	0,221	0,245
	Voice	1,53	1,77	1,101	1,125	1,149	1,173	1,197	1,221	1,245
23	Data	0,54	0,78	0,102	0,126	0,150	0,174	0,198	0,222	0,246
	Voice	1,54	1,78	1,102	1,126	1,150	1,174	1,198	1,222	1,246
24	Data	0,55	0,79	0,103	0,127	0,151	0,175	0,199	0,223	0,247
	Voice	1,55	1,79	1,103	1,127	1,151	1,175	1,199	1,223	1,247

Table B-2. Line Card and SCM Mapping for Chassis Slots 10–18 (1 of 2)

Ports	VC Type	Chassis Slot Number								
		10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
1	Data Voice	0,248 1,248	0,272 1,272	0,296 1,296	0,320 1,320	0,344 1,344	0,368 1,368	0,392 1,392	0,416 1,416	0,440 1,440
2	Data Voice	0,249 1,249	0,273 1,273	0,297 1,297	0,321 1,321	0,345 1,345	0,369 1,369	0,393 1,393	0,417 1,417	0,441 1,441
3	Data Voice	0,250 1,250	0,274 1,274	0,298 1,298	0,322 1,322	0,346 1,346	0,370 1,370	0,394 1,394	0,418 1,418	0,442 1,442
4	Data Voice	0,251 1,251	0,275 1,275	0,299 1,299	0,323 1,323	0,347 1,347	0,371 1,371	0,395 1,395	0,419 1,419	0,443 1,443
5	Data Voice	0,252 1,252	0,276 1,276	0,300 1,300	0,324 1,324	0,348 1,348	0,372 1,372	0,396 1,396	0,420 1,420	0,444 1,444
6	Data Voice	0,253 1,253	0,277 1,277	0,301 1,301	0,325 1,325	0,349 1,349	0,373 1,373	0,397 1,397	0,421 1,421	0,445 1,445
7	Data Voice	0,254 1,254	0,278 1,278	0,302 1,302	0,326 1,326	0,350 1.350	0,374 1,374	0,398 1,398	0,422 1,422	0,446 1,446
8	Data Voice	0,255 1,255	0,279 1,279	0,303 1,303	0,327 1,327	0,351 1,351	0,375 1,375	0,399 1,399	0,423 1,423	0,447 1,447
9	Data Voice	0,256 1,256	0,280 1,280	0,304 1,304	0,328 1,328	0,352 1,352	0,376 1,376	0,400 1,400	0,424 1,424	0,448 1,448
10	Data Voice	0,257 1,257	0,281 1,281	0,305 1,305	0,329 1,329	0,353 1,353	0,377 1,377	0,401 1,401	0,425 1,425	0,449 1,449
11	Data Voice	0,258 1,258	0,282 1,282	0,306 1,306	0,330 1,330	0,354 1,354	0,378 1,378	0,402 1,402	0,426 1,426	0,450 1,450
12	Data Voice	0,259 1,259	0,283 1,283	0,307 1,307	0,331 1,331	0,355 1,355	0,379 1,379	0,403 1,403	0,427 1,427	0,451 1,451

Table B-2. Line Card and SCM Mapping for Chassis Slots 10–18 (2 of 2)

Ports	VC Type	Chassis Slot Number								
		10	11	12	13	14	15	16	17	18
13	Data	0,260	0,284	0,308	0,332	0,356	0,380	0,404	0,428	0,452
	Voice	1,260	1,284	1,308	1,332	1,356	1,380	1,404	1,428	1,452
14	Data	0,261	0,285	0,309	0,333	0,357	0,381	0,405	0,429	0,453
	Voice	1,261	1,285	1,309	1,333	1,357	1,381	1,405	1,429	1,453
15	Data	0,262	0,286	0,310	0,334	0,358	0,382	0,406	0,430	0,454
	Voice	1,262	1,286	1,310	1,334	1,358	1,382	1,406	1,430	1,454
16	Data	0,263	0,287	0,311	0,335	0,359	0,383	0,407	0,431	0,455
	Voice	1,263	1,287	1,311	1,335	1,359	1,383	1,407	1,431	1,455
17	Data	0,264	0,288	0,312	0,336	0,360	0,384	0,408	0,432	0,456
	Voice	1,264	1,288	1,312	1,336	1,360	1,384	1,408	1,432	1,456
18	Data	0,265	0,289	0,313	0,337	0,361	0,385	0,409	0,433	0,457
	Voice	1,265	1,289	1,313	1,337	1,361	1,385	1,409	1,433	1,457
19	Data	0,266	0,290	0,314	0,338	0,362	0,386	0,410	0,434	0,458
	Voice	1,266	1,290	1,314	1,338	1,362	1,386	1,410	1,434	1,458
20	Data	0,267	0,291	0,315	0,339	0,363	0,397	0,411	0,435	0,459
	Voice	1,267	1,291	1,315	1,339	1,363	1,387	1,411	1,435	1,459
21	Data	0,268	0,292	0,316	0,340	0,364	0,398	0,412	0,436	0,460
	Voice	1,268	1,292	1,316	1,340	1,364	1,398	1.412	1,436	1,460
22	Data	0,269	0,293	0,317	0,341	0,365	0,399	0,413	0,437	0,461
	Voice	1,269	1,293	1,317	1,341	1,365	1,399	1,413	1,437	1,461
23	Data	0,270	0,294	0,318	0,342	0,366	0,400	0,414	0,438	0,462
	Voice	1,270	1,294	1,318	1,342	1,366	1,400	1,414	1,438	1,462
24	Data	0,271	0,295	0,319	0,343	0,367	0,401	0,415	0,439	0,463
	Voice	1,271	1,295	1,319	1,343	1,367	1,401	1,415	1,439	1,463

Glossary

2B1Q Two Binary, one Quaternary. A line coding technique that compresses two binary bits of data into one time state as a four-level code.

AAL-5 The ITU-T classification for a simplified ATM Adaptation Layer (AAL) that supports variable bit rate, connection-oriented, delay-tolerant data traffic.

ABR Available Bit Rate. An ATM layer service type in which feedback is sent to the end system to limit traffic according to available bandwidth.

ATM Asynchronous Transfer Mode. A high-speed, low-delay, connection-oriented switching and multiplexing technique using 53-byte cells to transmit different types of data simultaneously.

ATM Forum An international organization for the promotion and standardization of ATM.

ATM switch A high-capacity, cell-based switch in the carrier backbone network. It provides access, multiplexing, and switching functions, permitting combined data, video, imaging, and voice services on a single platform.

ATM traffic descriptor A list of traffic management parameters that characterizes a virtual connection, including Peak Cell Rate (PCR), Sustainable Cell Rate (SCR), and Maximum Burst Size (MBS).

B_c Committed burst size. In frame relay networks, the maximum amount of data the network agrees to deliver in a particular time interval under normal conditions. Expressed in bits.

B_e Excess burst size. In frame relay networks, the maximum amount of uncommitted data over the committed burst size that the network can attempt to deliver in a particular time interval. Expressed in bits.

BT Burst Tolerance. The limit parameter of the Generic Cell Rate Algorithm (GCRA).

byte A sequence of successive bits (usually eight) handled as a unit in data transmission.

CAC Connection Admission Control. The set of actions taken at SVC or PVC establishment to determine whether the connection should be rejected.

cell The unit of transmission in ATM. An ATM cell contains a 5-byte header and a 48-byte data payload.

CIR Committed Information Rate. Less than or equal to the access rate, the CIR is used by the service provider for rate enforcement when the network allocates bandwidth. When rates exceed the CIR, frames may be discarded.

CLP Cell Loss Priority. A bit in the ATM header that identifies cells that can be discarded during periods of congestion. Cells with a CLP of 1 have lower priority than cells with a CLP of 0.

CO Central Office/Central Site. The PSTN facility that houses one or more switches serving local telephone subscribers.

CPE Customer Premises Equipment. Terminal equipment on the service user's side of the telecommunications network interface.

DLCI Data Link Connection Identifier. The virtual circuit number corresponding to a particular connection between two destinations. This number is used as part of the frame relay header. The total number of DLCIs between endpoints make up the PVC. DLCIs are a local means of identifying a PVC.

DSL	Digital Subscriber Line. The non-loaded, local-loop copper connection between the customer and the first node within the network.
DSLAM	Digital Subscriber Line Access Multiplexer. A platform for DSL modems that provides high-speed data transmission with POTS over traditional twisted-pair wiring.
EDLCI	Embedded Data Link Connection Identifier. The number or frame relay address that identifies an individual logical link/connection when a multiplexed DLCI has been selected for the link. Using a proprietary method, the access unit aggregates multiple frame relay DLCIs going to the same destination access unit.
EIR	Excess Information Rate. In frame relay networks, the rate of transmission above the insured rate. Calculated as the maximum information rate less the Committed Information Rate (CIR).
FRAD	Frame Relay Assembler/Disassembler. The equivalent of an X.25 PAD, a FRAD connects non-frame relay devices to the frame relay network. It also provides encapsulation and translation capability.
frame	One identifiable group of data bits that includes a sequence of bits for control and identification information.
frame relay	A high-speed connection-oriented packet switching WAN protocol using variable-length frames.
Frame Relay Forum	An association of vendors, carriers, users, and consultants that creates standards for the implementation of frame relay systems.
FRF.8	An implementation agreement endorsed by the Frame Relay Forum and the ATM Forum that describes frame relay and ATM PVC service interworking.
FRS	Frame Relay Service. A service providing frame relay transmission.
FTP	File Transfer Protocol. A TCP/IP standard protocol that allows a user on one host to access and transfer files to and from another host over a network, provided that the client supplies a login identifier and password to the server.
GranDSLAM	A high-density DSLAM supporting a variety of DSL transport types and network services.
ILMI	Integrated Local Management Interface. An ATM Forum specification for network management between public and private networks.
IP	Internet Protocol. An open networking protocol used for internet packet delivery.
IP address	Internet Protocol address. The address assigned to an internet host.
IPC	Interworking Packet Concentrator. A device that concentrates traffic from multiple LANs onto a high-speed WAN interface.
IWF	InterWorking Function. A process for protocol conversion, or the entity that performs the conversion.
IXC	IntereXchange Carrier. A provider of telecommunications services between exchanges or LATAs.
LAN	Local Area Network. A privately owned and administered data communications network limited to a small geographic area.
LATA	Local Access Transport Area. A region served by a local exchange carrier (LEC) that consists of one or more area codes.
leased line	A private line connection exclusively for the user. No dialing is necessary.

LMI Local Management Interface. In frame relay, the standard set of procedures and messages for link-management signaling (information exchange) between a DTE and the network.

MBS Maximum Burst Size. In ATM, the number of cells that may be transmitted at the peak rate without violating the the Generic Cell Rate Algorithm (GCRA).

MCP Management Communications Processor. The circuit card used to provide consolidated management access for DSL cards in the Hotwire 8610 DSLAM and 8820 GranDSLAM.

NAT Network Address Translation or Network Address Translator. A technique or device for binding addresses in a private network with addresses in a global network to allow transparent routing between the two domains. The two main variations of NAT are called basic NAT and NAPT.

NMS Network Management System. A computer system used for monitoring and controlling network devices.

NNI Network-to-Network Interface. The point of connection of two frame relay networks.

NNI Network Node Interface. The interface of ATM switches on different networks.

NOC Network Operations Center. The point at which a network is monitored and controlled.

nrt-VBR Non-real-time Variable Bit Rate. An ATM service category that supports average and peak traffic rate parameters, designed for applications with highly variable traffic.

NSP Network Service Provider. A local telephone company or ISP that provides network services to subscribers.

OAM Operations, Administration, and Maintenance. A group of network management functions in ATM.

OpenLane A standards-based network management system providing diagnostics, real-time performance monitoring, historical reports, and health and status indications for Paradyne SNMP-managed devices.

PCR Peak Cell Rate. In ATM, the rate of cell transmission that the source may never exceed. Also known as Maximum Information Rate (MIR).

PVC Permanent Virtual Circuit. A connection established administratively. Used in networks supporting frame relay, X.25, and ATM.

QoS Quality of Service. In ATM, a level of service dependent on Cell Loss Ratio (CLR), Cell Transfer Delay (CTD), and Cell Delay Variation (CDV).

RFC Request for Comments. One of the documents published by the Internet Engineering Task Force that describe Internet protocols and policies.

RFC 1490-compliant Standard of multiprotocol interconnect over frame relay. The encapsulation method for carrying network interconnect traffic over a frame relay backbone; it also covers both bridging and routing.

RMON Remote MONitoring. A management standard that was developed to provide traffic statistics and analysis for comprehensive network fault diagnosis, planning, and performance tuning.

RMON1 Remote MONitoring, Version 1. A management standard that was developed to provide traffic statistics and analysis for comprehensive network fault diagnosis, planning, and performance tuning.

RMON2 Remote MONitoring, Version 2. An industry standard used to remotely and proactively monitor and troubleshoot switched networks at layers higher than the data link. RMON2 can identify the server that sent a packet, the user the packet is going to, and the application that the packet represents.

router A device that connects LANs by dynamically routing data according to destination and available routes.

rt-VBR Real-time Variable Bit Rate. An ATM service category that supports average and peak traffic rate parameters, designed for applications with a low tolerance for delay and delay variation.

SCR Sustainable Cell Rate. The upper limit of the average rate of an ATM connection.

SCM Shelf Concentration Module. A circuit card that provides connectivity between DSL modems and an ATM uplink.

SDSL Symmetric Digital Subscriber Line. A technique for the use of an existing twisted-pair line that permits high bandwidth, bidirectional transmission.

SLA Service Level Agreement. A contract between a frame relay service provider and a customer in which the service provider guarantees a certain level or quality of service to the customer. Level of service is defined by a set of measurable parameters, each having thresholds that are negotiated by the service provider and customer.

SNMP Simple Network Management Protocol. Protocol for open networking management.

SNMP trap A message sent to an SNMP manager to notify it of an event, such as a device being reset.

T_c Committed Rate Measurement Interval. In frame relay networks, the variable time interval during which only the Committed Burst Size ($B_{c)}$ plus the Excess Burst Size ($B_{e)}$ can be sent.

TDM Time Division Multiplexer. A device that enables the simultaneous transmission of multiple independent data streams into a single high-speed data stream by simultaneously sampling the independent data streams and combining these samples to form the high-speed stream.

Telnet Virtual terminal protocol in the Internet suite of protocols. Allows the user of one host computer to log into a remote host computer and interact as a normal terminal user of the remote host.

trap (SNMP) A notification message to the SNMP manager when an unusual event occurs on a network device, such as a reinitialization.

UBR Unspecified Bit Rate. An ATM service category with no commitment of bandwidth.

VBR Variable Bit Rate. An ATM service category that supports average and peak traffic rate parameters.

VC Virtual Circuit. A logical connection or packet-switching mechanism established between two devices at the start of transmission.

VCI Virtual Channel Identifier. The 16-bit field in an ATM cell header that specifies the virtual channel over which the cell is to be transmitted.

VPI Virtual Path Identifier. The 8-bit field in an ATM cell header that specifies the virtual path over which the cell should be routed.

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