46 Managing IISP and PNNI Routes

PNNI is a dynamic routing protocol that is capable of establishing switched virtual connections based on ATM End System requests. It is also capable of managing connections that use pre-configured static routes. You configure static routes through options on the PNNI Route Management submenu. Static routes are used by the Interim Inter-Switch Signalling Protocol (IISP), which is an ATM static routing protocol.

This Route Management submenu allows you to add and delete static routes. Static routes are useful in directing calls to ATM ports that do not participate in PNNI exchanges or are outside the PNNI peer group.

Setting Up Static Routes

Setting up static routes requires two steps:

1. Configure a route property, or template, that describes route characteristics, such as Quality of Service and metrics. This step requires using the **prpadd** command. Instructions for this step start on page 46-3.

2. Add route addresses to one of the pre-configured route properties. All addresses added to a route property will use the characteristics configured for that property. This step requires using the **pradd** command. Before adding a static route address, you must first configure a route property. Instructions for this step start on page 46-9.

In addition, if you want a CSM port to support IISP for static routes, then you must configure the port to be an IISP port in the **map** command. The **map** command is described in Chapter 42, "Managing CSM Modules (CSMs)." There are two types of IISP ports—user side and network side. Be sure you configure your IISP port according to its function.

The PNNI/IISP Route Management Menu

The PNNI/IISP Route Management menu is a submenu of the PNNI menu. It contains commands for viewing learned routes and for configuring and viewing static routes. It displays as follows:

```
Command      ATM PNNI Route Management Menu
-----------  ------------------------------------------------------------
proutea      View the Table of routes from nodes to reachable addresses
prouten      View the Table of routes to other nodes

prpadd       Add a PNNI static route property (type, metrics, TNS)
prpdel       Delete a PNNI static route property

pradd        Add PNNI static route address(es) to a route property
prdel        Delete PNNI static route address(es) from a route property

prp          View PNNI configured route properties
prt          View PNNI configured route prefixes

Related Menus:
Pconfig    Proute     Pinfo     Pstats     Padmin
```

The first two commands on this menu (**proutea** and **prouten**) provide information on dynamically learned routes in the network. The remaining commands (i.e., those listed after **prouten**) allow you to configure, delete, or view static route properties and addresses.

Configuring a PNNI/IISP Static Route Property

The **prpadd** command allows you to configure a PNNI/IISP static route property for a given CSM port. Note that a route property may be set up without assigning any actual route addresses. (Static route addresses are assigned to route properties through the **pradd** command. See *Adding a PNNI/IISP Static Route Address* on page 46-9).

Follow the steps below to set up a static route property.

1. Enter **prpadd** followed by the slot and port number of the CSM where this property will be valid. For example, to set up a static route property on port 2 of the CSM module in slot 3, you would enter the following:

   prpadd 5/1

   Virtual Path Tunnels. To configure a static route property for a specific virtual path tunnel, you need to include the instance number of the virtual tunnel in the **prpadd** command. (Physical level parameters for virtual tunnels are configured through the **cvpt** command, which is described in Chapter 43.) The **prpadd** format for virtual path tunnels is as follows:

   prpadd <slot>/<port>/<virtual tunnel instance>

   where **<virtual tunnel instance>** is a unique value assigned to each virtual tunnel on a CSM module port. You can find a specific virtual tunnel instance through the **lvpt** command. If you wanted to configure a static route property for the second virtual tunnel instance on first port on the CSM module in slot 5, you would specify:

   prpadd 5/1/2

   After you enter the command line, a display similar to the following displays:

```
                Route Property Configuration for Slot 5 Port 1

1) Internal or exterior (i or e)      [i]:  Unspecified
2) Scope (1-104)                     [80]:  Unspecified
3) VP Capable (t or f)                [t]:  Unspecified
4) VPI                                 :  Unspecified
5) E.164 Address                       :  Unspecified

6) Topology State Parameter Configuration Menu

7) Associated Transit Network Configuration Menu

   To configure a parameter, type "item = value"  (as in 1=i)
   To quit out of configuration, type "quit"
   To save the configured info, type "save"
->
```

2. To alter a parameter, enter the line number for the parameter, followed by an equal sign (=), and then the new value for the parameter. For example, to change the **Scope** (line 2) from level 80 to 96, you would enter:

   2=96

   Options on line numbers 6 and 7 enter submenus with additional configuration parameters. Simply enter the submenu's line number (6 or 7) and press **<Enter>** to go to that submenu. Descriptions for the parameters under option 6 can be found in *Configuring QoS and Metrics for Inbound and Outbound Routes* on page 46-5. Descriptions for parameters under option 7 can be found in *Configuring the Associated Transit Network* on page 46-6.

1) Internal or exterior (i or e)

The type of reachability (internal or exterior) from the advertising node to the end address prefix. Internal means this route property is within this PNNI routing domain, or peer group; specify an **i** here for an internal route property. Exterior means this route property is outside this routing domain, or peer group; specify an **e** for an exterior route property.

2) Scope (1-104)

The PNNI scope (i.e., level within the PNNI hierarchy) where addresses configured on this route property will be advertised. Values may range from 0 to 104 with higher values indicating addresses that are lower in the PNNI hierarchy.

3) VP Capable [t or f]

Indicates whether to advertise to reachable address prefixes that the establishment of Virtual Paths is supported. **True** means Virtual Path capability will be advertised for static routes set up using this property. **False** means Virtual Path capability will not be advertised for static routes set up using this property.

4) VPI

The Virtual Path Identifier (VPI) to use for static route addresses set up using this property. Note that the VPI value you select must be within the range of VPIs established for this CSM port through the **map** command. The range of VPIs available on a CSM port is configured through the **Max VPI Bits** variable in the **map** command; see Chapter 42 for more information.

5) E.164 Address

The E.164 address associated with this route property. E.164 addresses are typically required for routes traversing public carrier networks. In contrast to default OmniSwitch PNNI Node addresses, which have a prefix of 39, E.164 addresses use a prefix of 45.

Note

The OmniSwitch is not a public ATM switch. The E.164 capability allows the OmniSwitch to act as a gateway between a private network and a public ATM switched network.

3. When you have completed configuring parameters, enter **save**. Your new values will be saved and you will exit this menu. If you want to exit this menu without saving changes, simply enter **quit**.

Configuring QoS and Metrics for Inbound and Outbound Routes

Option 6 on the **prpadd** main menu enters a submenu of command options for configuring topology metrics for each Class of Service inbound or outbound on this route. If you enter a **6** at the main **prpadd** screen, the following displays:

```
                    Topology State Parameter Configuration for PNNI Port 136 (on 3/2)

                                        Internal Inbound Metrics
                    Admin Weight        Cell Transfer Delay        Cell Delay Variation
                      (a)   [0]           (b)   [0]                  (c)   [0]
                    ==========          ==========                 ==========
1) CBR              Unspecified
2) Rt-VBR           Unspecified
3) Nrt-VBR          Unspecified
4) ABR              Unspecified
5) UBR              Unspecified
                                        Internal Outbound Metrics
                    Admin Weight        Cell Transfer Delay        Cell Delay Variation
                      (a)   [0]           (b)   [0]                  (c)   [0]
                    ==========          ==========                 ==========
6) CBR              Unspecified
7) Rt-VBR           Unspecified
8) Nrt-VBR          Unspecified
9) ABR              Unspecified
10) UBR             Unspecified


    To configure a parameter, type "item = value"  (as in 1a=5040)
    To quit out of configuration, type "quit"
    To save the configured info, type "save"
    To return to the route property parameters menu, type "return"
 ->
```

You configure topology metrics for a given Class of Service by entering the number for the traffic class type, the letter of the topology metric you want to change (**a**, **b**, or **c**), an equal sign (=), and then the value for the topology metric. For example, if you wanted to set the administrative weight for inbound Available Cell rate (ABR) traffic to 1000, you would enter:

```
4a=1000
```

a) Admin Weight

The cumulative administrative weight calculated for the forward (inbound) or backward (outbound) direction on this route. If this metric is not used, its value should be set to 0xFFFFFFFF.

b) Cell Transfer Delay

The cumulative Cell Transfer Delay (in microseconds) for the forward (Inbound) or backward (Outbound) direction of the route. This value is the average time it takes for cells to transmit from any incoming port to the outgoing port in the switch for a particular Class of Service. If this parameter is not used, its value will be set to 0xFFFFFFFF.

c) Cell Delay Variation

The cumulative Cell Delay Variation (in microseconds) for the forward (In) or backward (Outbound) direction of the route. Also referred to as “jitter,” this metric is the change that occurs in cell spacing from the time cells leave one node and arrive at another node. If this parameter is not used, its value will be set to 0xFFFFFFFF.

Configuring the Associated Transit Network

Option 7 on the **prpadd** main menu enters a submenu of command options for configuring transit networks associated with this route property. The transit network is a network data must travel through before reaching the destination at the end of the route. The transit network is outside a node's peer group. Transit networks are used to tunnel call requests from an ATM End System in one peer group to an ATM End System in another peer group.

Follow these steps to set up transit networks for a static route property:

1. Enter a **7** at the first screen of **prpadd** options.

2. A screen similar to the following displays:

```
                Transit Network Configuration for Routes on PNNI Port 136 (on 3/2)

     1) Number of Associated Transit Networks [0-5]:          Unspecified
```

   Enter a 1 followed by an equal sign and then the number of transit networks you want to setup. Press **<Enter>**. You may configure up to five transit networks.

3. A screen similar to the following displays:

```
     Type(a)    Plan(b)              Id(c)
     =======    =======    ========================================
  2)      0          0
  3)      0          0
  4)      0          0

     Where Type is 0-7 Plan is 0-15 and ID is less than 20 characters
          (all according to ATM Forum Specification Section 5.14.7)

     To configure a parameter, type "item = value"  (as in 1=2)
     To abort out of configuration, type "quit"
     To return to the route property parameters menu, type "return"
     To save the configured info, type "save"
  ->
```

   This sample shows three transit networks numbered from 2 through 4.

4. Enter parameters for the first transit network. Start each specification with a 2, followed by the letter of the parameter (a, b, or c), an equal sign (=), and then the value of the parameter. For example, to enter a **Type** of **1**, a **Plan** of **1**, and an **Id** of **Northern Telecom -42**, you would enter:

```
-> 2a=1, 2b=1, 2c=public_1
```

   Each of the three transit network parameters are described below.

   Type. The type of transit network. The type, which is a 3-bit field in the Reachable Address Information Group (RAIG), may be a national network or other type. The network administrator should consult with the ATM service provider for the correct value to enter here.

   Plan. The network identification plan for this transit network. This value, which is a 4-bit field in the Reachable Address Information Group (RAIG), may be an identification code for the particular carrier. The network administrator should consult with the ATM service provider for the correct value to enter here.

   Id. A textual identifier for this transit network. Enter a description that identifies the the type and carrier for this transit network.

5. Repeat Step 4 for the remaining transit networks. The second transit network specifications should start with a 3, the third transit network starts with a 4, and so on.

The following screen shows an example of what the final transit network specifications might look like:

```
Transit Network Configuration for Routes on Slot 3 Port 2:

 1) Number of Associated Transit Networks [0-5]:3

     Type(a)      Plan(b)          Id(c)
    =======      =======    ====================
2)        1            1    public_1
3)        2           14    3900102030405060708
4)        1            5    public_2

     Where Type is 0-7 Plan is 0-15 and ID is less than 20 characters
        (all according to ATM Forum Specification Section 5.14.7)

   To configure a parameter, type "item = value"  (as in 1=2)
   To abort out of configuration, type "quit"
   To return to the route property parameters menu, type "return"
   To save the configured info, type "save"
  ->
```

Deleting a PNNI/IISP Static Route Property

You can delete a PNNI/IISP static route property that has been previously configured. The **prpdel** command allows you to delete one or more static route properties on a CSM port or ports that you specify.

The command first displays the static routes for the port(s) and then prompts you to enter the routes that you want to delete. The syntax for this command is as follows:

prpdel <slot>/<ports>

For example, to delete static routes on port 2 of the CSM module in slot 3, you would enter:

prpdel 3/2

Virtual Path Tunnels. To delete a static route property for a specific virtual path tunnel, you need to include the instance number of the virtual tunnel in the **prpdel** command. (Physical level parameters for virtual tunnels are configured through the **cvpt** command, which is described in Chapter 43.) The **prpdel** format for virtual path tunnels is as follows:

prpdel <slot>/<port>/<virtual tunnel instance>

where **<virtual tunnel instance>** is a unique value assigned to each virtual tunnel on a CSM module port. You can find a specific virtual tunnel instance through the **lvpt** command. If you wanted to delete a static route property for the second virtual tunnel instance on first port on the CSM module in slot 5, you would specify:

prpdel 5/1/2

A screen similar to the following displays:

```
Deleting static PNNI route properties for Slot 3 Port 2:

Currently there are 3 route configurations for this port as follows:

                                                                  # Route
Rt  Slot/Port  Int/Ext  Scope          Metrics                    Prefixes
==  =========  =======  =====  ========================================
 1    3/2       Int     104    CBR In: configured  Out:configured    2
                               RT  In: configured  Out:configured
                               NRT In:             Out:
                               ABR In: configured  Out:configured
                               UBR In: configured  Out:configured

 2    3/2       Int     104    CBR In: configured  Out:              2
                               RT  In:             Out:configured
                               NRT In:             Out:
                               ABR In:             Out:
                               UBR In:             Out:

 3    3/2       Ext     92     CBR In:             Out:              2
                               RT  In: configured  Out:
                               NRT In:             Out:
                               ABR In:             Out:
                               UBR In:             Out:

Which property do you wish to delete? (Note that all metric,
  route prefix and tns info will be deleted as well)       (1-3):
```

Enter the route property number(s) that you want to delete at the prompt at the bottom of the screen. The route numbers are listed in the leftmost column of the table. Once you delete a route, all associated metrics, addresses, and transit network information will be cleared from the database.

Adding a PNNI/IISP Static Route Address

The **pradd** command allows you to add PNNI/IISP route address prefixes to previously configured static route properties. Note that you must set up a static route property through the **prpadd** command first before you can add addresses.

Follow the steps below to add one or more static route address(es).

1. Enter **pradd** followed by the slot and port number where you want to set up the static route address(es). For example, to set up an address for a static route on port 2 of the CSM module in slot 3, you would enter the following:

   pradd 3/2

   If there are no static route properties set up for this CSM port, then the following message displays:

   There are no route properties on this interface. Before you can add route addresses, first add the property to this interface via the Prpadd command.

   Virtual Path Tunnels. To add a static route address for a specific virtual path tunnel, you need to include the instance number of the virtual tunnel in the **pradd** command. (Physical level parameters for virtual tunnels are configured through the **cvpt** command, which is described in Chapter 43.) The **pradd** format for virtual path tunnels is as follows:

   pradd <slot>/<port>/<virtual tunnel instance>

   where **<virtual tunnel instance>** is a unique value assigned to each virtual tunnel on a CSM module port. You can find a specific virtual tunnel instance through the **lvpt** command. If you wanted to add a static route address for the second virtual tunnel instance on first port on the CSM module in slot 5, you would specify:

   pradd 5/1/2

   If static route properties were previously set up for this port (using the **prpadd** command), a display similar to the following displays:

   Currently there are 3 route configurations for this port as follows:

Rt	Slot/ Port	Int/ Ext	Scope	Admin Weight Metrics			# Route Prefixes
==	=====	====	=====	==========	==========	==========	==========
1	5/1	Int	104	CBR	In:5000	Out:0	0
				rtVBR	In:0	Out:2000	
				nrtVBR	In: 0	Out:0	
				ABR	In:0	Out:0	
				UBR	In:0	Out:0	

   Do you wish to add to this property? (y)

2. Enter a **y** at this prompt to begin adding route addresses. If more than one route property exists, then you will be prompted to enter the route number for which you want to add addresses. Route numbers are listed in the left-most column of the table.

3. The following prompt displays:

   1) Number of routes (0-20) : Unspecified

   To configure a parameter, type "item = value" (as in 1=2)
   To abort out of configuration, type "quit"
   To return to the route property parameters menu, type "return"
   ->

Enter the number of address you to configure for this static route property by entering a **1**, an equal sign (=) and then the number of addresses to add. Up to 20 route prefixes may be added to a route property.

4. After you specify the number of route prefixes, the menu updates to reflect the number of routes you requested to set up, as follows:

```
Route Address Configuration for Routes on Slot 3 Port 2:

1) Number of routes (0-20)                          : 2
                  Address Prefix (a)                 Prefix bit-length (b)
  ========================================== ======================
2)                                                          0
3)                                                          0

 To configure a parameter, type "item = value"  (as in 1=2)
 To quit out of configuration, type "quit"
 To save the configuration, type "save"
```

Enter parameters for the first address. Start each specification with a **2**, followed by the letter of the parameter (**a** or **b**), an equal sign (=), and then the value of the parameter. For example, to enter an address prefix of **1** and an Length of **75**, you would enter:

```
-> 2a=47000400063456230000470004000063456230000, 2b=75
```

Be sure to separate each parameter specification by a comma (,). Each of the static route address parameters is described below.

Address Prefix. The ATM End System address prefix. This prefix is an ATM address of up to 19 octets. The default address prefix length is set to the number of characters entered here multiplied by 4. For example, if you enter **49**, then the default prefix length is **8** (4 x 2 characters=8).

Prefix Length. The prefix length to be applied to the ATM End System address prefix. This value may range from 0 to 152; it specifies the prefix bit length. This field allows you to change the default prefix length derived from the address prefix entered in column **a**. The **prt** command uses this length when displaying address prefixes.

Note

A prefix with a length of zero (0) specifies a default route for all unmatched addresses.

5. Repeat Step 4 for other addresses you want to add. The second address specification should start with a 3, the third address starts with a 4, and so on. The following screen shows an example of what the final address specifications might look like:

```
Route Address Configuration for Routes on Slot 3 Port 2:

1) Number of routes (0-20)                          : 2
                  Address Prefix (a)                   Prefix bit-length (b)
  ========================================== ====================
2) 47000400063456230000470004000063456230000 75
3) 470005                                               22

 To configure a parameter, type "item = value"  (as in 1=2)
 To quit out of configuration, type "quit"
 To save the configuration, type "save"
->
```

Deleting a PNNI/IISP Static Route Address

The **prdel** command allows you to delete one or more PNNI/IISP static route addresses on a CSM port or ports. The command first displays the static routes for the port(s) and then prompts you to enter the routes containing addresses that you want to delete. The syntax for this command is as follows:

prdel <slot>/<ports>

For example, to delete static route addresses on port 2 of the CSM module in slot 3, you would enter:

prdel 3/2

You can also enter the command without a CSM port to obtain a listing of static routes for all CSM ports in the OmniSwitch.

Virtual Path Tunnels. To delete a static route address for a specific virtual path tunnel, you need to include the instance number of the virtual tunnel in the **prdel** command. (Physical level parameters for virtual tunnels are configured through the **cvpt** command, which is described in Chapter 43.) The **prdel** format for virtual path tunnels is as follows:

prdel <slot>/<port>/<virtual tunnel instance>

where **<virtual tunnel instance>** is a unique value assigned to each virtual tunnel on a CSM module port. You can find a specific virtual tunnel instance through the **lvpt** command. To delete a static route address for the second virtual tunnel instance on first port on the CSM module in slot 5, specify:

prdel 5/1/2

Follow these steps to delete a static route address:

1. Enter the **prdel** command followed by a CSM slot number, a slash, and a CSM module port number. If no static route properties have been set up on this port, then a message similar to the following display:

   There are no route properties on this interface.

   If there are static route properties on this port, then a list of routes displays as follows:

```
Currently there are 3 route configurations for this port as follows:

 Rt  Slot/ Int/                                                  # Route
     Port  Ext  Scope            Metrics                         Prefixes
 ==  ===== ==== ===== ========================================  ========
  1  3/2   Int   80   CBR In: configured  Out:configured          2
                      RT  In: configured  Out:configured
                      NRT In:             Out:
                      ABR In: configured  Out:configured
                      UBR In: configured  Out:configured

  2  3/2   Int   80   CBR In: configured  Out:                   2
                      RT  In:             Out:configured
                      NRT In:             Out:
                      ABR In:             Out:
                      UBR In:             Out:

  3  3/2   Ext   80   CBR In:             Out:                   2
                      RT  In: configured  Out:
                      NRT In:             Out:
                      ABR In:             Out:
                      UBR In:             Out:

From which route property do you wish to delete reachable addresses? (1-3): 1
```

2. Enter the number for the static route property containing the addresses you want to delete. Route property numbers are in the left-most column of the table. If there are no addresses assigned to the static route property you enter, then the following message displays:

   There are no reachable addresses configured for this route property.

   If there are associated addresses, then a listing of addresses follows:

   The following reachable addresses exist:

   ```
                    Address Prefix (a)                    Prefix bit-length (b)
   ========================================== ====================
   2) 47000400063456230000470004000634562300000 152
   3) 470005                                              22

   Delete which prefixes? (return when done)
   ->
   ```

3. Enter the address number that you want to delete. Address numbers are in the leftmost column of the table. Repeat entering address numbers until you have deleted all those addresses that you want to delete. When you have finished deleting addresses, simply press **<Return>** without entering an address line number.

   If you remove all addresses associated with a given static route property then the following message displays:

   Since you've removed all prefixes, do you wish to remove this property and its associated metrics and TNS configurations as well? (y,n):

4. Enter a **Y** if you want to delete the entire static route property. You are not required to delete the route property since you can add other addresses to it later. Enter an **N** if you do not want to delete the route property.

Viewing PNNI/IISP Static Route Properties

The **prp** command displays currently configured PNNI/IISP static route properties in this switch. These route properties, or templates, were configured through the **prpadd** command. The syntax for this command is as follows:

prp <slot>/<ports>

For example, if you wanted to view the current static route properties configured on port 2 of the CSM module in slot 3, you would enter:

prp 3/2

In addition, you can view the route properties for a specific virtual path tunnel on a CSM port. Simply enter the virtual tunnel instance after the slot and port. For example, to view the current static route properties configured for virtual tunnel instance 1 on port 2 of the CSM module in slot 3, you would enter:

prp 3/2/1

You could also view route properties for the entire switch by entering the command with no slot and port parameters:

prp

After you enter the command, the number of currently configured route properties displays followed by information on these route properties. The following display shows a sample of the output from the **prp** command:

```
Currently there is 1 route configurations as follows:

 Rt  Slot/Port  Int/Ext  Scope  Admin Weight Metrics                TNS in use  # Route Prefixes
 ==  =========  =======  =====  ================================  ==========  ================
  1     5/1       Int     80    CBR      In:5000     Out:0             Y             0
                                 rtVBR    In:0        Out:2000
                                 nrtVBR   In: 0       Out:0
                                 ABR      In:0        Out:0
                                 UBR      In:0        Out:0
```

Rt. The route index number uses to identify this property in the table.

Slot/Port. The CSM slot and port on which this route property was configured.

Int/Ext. Indicates whether this route is and interior route (i.e., within the same peer group) or an exterior route (i.e., outside the peer group).

Scope. The level within the PNNI hierarchy where this route property is configured.

Admin Weight Metrics. Indicates whether metrics have been configured for a given Class of Service. Service classes are listed with the current status of Incoming and Outgoing traffic. If metrics have been configured, then the field next to the class name will read **configured**. If no metrics are configured for a service class, then the field next to the service class name will be blank.

TNS in use. Indicates whether associated transit networks were set up for this route property.

 # Route Prefixes. The number of route addresses configured for this property through **Pradd**.

Viewing PNNI/IISP Static Route Prefixes

The **prt** command displays currently configured PNNI/IISP address prefixes for this switch. These address prefixes were configured through the **pradd** command. The syntax for this command is as follows:

prt <slot>/<ports>

For example, if you wanted to view the current static route addresses configured on port 2 of the CSM module is slot 3, then you would enter:

prt 3/2

In addition, you can view the static route addresses for a specific virtual path tunnel on a CSM port. Simply enter the virtual tunnel instance after the slot and port. For example, to view the current static route addresses configured for virtual tunnel instance 1 on port 2 of the CSM module in slot 3, you would enter:

prt 3/2/1

You could also view static route addresses for the entire switch by entering the command with no slot and port parameters:

prt

After you enter the command, the number of currently configured route addresses are displayed. The following display shows a sample of the output from the **prp** command:

ATM PNNI Configured Route Prefixes

Prefix Len	Address Prefix	Slot Port	Internal/ Exterior	Scope
0	-- Default Route --	3/3	Ext	20
20	47001	3/3	Int	104
20	47002	3/3	Int	104
20	47003	3/3	Int	104
80	47000400081e2f400005	3/3	Int	104

Prefix Len. The number of octets included in the address prefix.

Address Prefix. The address prefix configured for the static route.

Slot/Port. The CSM slot and port where this address was configured.

Internal/Exterior. Indicates where this address is in the same peer group as this node (**Int**) or whether it is outside this peer group (**Ext**).

Scope. Indicates the scope, or level within the PNNI hierarchy, for this address.

Viewing Learned PNNI/IISP Routes to Reachable Addresses

The **proutea** command displays all PNNI/IISP routes learned by this node to reachable ATM End System addresses in the peer group. This table indicates which ES addresses PNNI believes are reachable from this node.When you enter **Proutea** a screen similar to the following displays:

PNNI Route Table From Nodes To Reachable Addresses

```
Addr Prefix:  3903488001bc9000010178aee00020da78aee0(len=152)  Type:Internal
Advrtsed by: 50a03903488001bc9000010178aee00020da78aee000      port:0 (MYSELF)
Learned via: Local          Scope: 80        VP Capable:FALSE          PTSE:1
          on: TUE FEB 10 15:14:38 1998
================================================================================
Addr Prefix:  3903488001bc9000010178aee0(len=104)                  Type:Internal
Advrtsed by: 50a03903488001bc9000010178aee00020da78aee000      port:1 (MYSELF)
Learned via: Local          Scope: 80      VP Capable:FALSE          PTSE:2
      on: TUE FEB 10 15:14:38 1998
================================================================================
Addr Prefix:  3903488001bc900001017a1bd00020da7a1bd0(len=152)  Type:Internal
Advrtsed by: 50a03903488001bc900001017a1bd00020da7a1bd000      port:0
Learned via: PNNI           Scope: 80        VP Capable:FALSE          PTSE:1
          on: THU FEB 12 16:43:21 1998
================================================================================
Addr Prefix:  3903488001bc900001017a1bd0(len=104)                  Type:Internal
Advrtsed by: 50a03903488001bc900001017a1bd00020da7a1bd000      port:1
Learned via: PNNI           Scope: 80        VP Capable:FALSE          PTSE:2
          on: THU FEB 12 16:43:21 1998
```

Addr Prefix. The value of the ATM End System address prefix.

len. The prefix length to be applied to the ATM End System address prefix.

Type. The type of reachability from the advertising node to the address prefix. This value will be **Internal** (within the same peer group) or **Exterior** (uplink or border link to another peer group). A value of **Reject** refers to an address prefix which if matched indicates that the message should be discarded as unreachable. This value is used in some protocols as a means of correctly aggregating routes.

Advrtsed by. The node ID of a node advertising reachability to the address prefix. If the local node index is zero, then the advertising node ID must be set to all zeros.

port. The port identifier used by the advertising node to reach the given address prefix.

Learned via. The routing mechanism through which the connectivity from the advertising node to the reachable address prefix was learned. A value of **Local** means the the reachable address prefix was learned through ILMI. **Mgmt** means the reachable address was configured statically through SNMP or the User Interface. **PNNI** means the address was learned through the PNNI routing protocol.

Learned on. Indicates the time and date when the connectivity from the advertising node to the reachable address prefix became known to the local node.

Scope. The PNNI scope of advertisement (i.e., level within the PNNI hierarchy) from the advertising node to the address prefix.

VP Capable. Indicates whether the establishment VPCs from the advertising node to the reachable address prefix is advertised.

PTSE. The identifier for the PTSE that describes the reachable address. For reachable addresses learned by means other than PNNI, this attribute is set to zero.

Summary Output for proutea

You can also obtain summary output for the **proutea** command that displays just address information. By using the **-s** flag with **proutea** as follows

```
proutea -s
```

you obtain output similar to the following:

```
                    PNNI Route Table From Nodes To Reachable Addresses
                                    (Summary)

                Address Prefix                          Advertised by Node (on port)
3903488001bc900001017a1bd00020da7a1bd0
                    50a03903488001bc900001017a1bd00020da7a1bd000 (0)  (MYSELF)
3903488001bc900001017a1bd0
                    50a03903488001bc900001017a1bd00020da7a1bd000 (1)  (MYSELF)
47007900000000000000000000a03e000001
                    50a03903488001bc900001017a1bd00020da7a1bd000 (248)  (MYSELF)
```

Each pair of Address Prefix/Advertised by Node pair is organized as a two-line step. The Address Prefix is on the first line and is left justified. The Advertised by Node variable is on the second line and is indented such that it is right justified within the table.

Viewing PNNI/IISP Learned Routes to Other Nodes

The **prouten** command displays all known PNNI/IISP routes between this node and other nodes. This table indicates which nodes PNNI believes are reachable from this node. Only nodes within the same peer group are listed.

When you enter **prouten** a screen similar to the following displays:

PNNI Table Of Routes To Other PNNI Nodes

```
Node:  50a03903488001bc900001017a1bd00020da7a1bd000        Class: UBR
       Learned via: PNNI on: THU FEB 12 16:43:21 1998
Admin Wt     Max CR      Avail CR    Cell TD     Cell DV   CLR(CLP=0   CLR(CLP=0+1)
  In/Out       In/Out      In/Out      In/Out      In/Out      In/Out       In/Out
-----------  ----------  ----------  ----------  ----------  ----------  ----------
      5040      350000      350000          10           2           8           8
      5040      350000      350000          10           2           8           8
================================================================================
Node:  50a03903488001bc900001017a1bd00020da7a1bd000        Class: CBR
       Learned via: PNNI on: THU FEB 12 16:43:21 1998
Admin Wt     Max CR      Avail CR    Cell TD     Cell DV   CLR(CLP=0)  CLR(CLP=0+1)
  In/Out       In/Out      In/Out      In/Out      In/Out      In/Out       In/Out
-----------  ----------  ----------  ----------  ----------  ----------  ----------
      5040      350000      350000          10           2           8           8
      5040      350000      350000          10           2           8           8
================================================================================
Node:  50a03903488001bc900001017a1bd00020da7a1bd000        Class: VBR-Rt
       Learned via: PNNI on: THU FEB 12 16:43:21 1998
Admin Wt     Max CR      Avail CR    Cell TD     Cell DV   CLR(CLP=0)  CLR(CLP=0+1)
  In/Out       In/Out      In/Out      In/Out      In/Out      In/Out       In/Out
-----------  ----------  ----------  ----------  ----------  ----------  ----------
      5040      350000      350000          10           2           8           8
      5040      350000      350000          10           2           8           8
================================================================================
Node:  50a03903488001bc900001017a1bd00020da7a1bd000        Class: VBR-Nrt
       Learned via: PNNI on: THU FEB 12 16:43:21 1998
Admin Wt     Max CR      Avail CR    Cell TD     Cell DV   CLR(CLP=0)  CLR(CLP=0+1)
  In/Out       In/Out      In/Out      In/Out      In/Out      In/Out       In/Out
-----------  ----------  ----------  ----------  ----------  ----------  ----------
      5040      350000      350000          10           2           8           8
      5040      350000      350000          10           2           8           8
================================================================================
Node:  50a03903488001bc900001017a1bd00020da7a1bd000        Class: ABR
       Learned via: PNNI on: THU FEB 12 16:43:21 1998
Admin Wt     Max CR      Avail CR    Cell TD     Cell DV   CLR(CLP=0)  CLR(CLP=0+1)
  In/Out       In/Out      In/Out      In/Out      In/Out      In/Out       In/Out
-----------  ----------  ----------  ----------  ----------  ----------  ----------
      5040      350000      350000          10           2           8           8
      5040      350000      350000          10           2           8           8
```

Node. The node ID of the destination node to which this route proceeds and where the Designated Transit List (DTL) stack for this route terminates.

Class. The service category with which this forwarding table entry is associated. The values will be CBR, rtVBR, nrtVBR, ABR, or UBR.

Learned via. The routing mechanism through which the connectivity from the advertising node to the reachable address prefix was learned. A value of **Local** means the the reachable address prefix was learned through ILMI. **Mgmt** means the reachable address was configured statically through SNMP or the User Interface. **PNNI** means the address was learned through the PNNI routing protocol. The time and date at which this route was last updated or otherwise determined to be correct is also reported.

Traffic Metrics and Attributes

Admin Wt. The cumulative administrative weight calculated for the forward (In) or backward (Out) direction on this route. If this metric is not used, its value should be set to 0xFFFFFFFF.

Max CR. The maximum possible cell rate (in cells per second) for the forward (In) or backward (Out) direction of this route. If this parameter is not used, its value will be set to 0xFFFFFFFF.

Avail CR. The Available Cell Rate (in cells per second) for the forward (In) or backward (Out) direction of the route. The Available Cell Rate is the amount of bandwidth available on this route; this value is dynamic and changes depending and changes depending on usage of the link. If this parameter is not used, its value will be set to 0xFFFFFFFF.

Cell TD. The cumulative Cell Transfer Delay (in microseconds) for the forward (In) or backward (Out) direction of the route. This value is the average time it takes for cells to transmit from any incoming port to the outgoing port in the switch for a particular Class of Service. If this parameter is not used, its value will be set to 0xFFFFFFFF.

Cell DV. The cumulative Cell Delay Variation (in microseconds) for the forward (In) or backward (Out) direction of the route. Also referred to as "jitter," this metric is the change that occurs in cell spacing from the time cells leave one node and arrive at another node. If this parameter is not used, its value will be set to 0xFFFFFFFF.

CLR(CLP=0). The cumulative Cell Loss Ratio for CLP=0 traffic for the forward (In) or backward (Out) direction of the route. This value is the ratio of the number of lost CLP=0 cells to the total number of CLP=0 cells transmitted across a link. If this parameter is not used, its value will be set to 0xFFFFFFFF.

CLR(CLP=0+1). The cumulative Cell Loss Ratio for CLP=0+1 traffic for the forward (In) or backward (Out) direction of the route. This value is the ratio of the number of lost CLP=0+1 cells to the total number of CLP=0+1 cells transmitted across a link. If this parameter is not used, its value will be set to 0xFFFFFFFF.

Summary Output for prouten

You can also obtain a summary display of information in the **prouten** command. The display shows just the Node Id, the Class of Service on that node, and then the Administrative Weight assigned to that Class of Service.

When you enter the **prouten** command using the **-s** flag as follows:

```
prouten -s
```

you can obtain a table similar to the following:

PNNI Table Of Routes To Other PNNI Nodes (Summary)

Node Id	Class	Admin Weight In	Admin Weight Out
50a03903488001bc900001017a1bd00020da7a1bd000	UBR	0	0 (MYSELF)
50a03903488001bc900001017a1bd00020da7a1bd000	CBR	0	0 (MYSELF)
50a03903488001bc900001017a1bd00020da7a1bd000	VBR-Rt	0	0 (MYSELF)
50a03903488001bc900001017a1bd00020da7a1bd000	VBR-Nrt	0	0 (MYSELF)
50a03903488001bc900001017a1bd00020da7a1bd000	ABR	0	0 (MYSELF)