

Cisco – Private Network–to–Network Interface (PNNI) Route Selection

Document ID: 19131

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Introduction

Private Network–to–Network Interface (PNNI) is a suite of network protocols that can be used in order to discover an ATM network topology, create a database of topology information, and route calls over the discovered topology. When you plan properly, the set up of a PNNI network is much easier and faster than the manual configuration of connections through an ATM network.

This document illustrates the PNNI route selection process through the use of several examples.

Prerequisites

Requirements

Cisco recommends that you have knowledge of PNNI. Read these documents for a detailed explanation on PNNI:

- Introduction to PNNI
- ATM Routing with IISp and PNNI
- Configuring ATM Routing and PNNI
- Understanding ATM Addresses with Cisco Devices

Components Used

The information in this document is based on these software and hardware versions:

- Cisco Catalyst 8540 MSR that runs Cisco IOS® Software Release 12.1(7a)EY1
- LightStream LS1010 that runs Cisco IOS Software Release 12.1(7a)EY

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

PNNI Route Selection

PNNI uses source-routing, where the source is responsible for the selection of the destination path. More precisely, the first node of each peer group selects the path across that peer group. The selected path is encoded as a Designated Transit List (DTL) which is included in the connection setup. This DTL specifies every node through which the call setup transits.

This explanation has been taken from the path selection of the PNNI 1.0 specification (af-pnni-0055.0 , section 5.13):

"When selecting a route to a destination ATM address, a node shall always route to the node which has advertised the longest prefix which matches the destination. If only nodes with the longest matching prefix are ancestors then the destination is not reachable. Only when several nodes have advertised equal length matching prefixes which are all longer than any other advertisement may the calculating node choose on a local basis which destination to use. Of the nodes advertising equal longest matching prefixes ignore any ancestors and select among the remaining ones, if any."

On Cisco devices, the route selection to a destination ATM address is based on this criteria:

- The most preferred route is the one with the longest ATM prefix match.
- If several matches exist, then the route selection is based on the precedence of the routes found. The lower the precedence, the higher the priority.
- If there are several routes with equal priority, then take the route with the better administrative weight.

This is the default precedence associated with each route:

```
switch#show atm pnni precedence
```

Prefix Poa Type	Working Priority	Default Priority
local-internal	1	1
static-local-internal-metrics	2	2
static-local-external	3	3
static-local-external-metrics	2	2
pnni-remote-internal	2	2
pnni-remote-internal-metrics	2	2
pnni-remote-external	4	4
pnni-remote-external-metrics	2	2

These values can be modified with the **precedence [prefix type] [priority]** command. This is an example:

```
switch#configure terminal
```

Enter configuration commands, one per line. End with CNTL/Z.

```
switch(config)#atm router pnni
switch(config-atm-router)#precedence ?
pnni-remote-external      Remote Exterior Prefix Without Metrics
pnni-remote-external-metrics Remote Exterior Prefix With Metrics
pnni-remote-internal      Remote Internal Prefix Without Metrics
pnni-remote-internal-metrics Remote Internal Prefix With Metrics
static-local-external      Static Exterior Prefix Without Metrics
static-local-external-metrics Static Exterior Prefix With Metrics
static-local-internal-metrics Static Internal Prefix With Metrics
```

```

<cr>

switch(config-atm-router)#precedence pnni-remote-exterior ?
<2-4> Priority For Remote Exterior Without Metrics

switch(config-atm-router)#precedence pnni-remote-exterior 2

```

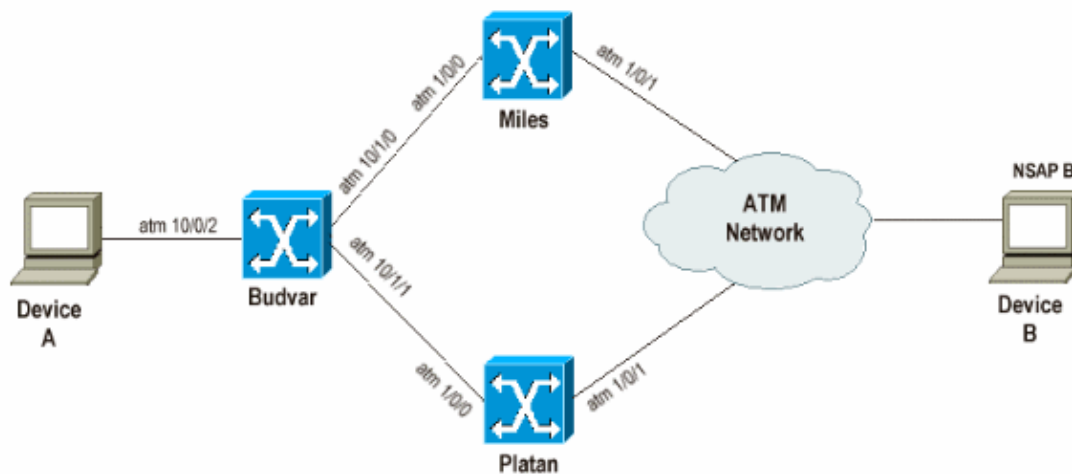
Illustration of the Route Selection

These three examples illustrate the PNNI route selection and use a single peer group.

Example 1

Network Diagram

Use this network diagram in this example:



```

NSAP B= 47.0091.8100.0000.00d0.58b8.5555.0000.0000.0001.00
NSAP Budvar= 47.0091.8100.0000.00d0.58b7.9a01.00d0.58b7.9a01.00
NSAP Platan= 47.0091.8100.0000.00d0.58b8.4201.00d0.58b8.4201.00
NSAP Miles= 47.0091.8100.0000.00d0.e203.0601.0050.e203.0601.00

```

Note:

- Budvar and Platan are Cisco Catalyst 8540 MSRs that run Cisco IOS Software Release 12.1(7a)EY1.
- Miles is a LS1010 that runs Cisco IOS Software Release 12.1(7a)EY.
- Devices A and B can be any type of devices able to establish SVCs.

Goal

This first test illustrates the fact that PNNI takes the longest match prefix, the route, with the higher priority, thus the lower precedence, first in order to route a call. In this example, Constant Bit Rate (CBR) call setups are made from device A to device B. These call setups can use these two different but equal paths with the same administrative weight in order to reach device B:

- Through Budvar and Platan
- Through Budvar and Miles

In this example, Platan advertises an internal PNNI route to device B and Miles advertises an external PNNI route to device B. Normally, in accordance with the definition of the path selection, Budvar must route the

call via the PNNI internal route.

Illustration

Device B has this Network Service Access Point (NSAP) address:
47.0091.8100.0000.00d0.58b8.5555.0000.0000.0001.00

See two routes for that destination when you look at the ATM routing table on Budvar:

```
budvar#  
show atm route
```

```
Codes: P - installing Protocol (S - Static, P - PNNI, R - Routing control),  
       T - Type (I - Internal prefix, E - Exterior prefix, SE -  
              Summary Exterior prefix, SI - Summary Internal prefix,  
              ZE - Suppress Summary Exterior, ZI - Suppress Summary Internal)
```

```
P  T Node/Port      St Lev Prefix  
~  ~ ~~~~~~  
P  I 10 0          UP 0  47.0091.8100.0000.00d0.58b8.5555.0000.0000.0001/152  
P  E 14 0          UP 0  47.0091.8100.0000.00d0.58b8.5555.0000.0000.0001/152
```

```
budvar#  
show atm pnni identifiers
```

```
Node  Node Id                                     Name  
1      56:160:47.00918100000000D058B79A01.00D058B79A01.00 budvar  
10     56:160:47.00918100000000D058B84201.00D058B84201.00 Platan  
14     56:160:47.0091810000000050E2030601.0050E2030601.00 Miles
```

As previously explained, there is an internal PNNI route learned from Platan and one external PNNI route learned from Miles.

Upon the reception of the call setup from device A to device B, Budvar can compute a DTL as well as the path through Platan. This output shows how Budvar computes the DTL.

```
budvar#show atm pnni dtl address 47.0091.8100.0000.00d0.58b8.5555.0000.0000.0001.00 cbr p  
budvar#  
00:42:34: PNNI: rcv CBR route req to addr 47.00918100000000D058B85555.000000000001.00  
00:42:34: PNNI: Looking For Nodes That Advertise This Prefix  
00:42:34: PNNI: Best Match Is 47.00918100000000D058B85555.000000000001.00/152  
00:42:34: PNNI: Found 2 POAs  
00:42:34: priority: 2 (10 0) pnni-remote-internal  
00:42:34: priority: 4 (14 0) pnni-remote-exterior  
00:42:34: PNNI: Compute On-Demand Route Based On Admin Weight  
00:42:34: PNNI: Found A Suitable Route Based On AW, Check CDV and CTD  
00:42:34: PNNI: Found A Route That Satisfies Both CDV and CTD  
00:42:34: PNNI: SOURCE ROUTE  
00:42:34: DTL 1> 2 Nodes  
00:42:34: budvar 85001000 (ATM10/0/1)  
00:42:34: Platan 0  
00:42:34: PNNI: Found 1 Ports To Next DTL Node 10 85001000 (ATM10/0/1)  
00:42:34: PNNI: Send Source Route Reply To Requestor: Code PNNI_SUCCESS
```

As previously explained, Budvar detects that there are two possible routes or Point of Attachments (POAs) to reach device B. The route through Budvar (pnni-remote-internal) has a better precedence than the route through Miles. Hence, the DTL is built with that route.

Remarks:

This command can be used in order to determine which DTL must be created for this call setup:

```
show atm pnni dtl [node|address] [NSAP-address|node number] [traffic class] [class parameters]
```

where:

- **NSAP-address** is the destination NSAP address (the address of device B in our case).
- **traffic class** is: CBR, UBR, VBR-rt, VBR-nrt, ABR.
- **class parameters** are the different parameters associated with the traffic class such as PCR, MCR, and SCR.

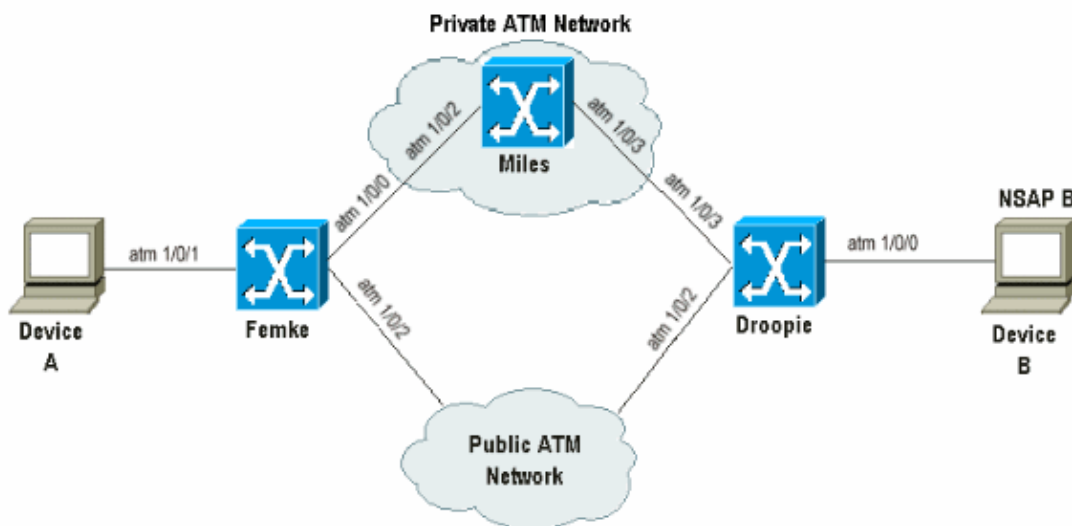
Note: The different rates (PCR, MCR, SCR) are defined in cells/sec and not Kbps.

Note: This command shows which DTL is computed when a call setup is made to the desired NSAP address or PNNI node number with the specified traffic parameters.

Example 2

Network Diagram

Use this network diagram in this example:



NSAP B= 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111.00

Goal

The goal of this example is to show that PNNI only takes into consideration the longest match prefixes and falls back to the next available POA when the current one is not usable.

CBR call setups are created between device A and device B. These two devices do not use ILMI and thus static routes, to E.164 address in this case also known as 45 addresses, that point to them are created on Femke and Droopie.

If congestion occurs within the private ATM cloud that goes through Miles, the CBR call setups must be made through the public ATM network.

Associate different precedence to different types of routes so that the lower the precedence, the higher the priority for the route, in order to make sure that the call setups are made in accordance with the prerequisites.

This is how the prerequisites are achieved:

On Femke and Droopie, the local static routes that point to the locally attached device are created as internal and a backup route that points to the remote device through the public ATM network is defined as external. Furthermore, both static routes are defined with the same length because of the PNNI path selection rule previously mentioned.

In addition to the local static internal route that points to the attached device, another static internal route with a shorter match is created in order to illustrate the fact that PNNI always takes the longest match route into consideration.

Look at Femke and see that there are three routes to reach device B:

1. An internal PNNI route that results from the redistribution of the internal static route created on Droopie.
2. A shorter internal PNNI route that results from the redistribution of the shorter match internal static route created on Droopie.
3. An external static route that is defined on Femke and points to the public ATM network.

Illustration

Device B has this NSAP address: 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111.00

On Droopie, these static routes are defined:

```
atm route 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111... ATM1/0/0 internal
atm route 45.0033.4455.6677.889f.1111.2222... ATM1/0/0 internal (*)
```

(*) this route is the shorter match route that points to device B.

On Femke, this backup static route is defined:

```
atm route 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111... ATM1/0/2
```

Hence, these entries for device B can be seen on the Femke routing table:

```
Femke#show atm route
```

```
Codes: P - installing Protocol (S - Static, P - PNNI, R - Routing control),
       T - Type (I - Internal prefix, E - Exterior prefix, SE -
               Summary Exterior prefix, SI - Summary Internal prefix,
               ZE - Suppress Summary Exterior, ZI - Suppress Summary Internal)
```

P	T	Node/Port	St	Lev	Prefix
~	~	~~~~~	~	~	~~~~~
P	I	14 0	UP	0	45.0033.4455.6677.889f.1111.2222/104
S	E	1 ATM1/0/2	UP	0	45.0033.4455.6677.889f.1111.2222.4000.0c80.1111/152
P	I	14 0	UP	0	45.0033.4455.6677.889f.1111.2222.4000.0c80.1111/152

In order to reach device B, you have:

- a /152 internal PNNI route
- a /104 internal PNNI route
- a /152 external static route that points to the public ATM network

The /152 and /104 are the the levels of hierarchy. For a more detailed explanation on the levels of hierarchy, refer to PNNIs with Different Peer Groups. This output shows how to verify the available resources between Femke and Miles:

```
Femke#show atm interface resource atm 1/0/0
```

```
Resource Management configuration:
```

```
Output queues:
```

```
Max sizes(explicit cfg): none cbr, none vbr-rt, none vbr-nrt, none abr-ubr
```

```
Max sizes(installed): 256 cbr, 256 vbr-rt, 4096 vbr-nrt, 12032 abr-ubr
```

```
Efci threshold: 25% cbr, 25% vbr-rt, 25% vbr-nrt, 25% abr, 25% ubr
```

```
Discard threshold: 87% cbr, 87% vbr-rt, 87% vbr-nrt, 87% abr, 87% ubr
```

```
Abr-relative-rate threshold: 25% abr
```

```
Pacing: disabled 0 Kbps rate configured, 0 Kbps rate installed
```

```
Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
```

```
Link Distance: 0 kilometers
```

```
Controlled Link sharing:
```

```
Max aggregate guaranteed services: none RX, none TX
```

```
Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
```

```
none abr RX, none abr TX, none ubr RX, none ubr TX
```

```
Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
```

```
none abr RX, none abr TX, none ubr RX, none ubr TX
```

```
Best effort connection limit: disabled 0 max connections
```

```
Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
```

```
Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
```

```
Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
```

```
Sustained-cell-rate: none vbr RX, none vbr TX
```

```
Minimum-cell-rate RX: none abr, none ubr
```

```
Minimum-cell-rate TX: none abr, none ubr
```

```
CDVT RX: none cbr, none vbr, none abr, none ubr
```

```
CDVT TX: none cbr, none vbr, none abr, none ubr
```

```
MBS: none vbr RX, none vbr TX
```

```
Resource Management state:
```

```
Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
```

```
Available bit rates (in Kbps):
```

```
72615 cbr RX, 72615 cbr TX, 72615 vbr RX, 72615 vbr TX,
```

```
0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
```

```
Allocated bit rates:
```

```
75000 cbr RX, 75000 cbr TX, 128 vbr RX, 128 vbr TX,
```

```
0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
```

```
Best effort connections: 1 pvcs, 0 svcs
```

Resources available between Miles and Droopie:

```
Miles#show atm interface resource atm 1/0/3
```

```
Resource Management configuration:
```

```
Service Classes:
```

```
Service Category map: c2 cbr, c2 vbr-rt, c3 vbr-nrt, c4 abr, c5 ubr
```

```
Scheduling: RS c1 WRR c2, WRR c3, WRR c4, WRR c5
```

```
WRR Weight: 15 c2, 2 c3, 2 c4, 2 c5
```

```
CAC Configuration to account for Framing Overhead : Disabled
```

```
Pacing: disabled 0 Kbps rate configured, 0 Kbps rate installed
```

```
overbooking : disabled
```

```
Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
```

```
Link Distance: 0 kilometers
```

```
Controlled Link sharing:
```

```
Max aggregate guaranteed services: none RX, none TX
```

```
Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
```

```

        none abr RX, none abr TX, none ubr RX, none ubr TX
Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
               none abr RX, none abr TX, none ubr RX, none ubr TX
Best effort connection limit: disabled 0 max connections
Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
Sustained-cell-rate: none vbr RX, none vbr TX
Minimum-cell-rate RX: none abr, none ubr
Minimum-cell-rate TX: none abr, none ubr
CDVT RX: none cbr, none vbr, none abr, none ubr
CDVT TX: none cbr, none vbr, none abr, none ubr
MBS: none vbr RX, none vbr TX

```

Resource Management state:

```

Available bit rates (in Kbps):
  57743 cbr RX, 57743 cbr TX, 57743 vbr RX, 57743 vbr TX,
  57743 abr RX, 57743 abr TX, 57743 ubr RX, 57743 ubr TX
Allocated bit rates:
  90000 cbr RX, 90000 cbr TX, 0 vbr RX, 0 vbr TX,
  0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
Best effort connections: 1 pvcs, 0 svcs

```

This output shows what happens when a CBR call setup is made from device A to device B when different PCR values are used:

a. CBR Call Setup from Device A to Device B with PCR= 727 Kbps (1715 cells/s)

There are available resources along the path in order to accommodate such a call setup. Proceed with these instructions in order to check the DTL, which is created on Femke, in order to reach device B:

```

Femke#show atm pnni dtl address 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111 cbr pcr 1
Femke#
Nov 13 08:16:08.310: PNNI: rcv CBR route req to addr 45.003344556677889F11112222.40000C801
Nov 13 08:16:08.310: PNNI: Looking For Nodes That Advertise This Prefix
Nov 13 08:16:08.310: PNNI: Best Match Is 45.003344556677889F11112222.40000C801111.00/152
Nov 13 08:16:08.310: PNNI: Found 2 POAs
Nov 13 08:16:08.310:          priority: 2 (16 0) pnni-remote-internal
Nov 13 08:16:08.310:          priority: 3 (1 80802000 (ATM1/0/2)) static-local-exterior
Nov 13 08:16:08.310: PNNI: Compute On-Demand Route Based On Admin Weight
Nov 13 08:16:08.310: PNNI: Found A Suitable Route Based On AW, Check CDV and CTD
Nov 13 08:16:08.310: PNNI: Found A Route That Satisfies Both CDV and CTD
Nov 13 08:16:08.310: PNNI: SOURCE ROUTE
Nov 13 08:16:08.310:          DTL 1> 3 Nodes
Nov 13 08:16:08.310:          Femke 80800000 (ATM1/0/0)
Nov 13 08:16:08.310:          Miles 80803000 (ATM1/0/3)
Nov 13 08:16:08.310:          Droopie
Nov 13 08:16:08.310: PNNI: Found 1 Ports To Next DTL Node 13 80800000 (ATM1/0/0)
Nov 13 08:16:08.314: PNNI: Send Source Route Reply To Requestor: Code PNNI_SUCCESS

```

In this call setup, these two POAs are found:

- /152 Internal PNNI route
- /152 External static route

The /104 route is not taken into account. The /152 PNNI internal route is then used because it has a better precedence, precedence 2, compared to the external static route, precedence 3, and because there are enough resources on the path in order to accommodate this call setup.

b. CBR Call Setup from Device A to Device B with PCR = 77620 Kbps (183066 cells/s)

```

Femke#show atm pnni dtl address 45.0033.4455.6677.889f.1111.2222.4000.0c80.1111 cbr pcr 1

```

```

Femke#
Nov 13 12:38:28.165: PNNI: rcv CBR route req to addr 45.003344556677889F11112222.40000C801
Nov 13 12:38:28.169: PNNI: Looking For Nodes That Advertise This Prefix
Nov 13 12:38:28.169: PNNI: Best Match Is 45.003344556677889F11112222.40000C801111.00/152
Nov 13 12:38:28.169: PNNI: Found 2 POAs
Nov 13 12:38:28.169:      priority: 2 (14 0) pnni-remote-internal
Nov 13 12:38:28.169:      priority: 3 (1 80802000 (ATM1/0/2)) static-local-exterior
Nov 13 12:38:28.169: PNNI: Compute On-Demand Route Based On Admin Weight
Nov 13 12:38:28.169: PNNI: Failed To Find An On-Demand Route, Code: PNNI_USER_CELL_RATE_U
Nov 13 12:38:28.169: PNNI: My Node Is Destination
PNNI: Port List: 80802000 (ATM1/0/2)
Nov 13 12:38:28.169: PNNI: Return 1 Ports In Source Route
Nov 13 12:38:28.169: PNNI: Send Source Route Reply To Requestor: Code PNNI_SUCCESS

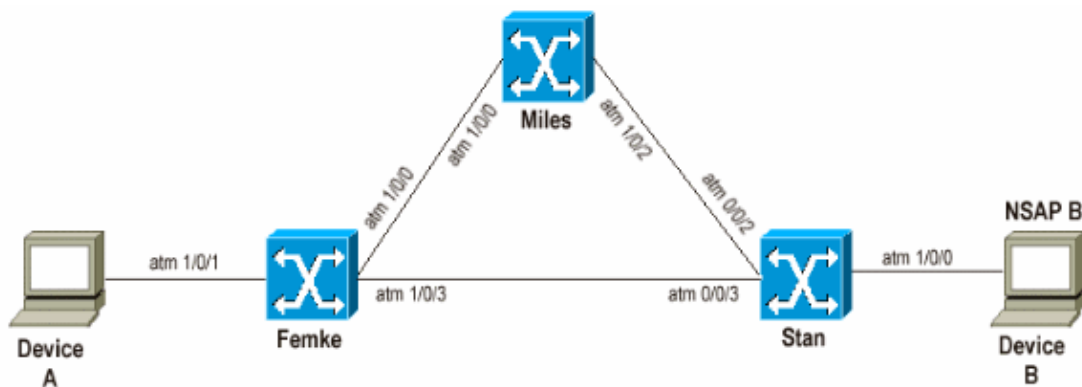
```

In the previous example, there are not enough resources along the PNNI path, so the LS1010 tries to use the second available route to the destination. Thus, the switch falls back to the static external route that points to the public ATM network as required.

Example 3

Network Diagram

Use this setup for this example. All links have the same administrative weight.



```

NSAP B= 47.033.4455.6677.889f.1111.2222.4000.0c80.1111.00
Femke= 47.0091.8100.0000.00e0.146c.b101.00e0.146c.6101.00
Stan= 47.0091.8100.0000.0060.705a.8f01.0060.705a.8f01.00
Miles= 47.0091.8100.0000.0050.e203.0601.0050.e203.0601.00

```

The goal of this example is to show that PNNI always uses the route with the smaller administrative weight. But, if the best path does not have enough resources in order to accommodate the current call, PNNI can fall back to a lower path.

In this scenario, when device A makes a call to device B, there are two possible paths:

1. Femke and then Stan
2. Femke, Miles and then Stan

Throughout normal operations, the call setups flow through the first path as that is the one with the smaller administrative weight.

Illustration

This illustrates the previous explanations:

Device B has this NSAP address: 47.0033.4455.6677.889f.1111.2222.4000.0c80.1111.00. See that the chosen route is the one that goes from Miles to Stan when you look in the routing table:

```
Femke#show atm route

Codes: P - installing Protocol (S - Static, P - PNNI, R - Routing control),
       T - Type (I - Internal prefix, E - Exterior prefix, SE -
              Summary Exterior prefix, SI - Summary Internal prefix,
              ZE - Suppress Summary Exterior, ZI - Suppress Summary Internal)

P  T Node/Port      St Lev Prefix
~  ~ ~~~~~
P  E 10 0          UP 0   47.0033.4455.6677.889f.1111.2222.4000.0c80.1111/152
[snip]
```

```
Femke#show atm pnni identifiers

Node  Node Id                                     Name
  1    56:160:47.00918100000000E0146CB101.00E0146CB101.00 Femke
 10    56:160:47.0091810000000060705A8F01.0060705A8F01.00 Stan
 11    56:160:47.0091810000000050E2030601.0050E2030601.00 la-miles
```

a. CBR Call Setup from Device A to Device B with PCR= 848 Kbps (2000 cells/s)

Such a call setup needs to go through the short path without any problem, as there are available resources in order to accommodate it:

```
Femke#show atm interface resource atm 1/0/3
Resource Management configuration:
[snip]

Resource Management state:
  Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 abr-ubr
  Available bit rates (in Kbps):
    72455 cbr RX, 72455 cbr TX, 72455 vbr RX, 72455 vbr TX,
    0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
  Allocated bit rates:
    75000 cbr RX, 75000 cbr TX, 288 vbr RX, 288 vbr TX,
    0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
  Best effort connections: 0 pvcs, 0 svcs
```

There is still 75 Mbps on that path. This is how to verify which DTL is computed by Femke upon reception of the call setup:

```
Femke#show atm pnni dtl address 47.0033.4455.6677.889f.1111.2222.4000.0c80.1111 cbr pcr 2000
Femke#
*Dec 20 05:46:11.740: PNNI: CBR route request from ATM_OWNER_UNKNOWN
*Dec 20 05:46:11.740: PNNI: To address 47.003344556677889F11112222.40000C801111.00
*Dec 20 05:46:11.740: PNNI: Best Match Is 47.003344556677889F11112222.40000C801111.00/152
*Dec 20 05:46:11.740: PNNI: Found 1 POAs
*Dec 20 05:46:11.740:      priority: 4 (10 0) pnni-remote-exterior
*Dec 20 05:46:11.740: PNNI: Compute On-Demand Route Based On Admin Weight
*Dec 20 05:46:11.740: PNNI: Found A Suitable Route Based On AW, Check CDV and CTD
*Dec 20 05:46:11.740: PNNI: Found A Route That Satisfies Both CDV and CTD
*Dec 20 05:46:11.740: PNNI: SOURCE ROUTE
*Dec 20 05:46:11.740:      DTL 1> 2 Nodes
*Dec 20 05:46:11.740:          Femke 80803000 (ATM1/0/3)
*Dec 20 05:46:11.740:          Stan 0
*Dec 20 05:46:11.744: PNNI: Found 1 Ports To Next DTL Node 10 80803000 (ATM1/0/3)
*Dec 20 05:46:11.744: PNNI: Send Source Route Reply To Requestor: Code PNNI_SUCCESS
```

This output shows that the call does indeed go through the shortest path.

b. CBR Call Setup from Device A to Device B with PCR = 84800 Kbps (200000 cells/s)

Upon reception of such a call setup by Femke, the direct path between Femke and Stan cannot be used because there are not enough unused resources. Femke can then try to use the other path through Miles. This is the DTL that Femke creates upon reception of such a call setup from device A:

```
Femke#show atm pnni dtl address 47.0033..4455.6677.889f.1111.2222.4000.0c80.1111 cbr pcr :
Femke#
*Dec 20 05:47:31.885: PNNI: CBR route request from ATM_OWNER_UNKNOWN
*Dec 20 05:47:31.885: PNNI: To address 47.003344556677889F11112222.40000C801111.00
*Dec 20 05:47:31.885: PNNI: Best Match Is 47.003344556677889F11112222.40000C801111.00/152
*Dec 20 05:47:31.885: PNNI: Found 1 POAs
*Dec 20 05:47:31.885:      priority: 4 (10 0) pnni-remote-exterior
*Dec 20 05:47:31.889: PNNI: Compute On-Demand Route Based On Admin Weight
*Dec 20 05:47:31.889: PNNI: Found A Suitable Route Based On AW, Check CDV and CTD
*Dec 20 05:47:31.889: PNNI: Found A Route That Satisfies Both CDV and CTD
*Dec 20 05:47:31.889: PNNI: SOURCE ROUTE
*Dec 20 05:47:31.889:      DTL 1> 3 Nodes
*Dec 20 05:47:31.889:          Femke 80800000 (ATM1/0/0)
*Dec 20 05:47:31.889:          la-miles 80801000 (ATM1/0/1)
*Dec 20 05:47:31.889:          Stan 0
*Dec 20 05:47:31.889: PNNI: Found 1 Ports To Next DTL Node 11 80800000 (ATM1/0/0)
*Dec 20 05:47:31.889: PNNI: Send Source Route Reply To Requestor: Code PNNI_SUCCESS
```

Since the shortest path to device B does not have enough resources to accommodate such a call, Femke creates a DTL that corresponds to the path through Miles.

Conclusion

In conclusion, in its route selection, PNNI:

- Takes only the longest match route(s) in consideration.
- Tries the routes in accordance to their priority, so the lower the precedence, the better, when several routes exist.
- Uses the next available route, the next available POA, if available, when the current cannot be used.
- Declares the route unreachable if none of the POAs can be used.

Related Information

- [Introduction to PNNI](#)
- [ATM Routing with IISP and PNNI](#)
- [Configuring ATM Routing and PNNI](#)
- [More ATM Information](#)
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Updated: Aug 14, 2006

Document ID: 19131
