PNNI Migration Examples

This appendix provides examples of how to migrate a flat network topology to a Private Network-Network Interface (PNNI) hierarchical network topology, and includes the following sections:

- Adding a Higher Level of PNNI Hierarchy on page A-1
- Adding a New Lowest Level of PNNI Hierarchy on page A-7

Note Detailed PNNI configuration instructions are described in the chapter Chapter 10, "Configuring ATM Routing and PNNI." For a functional description of hierarchical PNNI, refer to the *Guide to ATM Technology*. For a complete description of the commands mentioned in this chapter, refer to the *ATM Switch Router Command Reference* publication.

## Adding a Higher Level of PNNI Hierarchy

Figure A-1 shows an example network with two PNNI peer groups connected by an Interim Inter-Switch Signalling Protocol (IISP) interface.

Figure A-1   Two PNNI Peer Groups Connected by an IISP Interface
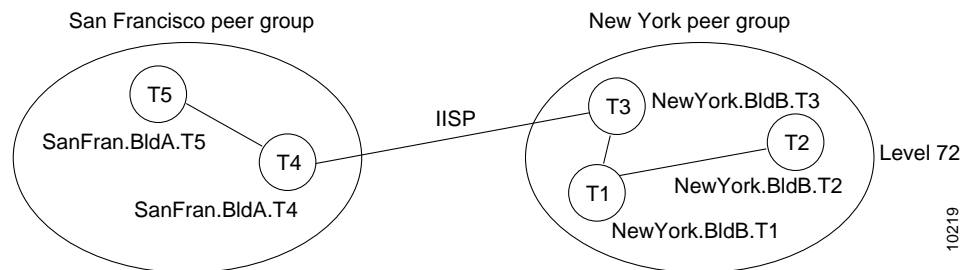
You can convert the network to a single hierarchical PNNI routing domain by configuring a second level of hierarchy in each peer group and converting the IISP interface to a PNNI interface, as shown in Figure A-2.

Figure A-2   Two-Level PNNI Hierarchical Network
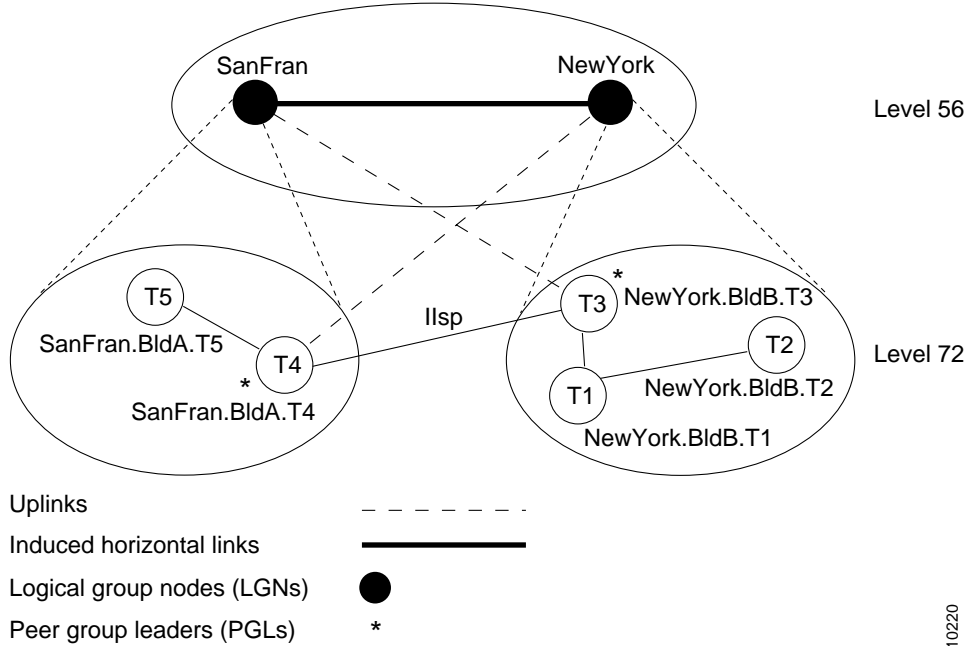
The initial configuration for each ATM switch router is shown in the sections that follow. The commands used to migrate the network to a two-level PNNI hierarchical network (shown in Figure A-2) are also provided.

Switch T1 Initial Configuration

The initial configuration for switch NewYork BldB.T1 follows:

```
hostname NewYork.BldB.T1
atm address 47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a01.00
atm router pnni
 node 1 level 72 lowest
  redistribute atm-static
```

Switch T2 Initial Configuration

The initial configuration for switch NewYork BldB.T2 follows:

```
hostname NewYork.BldB.T2
atm address 47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc01.00
atm router pnni
 node 1 level 72 lowest
  redistribute atm-static
```

To display the reachability information, use the **show atm route** command.

```
NewYork.BldB.T2# 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 9   0            UP 0   47.0091.4455.6677.1144.1011.1233/104
P SI 1   0            UP 0   47.0091.4455.6677.1144.1011.1244/104
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc01/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc02/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1244.4000.0c/128
P  I 11  0            UP 0   47.0091.4455.6677.1144.1011.1255/104
P  E 11  0            UP 0   47.0091.4455.6677.22/64
S  E 1   ATM0/0/1     DN 0   47.0091.8200.0001.1/60
```

Switch T3 Initial Configuration

The initial configuration for switch NewYork BldB.T3 follows:

```
hostname NewYork.BldB.T3
atm address 47.0091.4455.6677.1144.1011.1255.0060.3e5b.c401.00
atm router pnni
 node 1 level 72 lowest
  redistribute atm-static

interface ATM0/0/2
 no ip address
atm route 47.0091.4455.6677.22... ATM0/0/2
```

To display the reachability information, use the **show atm route command**. To display the interface type, use the **show atm interface** command:

```
NewYork.BldB.T3# show atm interface atm 0/0/2

Interface:     ATM0/0/2      Port-type:     oc3suni
IF Status:     UP            Admin Status:  up
Auto-config:   enabled       AutoCfgState:  completed
IF-Side:       Network       IF-type:       IISP
Uni-type:      not applicable Uni-version:   V4.0

<information deleted>
```

Note In the example, the interface type of interface atm 0/0/2 on NewYork.BldB.T3 is determined using Integrated Local Management Interface (ILMI) autoconfiguration. Because the other side of the link on SanFran.BldA.T4 is configured as IISP, the interface type is determined to be IISP. When using ILMI autoconfiguration on one side of the link and manually configuring the other side as IISP, be careful to specify the configured side as either the user or network side, depending on whether it has the larger value of atmfMySystemIdentifier.

Switch T4 Initial Configuration

The initial configuration for switch SanFran.BldA.T4 follows:

```
hostname SanFran.BldA.T4
atm address 47.0091.4455.6677.2233.1011.1266.0060.3e7b.2001.00
atm router pnni
 node 1 level 72 lowest
  redistribute atm-static

interface ATM0/0/3
 no ip address
 no atm auto-configuration
 atm iisp side user version 4.0
atm route 47.0091.4455.6677.11... ATM0/0/3
```

To display the reachability information, use the **show atm route command**. To display the interface type, side, and version, use the **show atm interface** command:

```
SanFran.BldA.T4# show atm interface atm 0/0/3

Interface:      ATM0/0/3       Port-type:      oc3suni
IF Status:      UP             Admin Status:   up
Auto-config:    disabled       AutoCfgState:   not applicable
IF-Side:        User           IF-type:        IISP
Uni-type:       not applicable Uni-version:    V4.0
```

Switch T5 Initial Configuration

The initial configuration for switch SanFran.BldA.T5 follows:

```
hostname SanFran.BldA.T5
atm address 47.0091.4455.6677.2233.1011.1244.0060.3e7b.2401.00
atm router pnni
 node 1 level 72 lowest
  redistribute atm-static
```

Configuring Second Level of PNNI Hierarchy on Switches T3 and T4

The following example shows how to configure and display the second level of PNNI hierarchy on switches NewYork.BldB.T3 and SanFran.BldA.T4 (see Figure A-2):

Note   In this example, the configuration of the second level of PNNI hierarchy on switch NewYork.BldB.T3 or switch SanFran.BldA.T4 has no effect on new or existing connections.

```
NewYork.BldB.T3# configure terminal
NewYork.BldB.T3(config)# atm router pnni
NewYork.BldB.T3(config-atm-router)# node 2 level 56
NewYork.BldB.T3(config-pnni-node)# name NewYork
NewYork.BldB.T3(config-pnni-node)# exit
NewYork.BldB.T3(config-atm-router)# node 1
NewYork.BldB.T3(config-pnni-node)# parent 2
NewYork.BldB.T3(config-pnni-node)# election leadership-priority 45
NewYork.BldB.T3(config-pnni-node)# end
NewYork.BldB.T3#
```

```
SanFran.BldA.T4# configure terminal
SanFran.BldA.T4(config)# atm router pnni
SanFran.BldA.T4(config-atm-router)# node 2 level 56
SanFran.BldA.T4(config-pnni-node)# name SanFran
SanFran.BldA.T4(config-pnni-node)# exit
SanFran.BldA.T4(config-atm-router)# node 1
SanFran.BldA.T4(config-pnni-node)# parent 2
SanFran.BldA.T4(config-pnni-node)# election leadership-priority 45
SanFran.BldA.T4(config-pnni-node)# end
SanFran.BldA.T4#
```

Use the following commands to confirm the creation of the PNNI hierarchy:

```
SanFran.BldA.T4# show atm pnni local-node

PNNI node 1 is enabled and running
  Node name: SanFran.BldA.T4
  System address          47.0091445566772233310111266.00603E7B2001.01
  Node ID          72:160:47.0091445566772233310111266.00603E7B2001.00
  Peer group ID        72:47.0091.4455.6677.2233.0000.0000
  Level 72, Priority 45 95, No. of interfaces 3, No. of neighbors 1
  Parent Node Index: 2

<information deleted>

PNNI node 2 is enabled and running
  Node name: SanFran
  System address          47.0091445566772233310111266.00603E7B2001.02
  Node ID          56:72:47.0091445566772233300000000.00603E7B2001.00
  Peer group ID        56:47.0091.4455.6677.0000.0000.0000
  Level 56, Priority 0 0, No. of interfaces 0, No. of neighbors 0
  Parent Node Index: NONE

<information deleted>

SanFran.BldA.T4# show atm pnni hierarchy
  Locally configured parent nodes:
  Node         Parent
  Index  Level  Index   Local-node Status      Node Name
  ~~~~~  ~~~~~  ~~~~~~  ~~~~~~~~~~~~~~~~~~~~  ~~~~~~~~~~~~~~~~~~~~~~
  1      72     2       Enabled/ Running      SanFran.BldA.T4
  2      56     N/A     Enabled/ Running      SanFran

SanFran.BldA.T4# show atm pnni hierarchy network
  Summary of active parent LGNs in the routing domain:
  Node  Level  Parent  Node Name
  ~~~~  ~~~~~  ~~~~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  1     72     2       SanFran.BldA.T4
  2     56     0       SanFran

SanFran.BldA.T4# show atm pnni hierarchy network detail
  Detailed hierarchy network display:
  Number Of Network LGN Ancestors: 1

  Lowest Level (72) information:
  Node No.....: 1    Node Name: SanFran.BldA.T4
  Node's ID...:   72:160:47.0091445566772233310111266.00603E7B2001.00
  Node's Addr.:       47.0091445566772233310111266.00603E7B2001.01
  Node's PG ID:      72:47.0091.4455.6677.2233.0000.0000
  PGL No......: 1    PGL Name: SanFran.BldA.T4
  PGL ID......:   72:160:47.0091445566772233310111266.00603E7B2001.00
```

```
Level 56 ancestor information:
Parent LGN..: 2    LGN Name: SanFran
LGN's ID....:    56:72:47.0091445566677223300000000.00603E7B2001.00
LGN's Addr..:        47.0091445566677223310111266.00603E7B2001.02
LGN's PG ID.:     56:47.0091.4455.6677.0000.0000.0000
LGN PGL No..:      Unelected or unknown
LGN's PGL ID:     0:0:00.000000000000000000000000000.000000000000.00
```

Configuring the Link Between Switch T3 and Switch T4 for PNNI

The following example shows how to configure the link between switch NewYorkBldB.T3 and SanFran.BldA.T4 for PNNI.

✎
Note   In this example, only one side of the IISP interface is configured to change the link from IISP to PNNI because the other side of the link is using ILMI autoconfiguration for the interface type. You can use either the **atm auto-configuration** or **atm nni** command to change the link from IISP to PNNI.

```
SanFran.BldA.T4# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T4(config)# interface atm 0/0/3
SanFran.BldA.T4(config-if)# atm auto-configuration
SanFran.BldA.T4(config-if)# end
SanFran.BldA.T4#
%ATM-5-ATMSOFTSTART: Restarting ATM signalling and ILMI on ATM0/0/3.
```

✎
Note   When you change the link from IISP to PNNI, all existing connections across the interface are cleared. The ability to route new connections across the link is restored within a few seconds, when the PNNI uplinks and induced horizontal link come up.

Verifying Connectivity to All ATM Addresses and Deleting an Old Static Route on Switches T4 and T3

The following example shows how to verify connectivity to all ATM addresses before deleting an old static route on switch T4:

```
SanFran.BldA.T4# 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
~ ~~ ~~~~~~~~~~~~~~~~ ~~ ~~~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
➜ S  E 1   ATM0/0/3    DN 0   47.0091.4455.6677.11/64
  P  I 12  0           UP 0   47.0091.4455.6677.1144/72
  P SI 2   0           UP 0   47.0091.4455.6677.2233/72
  P  I 9   0           UP 0   47.0091.4455.6677.2233.1011.1244/104
  P SI 1   0           UP 0   47.0091.4455.6677.2233.1011.1266/104
  R  I 1   ATM2/0/0    UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2001/152
  R  I 1   ATM2/0/0    UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2002/152
  R  I 1   ATM2/0/0    UP 0   47.0091.4455.6677.2233.1011.1266.4000.0c/128
```

 The following example shows how to delete the old static route from switch T4:

```
SanFran.BldA.T4# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T4(config)# no atm route 47.0091.4455.6677.11 atm0/0/3
SanFran.BldA.T4(config)# end
SanFran.BldA.T4#
```

The following example verifies that the old static route on switch T4 has been deleted:

```
SanFran.BldA.T4# 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 12  0             UP 0   47.0091.4455.6677.1144/72
P SI 2   0             UP 0   47.0091.4455.6677.2233/72
P  I 9   0             UP 0   47.0091.4455.6677.2233.1011.1244/104
P SI 1   0             UP 0   47.0091.4455.6677.2233.1011.1266/104
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2001/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2002/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.4000.0c/128
```

The following example shows how to delete the old static route from switch T3:

```
NewYork.BldB.T3# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NewYork.BldB.T3(config)# no atm route 47.0091.4455.6677.22 atm 0/0/2
NewYork.BldB.T3(config)# end
NewYork.BldB.T3#
```

To verify the deletion of the old static route on switch T3, use the **show atm route** command.

# Adding a New Lowest Level of PNNI Hierarchy

Figure A-3 shows an example network configured with only one level of PNNI hierarchy at level 56.

Figure A-3   One-Level PNNI Hierarchical Network
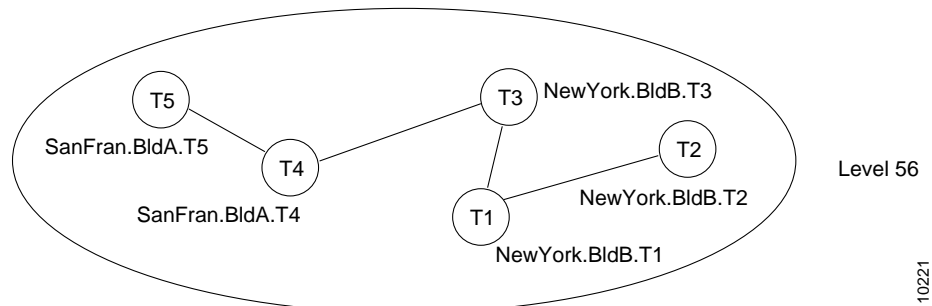
You can convert the network into a two-level hierarchical PNNI network by bringing each lowest level node down to level 72 and splitting the network into two peer groups. At the same time, you can add a second level of hierarchy at level 56. The resulting network topology is shown in Figure A-4.

Figure A-4 Two-Level PNNI Hierarchical Network
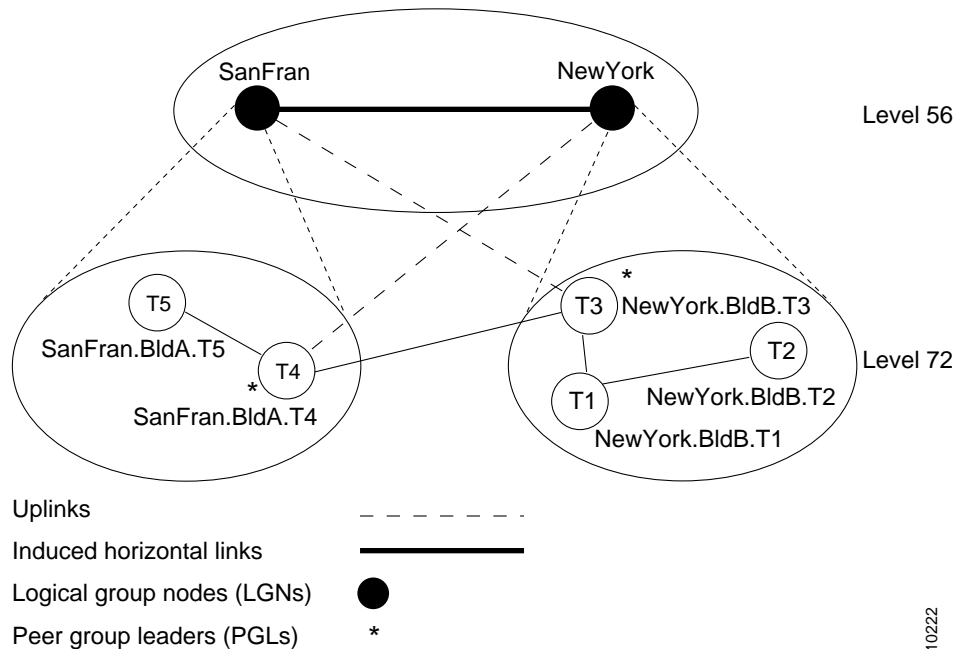
Note This example assumes that all addresses have already been assigned according to a hierarchical ATM address plan. All the ATM switch routers share the same 56-bit prefix. The ATM switch routers in Building A in San Francisco share the same 72-bit prefix. The ATM switch routers in Building B in New York share a different 72-bit prefix. As a result, no renumbering is necessary to migrate the network from a single level of PNNI hierarchy to two levels of PNNI hierarchy.

Note If no renumbering is necessary and all ATM switch routers are peer group leader/logical group node (PGL/LGN)-capable (Cisco IOS Release 11.3T, WA4, or later releases), existing connections are not affected by the migration process. The existing connections remain active while you modify the PNNI configuration.

You can implement the migration process one ATM switch router at a time. As each ATM switch router is moved down to level 72, the ability to establish new connections across that ATM switch router is lost temporarily and then automatically restored. You can pause for long periods of time during the migration process without any harmful effects.

The initial configuration for each ATM switch router is shown in the sections that follow. The commands used to migrate the network to the two-level PNNI hierarchical network (shown in Figure A-4) are also provided.

Switch T1 Initial Configuration

The initial configuration for switch NewYork BldB.T1 follows:

```
hostname NewYork.BldB.T1
atm address 47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a01.00
atm router pnni
 node 1 level 56 lowest
  redistribute atm-static
```

The following example shows the output from the **show atm route** command for the switch:

```
NewYork.BldB.T1# 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 SI 1   0            UP 0   47.0091.4455.6677.1144.1011.1233/104
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a01/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a02/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a03/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a04/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.0060.3e7b.3a05/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1233.4000.0c/128
P  I 9   0            UP 0   47.0091.4455.6677.1144.1011.1244/104
P  I 10  0            UP 0   47.0091.4455.6677.1144.1011.1255/104
P  I 12  0            UP 0   47.0091.4455.6677.2233.1011.1244/104
P  I 11  0            UP 0   47.0091.4455.6677.2233.1011.1266/104
```

Switch T2 Initial Configuration

The initial configuration for switch NewYork BldB.T2 follows:

```
hostname NewYork.BldB.T2
atm address 47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc01.00
atm router pnni
 node 1 level 56 lowest
  redistribute atm-static
```

Switch T3 Initial Configuration

The initial configuration for switch NewYork BldB.T3 follows:

```
hostname NewYork.BldB.T3
atm address 47.0091.4455.6677.1144.1011.1255.0060.3e5b.c401.00
atm router pnni
 node 1 level 56 lowest
  redistribute atm-static
```

Switch T4 Initial Configuration

The initial configuration for switch SanFran.BldA.T4 follows:

```
hostname SanFran.BldA.T4
atm address 47.0091.4455.6677.2233.1011.1266.0060.3e7b.2001.00
atm router pnni
 node 1 level 56 lowest
  redistribute atm-static
```

Switch T5 Initial Configuration

The initial configuration for switch SanFran.BldA.T5 follows:

```
hostname SanFran.BldA.T5
atm address 47.0091.4455.6677.2233.1011.1244.0060.3e7b.2401.00
atm router pnni
 node 1 level 56 lowest
  redistribute atm-static
```

Moving Switch T4 Down into a New Peer Group

The first ATM switch router you move down into a new peer group at level 72 should be the ATM switch router you prefer as the peer group leader (PGL). Before moving down the first ATM switch router, configure the logical group node (LGN) for the second level of hierarchy on the ATM switch router.

Note We recommend that you enter the **no auto-summary** command to disable **auto-summary** on all new LGNs during the migration process. PNNI always routes to the node that advertises the longest matching reachable address prefix; therefore, auto-summary is not required. Furthermore, debugging is easier when **auto-summary** is disabled. If anything goes wrong during the migration process, you can use the **show atm route** command to debug the problem. After all the nodes have been moved into the child peer group represented by the LGN, restore **auto-summary** to reduce the number of reachable address prefixes advertised by the LGN.

Figure A-5 shows the network topology after moving ATM switch router SanFran.BldA.T4 down into a new peer group at level 72 and establishing an LGN representing that peer group at level 56.

Figure A-5   Moving a Switch Down in the PNNI Hierarchy
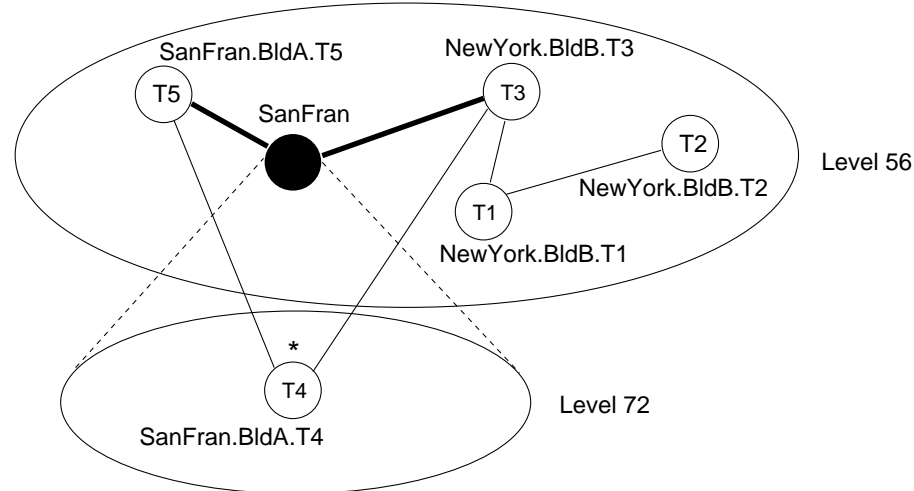
Although ATM switch router SanFran.BldA.T5 and NewYork.BldB.T3 are not running any PGLs or LGNs in this example, these ATM switch routers must be capable of establishing the PNNI hierarchy. This capability allows them to bring up the induced horizontal links to the LGN SanFran, maintaining PNNI connectivity across the network. For this reason, we recommend that you upgrade all ATM switch routers to Cisco IOS Release 11.3T, WA4 or later, before configuring PNNI hierarchy.

The following example shows how to move switch SanFran.BldA.T4 down into a new peer group:

```
SanFran.BldA.T4# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T4(config)# atm router pnni
SanFran.BldA.T4(config-atm-router)# node 2 level 56
SanFran.BldA.T4(config-pnni-node)# name SanFran
SanFran.BldA.T4(config-pnni-node)# no auto-summary
SanFran.BldA.T4(config-pnni-node)# exit
SanFran.BldA.T4(config-atm-router)# node 1
SanFran.BldA.T4(config-pnni-node)# election leadership-priority 45
SanFran.BldA.T4(config-pnni-node)# node 1 disable
SanFran.BldA.T4(config-pnni-node)# node 1 level 72
SanFran.BldA.T4(config-pnni-node)# parent 2
SanFran.BldA.T4(config-pnni-node)# node 1 enable
SanFran.BldA.T4(config-pnni-node)# end
SanFran.BldA.T4#
```

Note   When you move down the first switch into a new peer group, the ATM switch router cannot establish new connections until it can elect itself PGL. By default, this election process takes approximately 90 seconds, or less if a second ATM switch router is brought into the peer group quickly. After the new configuration on this ATM switch router is stable, the PNNI network is fully functional and new connections can be accepted across all ATM switch routers.

Moving Switch SanFran.BldA.T5 Down into an Existing Peer Group

After you move the first ATM switch router down to form a new peer group, you can move the remaining ATM switch routers down into the peer group one by one. You should move the ATM switch routers down in an order that keeps the peer group contiguous.

The following example shows how to move switch SanFran.BldA.T5 down into a peer group at level 72:

```
SanFran.BldA.T5# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T5(config)# atm router pnni
SanFran.BldA.T5(config-atm-router)# node 1 disable
SanFran.BldA.T5(config-pnni-node)# node 1 level 72 enable
SanFran.BldA.T5(config-pnni-node)# end
SanFran.BldA.T5#
```

Note When you move an ATM switch router down into an existing peer group, the ability to establish new connections across that ATM switch router is lost temporarily (up to several seconds).

To verify the configuration, use the **show atm pnni local-node** and **show atm pnni hierarchy** commands. For examples of these commands, see the ""Configuring Second Level of PNNI Hierarchy on Switches T3 and T4" section on page A-4.

You can configure one or more of the ATM switch routers that have been moved down into the peer group as a backup PGL. The following example shows how to configure SanFran.BldA.T5 as a backup PGL for the peer group SanFran (see Figure A-4):

```
SanFran.BldA.T5# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T5(config)# atm router pnni
SanFran.BldA.T5(config-atm-router)# node 2 level 56
SanFran.BldA.T5(config-pnni-node)# name SanFran
SanFran.BldA.T5(config-pnni-node)# no auto-summary
SanFran.BldA.T5(config-pnni-node)# exit
SanFran.BldA.T5(config-atm-router)# node 1
SanFran.BldA.T5(config-pnni-node)# election leadership-priority 10
SanFran.BldA.T5(config-pnni-node)# parent 2
SanFran.BldA.T5(config-pnni-node)# end
SanFran.BldA.T5#
SanFran.BldA.T5# show atm pnni local-node

PNNI node 1 is enabled and running
  Node name: SanFran.BldA.T5
  System address        47.009144556677223310111244.00603E7B2401.01
  Node ID        72:160:47.009144556677223310111244.00603E7B2401.00
  Peer group ID        72:47.0091.4455.6677.2233.0000.0000
  Level 72, Priority 10 10, No. of interfaces 2, No. of neighbors 1
  Parent Node Index: 2

<information deleted>

PNNI node 2 is enabled and not running
  Node name: SanFran
  System address        47.009144556677223310111244.00603E7B2401.02
  Node ID        56:72:47.009144556677223300000000.00603E7B2401.00
  Peer group ID        56:47.0091.4455.6677.0000.0000.0000
  Level 56, Priority 0 0, No. of interfaces 0, No. of neighbors 0
  Parent Node Index: NONE

<information deleted>
```

```
SanFran.BldA.T5# show atm pnni hierarchy
  Locally configured parent nodes:
  Node         Parent
  Index  Level  Index   Local-node Status       Node Name
  ~~~~~  ~~~~~  ~~~~~~  ~~~~~~~~~~~~~~~~~~~  ~~~~~~~~~~~~~~~~~~~~~~~
  1      72     2         Enabled/ Running      SanFran.BldA.T5
  2      56     N/A       Enabled/ Not Running  SanFran

SanFran.BldA.T5# show atm pnni hierarchy network
  Summary of active parent LGNs in the routing domain:
  Node  Level  Parent  Node Name
  ~~~~  ~~~~~  ~~~~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  1     72     14       SanFran.BldA.T5
  14    56     0        SanFran
```

Restoring Auto-Summary on the LGN SanFran

After all the nodes destined for the new peer group migrate into the peer group, you can restore **auto-summary** to reduce the number of reachable address prefixes advertised by the LGN.

The following example shows how to enable **auto-summary** on the LGN SanFran:

```
SanFran.BldA.T5# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T5(config)# atm router pnni
SanFran.BldA.T5(config-atm-router)# node 2
SanFran.BldA.T5(config-pnni-node)# auto-summary
SanFran.BldA.T5(config-pnni-node)# end
SanFran.BldA.T5#
```

The following example shows how to verify the configuration:

```
SanFran.BldA.T5# show atm pnni summary

Codes: Node - Node index advertising this summary
       Type - Summary type (INT - internal, EXT - exterior)
       Sup  - Suppressed flag (Y - Yes, N - No)
       Auto - Auto Summary flag (Y - Yes, N - No)
       Adv  - Advertised flag (Y - Yes, N - No)

 Node Type Sup Auto Adv  Summary Prefix
 ~~~~ ~~~~ ~~~ ~~~~ ~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   1  Int   N   Y    Y   47.0091.4455.6677.2233.1011.1244/104
   2  Int   N   Y    N   47.0091.4455.6677.2233/72
```

The switch that contains the active PGL is configured similarly:

```
SanFran.BldA.T4# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
SanFran.BldA.T4(config)# atm router pnni
SanFran.BldA.T4(config-atm-router)# node 2
SanFran.BldA.T4(config-pnni-node)# auto-summary
SanFran.BldA.T4(config-pnni-node)# end
SanFran.BldA.T4#
```

The following examples show how to verify the configuration:

```
SanFran.BldA.T4# show atm pnni summary

Codes: Node - Node index advertising this summary
       Type - Summary type (INT - internal, EXT - exterior)
       Sup  - Suppressed flag (Y - Yes, N - No)
       Auto - Auto Summary flag (Y - Yes, N - No)
       Adv  - Advertised flag (Y - Yes, N - No)

 Node Type Sup Auto Adv  Summary Prefix
 ~~~~ ~~~~ ~~~ ~~~~ ~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   1   Int   N   Y    Y    47.0091.4455.6677.2233.1011.1266/104
   2   Int   N   Y    Y    47.0091.4455.6677.2233/72

SanFran.BldA.T4# 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 12  0             UP 0   47.0091.4455.6677.1144.1011.1233/104
P  I 11  0             UP 0   47.0091.4455.6677.1144.1011.1244/104
P  I 9   0             UP 0   47.0091.4455.6677.1144.1011.1255/104
P SI 2   0             UP 0   47.0091.4455.6677.2233/72
P  I 13  0             UP 0   47.0091.4455.6677.2233.1011.1244/104
P SI 1   0             UP 0   47.0091.4455.6677.2233.1011.1266/104
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2001/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.0060.3e7b.2002/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.2233.1011.1266.4000.0c/128
```

Moving Switches T3, T1, and T2 Down into a New Peer Group

The following example shows how to move switch NewYork.BldB.T3 down into a new peer group:

```
NewYork.BldB.T3# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NewYork.BldB.T3(config)# atm router pnni
NewYork.BldB.T3(config-atm-router)# node 2 level 56
NewYork.BldB.T3(config-pnni-node)# name NewYork
NewYork.BldB.T3(config-pnni-node)# no auto-summary
NewYork.BldB.T3(config-pnni-node)# exit
NewYork.BldB.T3(config-atm-router)# node 1
NewYork.BldB.T3(config-pnni-node)# election leadership-priority 45
NewYork.BldB.T3(config-pnni-node)# node 1 disable
NewYork.BldB.T3(config-pnni-node)# node 1 level 72
NewYork.BldB.T3(config-pnni-node)# parent 2
NewYork.BldB.T3(config-pnni-node)# node 1 enable
NewYork.BldB.T3(config-pnni-node)# end
NewYork.BldB.T3#
```

The following example shows how to move switch NewYork.BldB.T1 down into a new peer group:

```
NewYork.BldB.T1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NewYork.BldB.T1(config)# atm router pnni
NewYork.BldB.T1(config-atm-router)# node 1 disable
NewYork.BldB.T1(config-pnni-node)# node 1 level 72 enable
NewYork.BldB.T1(config-pnni-node)# end
NewYork.BldB.T1#
```

The following example shows how to move switch NewYork.BldB.T2 down into a new peer group:

```
NewYork.BldB.T2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NewYork.BldB.T2(config)# atm router pnni
NewYork.BldB.T2(config-atm-router)# node 1 disable
NewYork.BldB.T2(config-pnni-node)# node 1 level 72 enable
NewYork.BldB.T2(config-pnni-node)# end
NewYork.BldB.T2#
```

The following examples show how to verify the results of the configuration:

```
NewYork.BldB.T2# show atm pnni local-node

PNNI node 1 is enabled and running
  Node name: NewYork.BldB.T2
  System address       47.00914455667711441410111244.00603E5BBC01.01
  Node ID         72:160:47.00914455667711441410111244.00603E5BBC01.00
  Peer group ID      72:47.0091.4455.6677.1144.0000.0000
  Level 72, Priority 0 0, No. of interfaces 3, No. of neighbors 1
  Parent Node Index: NONE


<information deleted>


NewYork.BldB.T2# 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 9   0             UP 0   47.0091.4455.6677.1144.1011.1233/104
P  I 13  0             UP 0   47.0091.4455.6677.1144.1011.1233/104
P SI 1   0             UP 0   47.0091.4455.6677.1144.1011.1244/104
P  I 13  0             UP 0   47.0091.4455.6677.1144.1011.1244/104
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc01/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.1144.1011.1244.0060.3e5b.bc02/152
R  I 1   ATM2/0/0      UP 0   47.0091.4455.6677.1144.1011.1244.4000.0c/128
P  I 11  0             UP 0   47.0091.4455.6677.1144.1011.1255/104
P  I 13  0             UP 0   47.0091.4455.6677.1144.1011.1255/104
P  I 12  0             UP 0   47.0091.4455.6677.2233/72
```

```
NewYork.BldB.T2# show atm pnni hierarchy network
  Summary of active parent LGNs in the routing domain:
  Node   Level  Parent  Node Name
  ~~~~   ~~~~~  ~~~~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  1      72     13      NewYork.BldB.T2
  13     56     0       NewYork

NewYork.BldB.T2# show atm pnni hierarchy network detail
  Detailed hierarchy network display:
  Number Of Network LGN Ancestors: 1

  Lowest Level (72) information:
  Node No.....: 1    Node Name: NewYork.BldB.T2
  Node's ID..:   72:160:47.0091445566771144410111244.00603E5BBC01.00
  Node's Addr.:          47.0091445566771144410111244.00603E5BBC01.01
  Node's PG ID:      72:47.0091.4455.6677.1144.0000.0000
  PGL No......: 11   PGL Name: NewYork.BldB.T3
  PGL ID......:   72:160:47.0091445566771144410111255.00603E5BC401.00

  Level 56 ancestor information:
  Parent LGN..: 13   LGN Name: NewYork
  LGN's ID....:   56:72:47.0091445566771144400000000.00603E5BC401.00
  LGN's Addr..:          47.0091445566771144410111255.00603E5BC401.02
  LGN's PG ID.:      56:47.0091.4455.6677.0000.0000.0000
  LGN PGL No..:      Unelected or unknown
  LGN's PGL ID:      0:0:00.000000000000000000000000.000000000000.00
```

Restoring Autosummary on the LGN NewYork

The following example shows how to restore autosummary on the LGN NewYork:

```
NewYork.BldB.T3# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
NewYork.BldB.T3(config)# atm router pnni
NewYork.BldB.T3(config-atm-router)# node 2
NewYork.BldB.T3(config-pnni-node)# auto-summary
NewYork.BldB.T3(config-pnni-node)# end
NewYork.BldB.T3#
```

The following examples show how to verify the configuration:

```
NewYork.BldB.T3# show atm pnni summary

Codes: Node - Node index advertising this summary
       Type - Summary type (INT - internal, EXT - exterior)
       Sup  - Suppressed flag (Y - Yes, N - No)
       Auto - Auto Summary flag (Y - Yes, N - No)
       Adv  - Advertised flag (Y - Yes, N - No)

 Node Type Sup Auto Adv  Summary Prefix
 ~~~~ ~~~~ ~~~ ~~~~ ~~~  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  1   Int   N   Y    Y   47.0091.4455.6677.1144.1011.1255/104
  2   Int   N   Y    Y   47.0091.4455.6677.1144/72

NewYork.BldB.T3# 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 SI 2   0            UP 0   47.0091.4455.6677.1144/72
P  I 12  0            UP 0   47.0091.4455.6677.1144.1011.1233/104
P  I 9   0            UP 0   47.0091.4455.6677.1144.1011.1244/104
P SI 1   0            UP 0   47.0091.4455.6677.1144.1011.1255/104
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1255.0060.3e5b.c401/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1255.0060.3e5b.c402/152
R  I 1   ATM2/0/0     UP 0   47.0091.4455.6677.1144.1011.1255.4000.0c/128
P  I 10  0            UP 0   47.0091.4455.6677.2233/72
```