Configuring Advanced Peer-to-Peer Networking

Many enterprises today maintain two networks: a traditional, hierarchical Systems Network Architecture (SNA) subarea network and an interconnected LAN network, based on connectionless, dynamic protocols. The advantage of the subarea SNA network is that it is manageable and deterministic and provides guaranteed response time. The disadvantages are that it requires extensive system definition and does not take advantage of the capabilities of intelligent devices.

Cisco provides remote source-route bridging (RSRB) and data-link switching plus (DLSw+), which enable encapsulation of SNA traffic and consolidation of SNA with multiprotocol networks.

Advanced Peer-to-Peer Networking (APPN) gives the additional flexibility to route SNA natively, without encapsulation. You can use APPN by itself or in combination with RSRB and DLSw+ to provide the best solution for your networking needs.

High Performance Routing (HPR) is an enhancement to APPN that improves network performance and reliability. Considered the next step in the evolution of SNA networking, HPR provides two new elements: Rapid Transport Protocol (RTP) and Automatic Network Routing (ANR).

This chapter describes how to configure APPN. For a complete description of the APPN commands in this chapter, refer to the "APPN Configuration Commands" chapter of the *Bridging and IBM Networking Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

APPN Command Modes

APPN offers the ability to define attributes of the APPN network that can become quite complex. To easily manage the capability to define the details of APPN, special configuration command modes and conventions have been developed.

Because APPN offers a large number of configuration options, specific configuration dialogues are used for each major APPN configuration task. When you define the major item, you will automatically enter the detailed configuration mode for that item. There are two options to exit the detailed mode. The **complete** command exits the detailed configuration mode and updates the APPN subsystem with the changes. The **exit** command leaves the definition in **no complete** state and does not update the APPN subsystem.

Completing APPN Definitions

No APPN definition is usable by the APPN subsystem until the definition is marked as complete. This is accomplished by using the **complete** command when you have finished defining items in the detailed configuration mode.

Changing APPN Definitions

To update a major definition item that is already known to APPN, enter the major item definition as it was originally defined. Then, to indicate that you wish to modify an existing definition, enter **no complete**. You will then be able to change the items in the detailed configuration mode for that major definition. Remember to enter **complete** when you have finished changing the configuration item to update the APPN subsystem with your changes.

APPN Configuration Task List

To configure APPN in your network, perform the tasks discussed in the following sections. Because of the hierarchical nature of APPN definitions, you should configure APPN by following the order specified below. Definition of an APPN Control Point and at least one APPN port are required. In addition, you must start the APPN subsystem to activate APPN routing. The other tasks in this list are optional, and may or may not need to be configured, depending on your APPN network.

- Define an APPN Control Point
- Configure HPR Resources
- Define an APPN Port
- Define an APPN Link Station
- Define an APPN Connection Network
- Define an APPN Class of Service
- Define an APPN Mode
- Define an APPN Partner LU Location
- Start the APPN Subsystem
- Stop the APPN Subsystem
- Start and Stop APPN Ports and Link Stations
- Tune the APPN Network
- Monitor the APPN Network

See the end of this chapter for “APPN Configuration Examples.”

Define an APPN Control Point

An APPN control point definition is required to use APPN. This definition adds the fully qualified control point name for the node, which is a combination of a network identifier and a control point name. The network identifier must be the same as other network nodes in the APPN subnetwork attached to this node. The control point name identifies this node uniquely within the particular subnetwork.

To define an APPN control point, use the following command in global configuration mode:

Command	Purpose
appn control-point *netid.cpname*	Define an APPN control point.

Using this command takes you from global configuration mode into APPN control point configuration mode. From this mode, you can perform any of the following optional definition tasks, which identify various capabilities and attributes of the control point.

APPN offers configuration commands that allow you to limit the resources on the router that are consumed for APPN. You may configure both the maximum memory and maximum percentage of system buffers that APPN is permitted to use. APPN cached directory entries and cached topology routing trees can additionally be limited to a maximum number.

To configure these resources, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**maximum-memory** *bytes*	Specify the maximum memory available to APPN.
2	**buffer-percent** *number*	Specify the maximum percentage of system buffers available to APPN.
3	**max-cached-entries** *number*	Specify the maximum number of cached directory entries.
4	**max-cached-trees** *number*	Specify the maximum number of cached topology routing trees.

By default, the central resource registration function is enabled in the router so that registration of downstream resources in the central directory server will be attempted by the router when it receives a request from the control point that owns the resource. If there is unpredictable behavior related to the central resource registration function or central directory server, use the **no central-resource-registration** command to disable the central resource registration function. In normal circumstances there should not be any reason to disable the central resource registration function.

To enable or disable the central resource registration function, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**central-resource-registration**	Enable the central resource registration function.
2	**no central-resource-registration**	Disable the central resource registration function.

If you plan to use Dependent LU Requestor (DLUR) to provide services for dependent LUs connected to this APPN node, you must indicate that this DLUR function is requested for this control point and may specify the number of PUs, from 1 to 100000, that are served by this DLUR. If you do not specify the maximum number of PUs, there is no limit on the number of PUs served by this DLUR. In addition, you may configure node-wide defaults for the Dependent LU Server and Backup Dependent LU Server that this node will contact.

To specify DLUR or DLUS services for this control point, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**dlur** [**max-pus** *number*]	Specify that the DLUR is supported on the control point and optionally specify the maximum number of physical units (PUs) served by this DLUR.
2	**dlus** *netid.cpname*	Specify the name of the default DLUS that provides SSCP services to the downstream PU.
3	**backup-dlus** *netid.cpname*	Specify the default backup DLUS to perform SSCP services for downstream PUs if the default DLUS is unavailable.

You may configure the relative resistance you wish this node to have when being considered for APPN intermediate session routing (ISR). This is a number in the range 0 through 255 that specifies this node's relative resistance. The default resistance is 128.

To configure the relative resistance of the local node, use the following command in APPN control point configuration mode:

Command	Purpose
route-additional-resistance *number*	Specify the resistance of the local node.

Cisco's APPN implementation allows you to save the APPN directory on a TFTP host. This feature allows the node to restore previously learned directory information when the node is restored to service or in the event of a failure.

To save the APPN directory, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**safe-store-host ip address** *address* **directory** *path*	Enable directory safe store and specify the IP host address and the file path for safe store.
2	**safe-store-cycle** *number*	Specify the number of separate cache instances to save before overwriting previous instances.
3	**safe-store-interval** *interval*	Specify how often the directory database is stored to permanent media.

The ID number and ID block combine to form the identifier for this node in the XID that is exchanged when the local node connects to other nodes.

To specify the ID number and ID block, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**xid-block-number** *number*	Specify the ID block (the first 3 digits of the node identifier for the local node).
2	**xid-id-number** *number*	Specify the ID number (the last 5 digits of the node identifier for the local node).

Configure HPR Resources

APPN HPR offers configuration commands that allow you to limit the resources on the router that are used for APPN HPR. To configure these resources, use the following commands in APPN control point configuration mode:

Step	Command	Purpose
1	**hpr**	Enable HPR.
2	**hpr max-sessions** *num-sessions*	Specify the maximum number of sessions allowed over an RTP connection.
3	**hpr retries** *low-retries medium-retries high-retries network-retries*	Specify the maximum number of request packets to send before closing the RTP connection.

Step	Command	Purpose
4	**hpr timers liveness** *low-time medium-time high-time network-time*	Specify how many seconds to wait for a packet to be received before initiating a path switch.
5	**hpr timers path-switch** *low-time medium-time high-time network-time*	Specify the amount of time allowed to attempt a path switch for an RTP connection.

To add, remove, or complete configuration items within the APPN control point configuration mode, use one of the following commands:.

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN control point definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN control point definition.
exit	Exit APPN control point definition dialog without completing the definition and without updating the APPN subsystem.

Configure Serial Interface Encapsulation

If you plan to use APPN over a serial interface, the interface must be configured as a serial encapsulation type supported by APPN. The following encapsulation types are supported:

- ATM
- Frame Relay
- PPP
- SDLC
- SMDS
- X25
- ISDN (via PPP)

Define an APPN Port

An APPN port definition is used to associate APPN capabilities with a specific interface APPN will use. Each interface that will be used for APPN communications requires an APPN port definition statement. A port can be associated with a specific interface by using the following command in global configuration mode:

Command	Purpose
appn port *portname interface*	Define an APPN port associated with an interface.

A port may also be associated with a source-route bridge ring group to enable APPN to send and receive traffic to any local or remote source-route bridged station. To configure a virtual port that connects to a source-bridge ring-group, use the following command in global configuration mode:

Command	Purpose
appn port *portname* **rsrb**	Define an APPN port associated with a source-route bridge group.

A port may also be associated with virtual data link control to allow link stations using this port to connect over DLSw+ using virtual data link control. To configure an APPN virtual data link control port, use the following command in global configuration mode:

Command	Purpose
appn port *portname* **vdlc**	Define an APPN port associated with virtual data link control.

Using any of these commands takes you from global configuration mode into APPN port configuration mode. From this mode, you can perform one or more of the definition tasks that follow. These tasks define various capabilities and attributes of the port. Some tasks are required; others are optional.

Configure APPN HPR Port Definitions

You can specify the SAP value used for Automatic Network Routing frames. The SAP value is used by all link stations that use the port. To specify the SAP value, use the following command in APPN port configuration mode:

Command	Purpose
hpr sap *sap*	Specify the SAP for Automatic Network Routing frames.

HPR is enabled at the control point configuration mode. To selectively disable HPR on a port definition, use the following command in APPN port configuration mode:

Command	Purpose
no hpr	Disable support for HPR on a port.

Each APPN link negotiates a maximum basic transmit unit size during the connection phase with an adjacent node. This value limits the size of an SNA frame that can be sent over the link. On a port, the maximum basic transmit unit that can be received on this port can be configured and will be enforced for every APPN link using this port. In addition, the desired maximum basic transmit unit that can be sent by this node can be specified. The maximum basic transmit unit must be smaller than the maximum transmission unit (MTU) for the interface associated with this port.

The maximum basic transmit unit for a link can affect APPN ISR performance. Larger maximum basic transmit units allow more data to be placed in each SNA frame, offering higher data throughput for APPN ISR.

The Basic Transmission Unit (BTU) specifies a maximum message size of all SNA control information and data, exclusive of DLC and LLC header information. BTU should be set lower than the MTU to allow for DLC control information such as station addresses, DLC control fields, and the routing information field (RIF), if present.

APPN, by default, uses a maximum BTU size which varies from 1280 to 4096 depending on the type of port being defined. Use the following commands in APPN port configuration mode if you wish APPN to use a different maximum BTU size.

Step	Command	Purpose
1	**max-rcv-btu-size** *size*	Specify the desired maximum receive basic transmit unit.
2	**desired-max-send-btu-size** *size*	Specify the maximum basic transmit unit size for transmission groups using this port.

APPN uses SAP 4 by default. If you wish APPN to use a different SAP on this port, use the following command in APPN port configuration mode:

Command	Purpose
local-sap *sap*	Specify the local SAP to activate on the interface.

The maximum number of link stations that can use an APPN port at any one time is configurable. Also configurable is the number of this maximum that are reserved for link stations connecting in to this port and link stations connecting out from this port.

To specify the maximum number of link stations, use the following commands in APPN port configuration mode:

Step	Command	Purpose
1	**max-link-stations** *number*	Specify the maximum number of active link stations allowed on this port.
2	**reserved-inbound** *number*	Specify the number of link stations to be reserved for inbound links.
3	**reserved-outbound** *number*	Specify the number of link stations to be reserved for outbound links.

A port is configured, by default, to accept connections from other APPN nodes dynamically without requiring a link station definition for that node. It is possible to configure a port so that it does not accept incoming connection requests unless a link station has been predefined for the partner node.

To configure a port so that it does not accept incoming connection requests, use the following command in APPN port configuration mode:

Command	Purpose
no service-any	Specify that this port will not create dynamic link stations.

The **null-xid-poll** command permits PU 2.0 devices that connect in with XID0 to build a dynamic link station. It is no longer necessary to configure a link definition. When this command is used, the router expects its partner to reveal its identity first by responding with either XID3 or XID0.

This feature works in a mixed environment of PU 2.0 and PU 2.1 devices where the same APPN port is shared by both types of devices. By default, XID3 is used to poll the devices. When a PU 2.0 device responds with XID0, the link is created and established dynamically. PU 2.1 devices are not affected by this change, and go through the XID3 negotiation as usual.

To configure **null-xid-poll**, use the following command in APPN port configuration mode:

Command	Purpose
null-xid-poll	Specify that the null XID should be used to poll the remote node associated with this APPN port.

Care must be exercised when configuring **null-xid-poll**. If two Cisco APPN network node routers connect across ports configured with **null-xid-poll**, the APPN connection will fail because both routers expect the other to respond first using either XID0 or XID3. Similar behavior may occur when a port configured with **null-xid-poll** attempts communication with a front-end processor configured for XID polling. You only need to configure **null-xid-poll** when dealing with a PU 2.0 device that does not respond gracefully to the XID3 poll.

If the port defined is an RSRB virtual port, the port must be assigned a MAC address and must be associated with a source-route bridge ring group. To assign a MAC address and associate it with a source-route bridging ring group, use the following command in APPN port configuration mode:

Command	Purpose
rsrb-virtual-station *mac-address local-ring bridge-number target-ring*	Assign a MAC address and ring number to an RSRB virtual port, and associate it with a source-route bridge ring group.

If the port defined is a virtual data link control port, the port must be associated with a source-route bridge ring group and assigned a MAC address. To associate the port with a ring group and assign it a MAC address, use the following command in APPN port configuration mode:

Command	Purpose
vdlc *ring-group* [**vmac** *vdlc-mac-address*]	Associate the virtual data link control port with a source-route bridge ring group, and assign a MAC address.

If the port is defined as an SDLC port, the secondary SDLC address can be specified. For X.25, an X.121 address for this port may be configured. To specify the secondary SDLC address or the X.25 subaddress, enter one of the following commands in APPN port configuration mode:

Command	Purpose
sdlc-sec-addr *address*	Assign a secondary SDLC address to this port.
x25-subaddress {**pvc** | **svc**} *address*	Assign an X.121 address for a port on an X.25 interface.

Many APPN port configuration commands are used to assign link station parameters for dynamic links that use this port. In addition, these values can be used to establish default values for defined link stations associated with this port. For more information on these commands, see the section "Define an APPN Link Station."

Use the following configuration commands to configure default link station values for link stations associated with this port.

Commands	Purpose
cost-per-byte *cost*	Specify the cost per byte transmission group characteristic for link stations on this port.
cost-per-connect-time *cost*	Specify the cost per connect time transmission group characteristic for link stations on this port.

Commands	Purpose
effective-capacity *capacity*	Specify the effective capacity transmission group characteristic for link stations on this port.
limited-resource	Specify that the link stations on this port should be taken down when no sessions are using the link.
propagation-delay {**minimum** | **lan** | **telephone** | **packet-switched** | **satellite** | **maximum**}	Specify the propagation delay transmission group characteristic for link stations on this port.
retry-limit {*retries* | **infinite**} [*interval*]	Specify how many times a link-station will attempt activation and the interval between retries
role {**negotiable** | **primary** | **secondary**}	Specify the link station role used in XID negotiations.
security *security-level*	Specify the security level transmission group characteristic for link stations on this port.
user-defined-1 *value*	Specify the user-defined-1 transmission group characteristic for link stations on this port.
user-defined-2 *value*	Specify the user-defined-2 transmission group characteristic for link stations on this port.
user-defined-3 *value*	Specify the user-defined-3 transmission group characteristic for link stations on this port.

The following commands allow for the addition, removal, or completion of configuration items within the APPN port configuration mode.

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN port definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN port definition.
exit	Exit APPN port definition dialog without completing the definition and without updating the APPN subsystem.

Define an APPN Link Station

A link station is a representation of the connection or potential connection to another node. In many cases, if the partner node is initiating the connection, a link station definition is not necessary. It will be built dynamically when the partner node initiates the connection. You must define a link station if you want this node to initiate APPN connections with other nodes. In addition, you may define a link station to specify attributes of an APPN connection regardless of which node initiates the connection.

To define an APPN logical link, use the following command in global configuration mode:

Command	Purpose
appn link-station *linkname*	Define an APPN logical link.

Defining an APPN logical link takes you from global configuration mode into APPN link station configuration mode. In the APPN link station configuration mode, you must associate the link station with an APPN port that it will use.

Command	Purpose
port *portname*	Associate a link station with the APPN port that it will use.

Configure APPN HPR Link Definitions

HPR is enabled at the control point configuration mode. To selectively disable HPR on a link definition, use the following command in APPN link station configuration mode:

Command	Purpose
no hpr	Disable support for HPR on a link.

When defining a link that can initiate a connection to a partner node, you must provide a destination address to allow this node to contact the partner. This address is also used for incoming connections to associate the appropriate link station with the incoming call. To specify a destination address, use one of the following commands in APPN link station configuration mode, depending on the media in use:

Command	Purpose
atm-dest-address *pvc*	Configure the remote address of a node across an ATM interface.
fr-dest-address *dlci* [*sap*]	Specify the Frame Relay DLCI of the partner node for Frame Relay links.
lan-dest-address *mac-addr* [*sap*]	Specify a destination address and destination SAP for LAN media that use a 6-byte hardware address. This includes Token Ring, Ethernet, FDDI, and connections through RSRB and virtual data link control.
ppp-dest-address *sap*	Specify the destination SAP across a PPP interface.
sdlc-dest-address *address*	Specify the SDLC address for the partner node for SDLC links.
smds-dest-address *address sap*	Specify the remote address of a node across an SMDS interface.
x25-dest-address *address*	Specify the X.25 address for the partner node for X.25 links.

For most APPN connections, the adjacent control point name, transmission group number, and link station role can be learned or negotiated dynamically so there is no reason to configure them. However, if necessary, use the following commands to configure these items:

Command	Purpose
adjacent-cp-name *netid.cpname*	Specify the name of the partner node for the link station.[1]
tg-number *number*	Specify the transmission group number for the link.
role {**negotiable** | **primary** | **secondary**}	Specify the link station role.

1 If the partner node requests values that differ from those configured, the link activation will fail.

A link station defaults to attempt a connection with the adjacent node when the APPN subsystem starts. If you wish to define a link, but not have it automatically attempt to establish a connection with the partner node, use the following command in APPN link station configuration mode:

Command	Purpose
no connect-at-startup	Specify that the link will not attempt to establish an APPN connection when the APPN subsystem is started.

APPN attempts to bring up CP-CP sessions on the first active link between network nodes. You can prevent CP-CP session establishment on a link by using the following command in APPN link station configuration mode:

Command	Purpose
no cp-cp-sessions-supported	Specify that no CP-CP sessions will be established on this link.

By default, APPN accepts connections and learns the node type of the partner node during XID exchange. If you wish to enforce that only a certain node type is permitted to connect via this link station, use the following command in APPN link station configuration mode:

Command	Purpose
verify-adjacent-node-type {**learn** | **len** | **nn**}	Specify that the adjacent node type must be verified as a requirement of link activation.

If you want this link to disconnect when no sessions are using it, you may indicate that the link is a limited resource by using the following command in APPN link station configuration mode:

Command	Purpose
limited-resource	Specify that the link is to be taken down when no sessions are using the link.

When this node is attempting to establish a connection with an adjacent node, you can configure the number of times this node will attempt to initiate contact and the time interval between connection attempts. Each time the link station is started, the retry count is reset and the node will attempt connection until the retry limit is reached. To specify the retry limit, use the following command in APPN link station configuration mode:

Command	Purpose
retry-limit {*retries* | **infinite**} [*interval*]	Specify how many times a link station will attempt activation, and the interval between retries.

APPN links can be configured to interoperate with priority or custom queuing mechanisms available in the Cisco IOS software. To configure an APPN link for priority or custom queuing, enter one of the following commands in APPN link station configuration mode:

Command	Purpose
link-queuing custom *queue-number*	Specify the custom queuing queue number for this link station.
link-queuing priority *level*	Specify the priority queuing parameter for this link station.

If you are using dependent LU requestor (DLUR), you may configure the primary and backup dependent LU server (DLUS) for links on which this node is providing SSCP services via the DLUR function. These definitions override the node-wide defaults that may have been configured in APPN control point configuration mode.

To configure the primary and backup dependent LU server (DLUS), use the following commands in APPN link station configuration mode:

Step	Command	Purpose
1	**dlus** *netid.cpname*	Specify the name of the DLUS node that provides SSCP services to the downstream PUs of the link.
2	**backup-dlus** *netid.cpname*	Specify the backup DLUS node that will be used in the event the primary DLUS is unreachable.

Normally, DLUR will discover the capabilities of the adjacent node and will initiate the proper XID exchange for PU type 2.0 nodes. However, a node which sends null XID but cannot receive XID3 will require configuration as a type 2.0 device to allow the node to connect properly for DLUR services. In addition, if you wish to configure this node to establish the link to the downstream PU in cases where the DLUS is initiating the activation of the device, you must configure the downstream PU name as it is known to the DLUS. In most cases, the DLUR initiates activation of the device, so coding the PU name is not necessary.

To configure a node as a type 2.0 device and configure the downstream PU name, use the following commands in APPN link station configuration mode:

Step	Command	Purpose
1	**pu-type-20**	Specify that the downstream PU whose dependent LU request is propagated through the link is a PU Type 2.0.
2	**dlur-dspu-name** *pu-name*	Specify the downstream PU name.

APPN calculates routes for SNA sessions using a complex algorithm that compares various characteristics of an APPN transmission group with the acceptable range of these characteristics defined in the APPN class of service (COS) requested. Cisco uses defaults for these values that offer basic APPN functionality without the need to customize transmission group characteristics. However, if you wish to configure transmission group characteristics for an APPN connection, use the configuration commands below.

To configure the transmission group characteristics for an APPN connection, enter one or more of the following commands in APPN link station configuration mode:

Commands	Purpose
cost-per-byte *cost*	Specify the cost per byte transmission group characteristic for this link.
cost-per-connect-time *cost*	Specify the relative cost per connection transmission group characteristic for the link.
effective-capacity *capacity*	Specify effective-capacity transmission group characteristic for the link.
propagation-delay {**minimum** | **lan** | **telephone** | **packet-switched** | **satellite** | **maximum**}	Specify the propagation delay transmission group characteristic for the link.
security *security-level*	Specify the security level transmission group characteristic for the link.

Commands	Purpose
user-defined-1 *value*	Specify the user-defined-1 transmission group characteristic for this link station.
user-defined-2 *value*	Specify the user-defined-2 transmission group characteristic for this link station.
user-defined-3 *value*	Specify the user-defined-3 transmission group characteristic for this link station.

The following commands allow for the addition, removal, or completion of configuration items within the APPN link station configuration mode:

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN link station definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN link station definition.
exit	Exit APPN link station definition dialog without completing the definition and without updating the APPN subsystem.

Define an APPN Connection Network

An APPN connection network allows nodes on the same shared media to connect directly, even if there is no APPN link defined between them. Connection networks can be used to provide any-to-any connectivity on shared media without the need to define any-to-any link station connectivity. When a route is calculated through a connection network, a dynamic link station will be built and a connection will be established between the nodes on each side of the connection network. You must configure the same connection network name at each node that will participate in the connection network.

To indicate that this node is a member of a specific connection network, use the following command from global configuration mode:

Command	Purpose
appn connection-network *netid.cnname*	Define an APPN connection network.

Using this command takes you from global configuration mode into APPN connection network configuration mode.

From APPN connection network configuration mode, you can specify up to five ports that are visible to the connection network. Usually, only a single port definition is desired for each connection network. However, in some instances it may be desirable to have more than one port as a member of a connection network, especially if two ports are attached to the same physical media. APPN route selection may choose any of the listed ports when calculating routes to or from any other member of this connection network. Therefore, it is important to ensure that each port listed is accessible by means of hardware address from every member of the connection network.

In addition, be aware that all transmission groups associated with a connection network inherently have the same transmission group characteristics.

Ensure the port you choose is on an interface type that supports APPN connection networks. Connection network definitions are supported on Token Ring, Ethernet, and FDDI interfaces, as well as RSRB and DLSw+ virtual ports.

To associate a port name with this connection network definition, use the following command in APPN connection network configuration mode:

Command	Purpose
port *portname*	Associate a port name with this connection network definition.

The following commands allow for the addition, removal, or completion of configuration items within the APPN connection network configuration mode.

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN connection network definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN connection network definition.
exit	Exit APPN connection network definition dialog without completing the definition and without updating the APPN subsystem.

Define an APPN Class of Service

Cisco provides standard predefined APPN class of service definitions that are commonly used in APPN networks. These are #BATCH, #BATCHSC, #CONNECT, #INTER, #INTERSC, SNASVCMG, CPSVCMG. You can define an APPN class of service or modify the predefined definitions. Each class of service definition must have between one and eight node rows, between one and eight transmission group rows, as well as a transmission priority to be used for this class of service.

Each node row defines the weight to be assigned to a node used in APPN route calculation which is within the range of values for this row. The first row should have the smallest weight and the most restrictive range of acceptable values. Subsequent rows should have higher weight and be less restrictive than the previous rows in the range of acceptable values. Note that if a node does not fit within the acceptable range for any of the node rows, it will not be considered for inclusion in a route with the class of service.

For each node row defined, specify maximum and minimum values for node congestion and route-additional-resistance. Node congestion is either yes or no; route-additional-resistance is a value between 0 and 255 with higher numbers indicating higher resistance to intermediate routes.

Similarly, each transmission group row defines the weight to be assigned to a link used in APPN route calculation which is within the acceptable range of values for this row. Like node rows, each subsequent row should increase in weight and be less restrictive than the previous in the range of acceptable values. If the transmission group characteristics do not lie within any the acceptable range for any of the transmission group rows, the link will not be considered when calculating a route with this class of service.

Each transmission group row allows you to specify the maximum and minimum values for cost per byte, cost per connect, link capacity, propagation delay, security and three user defined characteristics. Each of these values is specified using a relative value between 0 and 255.

To define a class of service, use the following command in global configuration mode:

Command	Purpose
appn class-of-service *cosname*	Define an APPN class of service.

Using this command takes you from global configuration mode into APPN class of service configuration mode. From the class of service mode, you must use the following commands:

Step	Command	Purpose
1	**node-row** *index* **weight** *weight* **congestion** {**yes** | **no**} {**yes** | **no**} **route-additional-resistance** *min max*	Specify a node row number, the weight for this row, and the minimum and maximum values that may be assigned this weight.
2	**tg-row** *index* **weight** *weight* **byte** *min max* **time** *min max* **capacity** *min max* **delay** *min max* **security** *min max* **user1** *min max* **user2** *min max* **user3** *min max*	Specify a transmission group row number, the weight for this row, and the minimum and maximum values for transmission groups that may be assigned this weight.
3	**transmission-priority** *priority*	Specify the transmission priority for the class of service.

The following commands allow for the addition, removal, or completion of configuration items within the APPN class of service configuration mode:

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN class of service definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN class of service definition.
exit	Exit APPN class of service definition dialog without completing the definition and without updating the APPN subsystem.

Define an APPN Mode

An APPN mode definition is used by a network node to associate a mode name received on an APPN search or session request with a class of service known to this node. Most APPN nodes will supply the class of service to their network node server, so mode definition may not be required in many APPN networks. However, if this node is providing network node services to an end node that does not supply a class of service, or if this node is providing network node services for a LEN node, mode definitions may be required for each mode that is used by the partner node.

Cisco provides standard predefined mode definitions for modes that are commonly used in an APPN network. The predefined mode names are the blank mode, #BATCH, #BATCHSC, #INTER, #INTERSC, CPSVCMG, and SNASVCMG. You can change a predefined mode or define a new mode.

To define an APPN mode, use the following command in global configuration mode:

Command	Purpose
appn mode *modename*	Define an APPN mode.

Using this command takes you from global configuration mode into APPN mode configuration mode. Within this mode, you must assign a class of service to the mode definition.

Command	Purpose
class-of-service *cosname*	Associate a class of service with the defined mode.

The following commands allow for the addition, removal, or completion of configuration items within the APPN mode configuration mode.

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN mode definition, return to global configuration mode, and update the APPN subsystem.
no complete	Allow modifications to a previously completed APPN mode definition.
exit	Exit APPN class of service definition dialog without completing the definition and without updating the APPN subsystem.

Define an APPN Partner LU Location

The APPN directory stores names of resources and their owners. Usually this information is learned dynamically via APPN searches. However, you may wish to manually define the location of specific resources. Doing so can improve network performance by allowing directed APPN searches to travel straight to the owning control point, without the need for an initial broadcast search for the resource. However, APPN is known for its dynamic capabilities, not its need for system definition. For this reason, and for easier manageability, it is good practice to define location names only when necessary.

When a LEN node is attached to an APPN network node, all destination resources that reside on the LEN node must be defined on the network node to be reachable via the APPN network.

To define a partner LU location, use the following command in global configuration mode:

Command	Purpose
appn partner-lu-location *netid.luname*	Specify the partner resource name.

Using this command takes you from the global configuration mode into the APPN partner LU location configuration mode.

You must configure an owning control point for each partner LU configured. The owning control point is the control point name for the LEN, end node, or network node on which the resource resides. To specify the name of the control point owning the partner LU, use the following command in APPN partner LU location configuration mode:

Command	Purpose
owning-cp *netid.cpname*	Specify the name of the control point owning the partner LU.

If this node is not the network node server for the resource, you may also configure the network node server name. To reduce APPN searching, the network node server operand must be coded and must be the current server for the resource.

If this node is the network node server for the resource being defined, do not configure a network node server.

To specify the name of the network node server for the resource, use the following command in APPN partner LU location configuration mode:

Command	Purpose
serving-nn *netid.cpname*	Specify the name of the network node server for the resource.

A partial name wildcard partner LU is a definition that applies to all resources that match a partial name. For example, a definition for location NETA.PE, which is specified as a wildcard definition, serves as a entry for NETA.PEANUT and NETA.PENNY, but not NETA.PUMKIN. Be careful when using partial name wildcards, as they can easily cause network problems if resources that match the partial name do not actually exist in the specified location.

A full wildcard partner LU definition is specified by defining a partner LU location without specifying a resource name and specifying the wildcard option. Full wildcards answer positively to any search for any resource in the network. Only one full wildcard definition can exist in an APPN network. Full wildcards are sometimes used when the APPN subnetwork is small and an attached LEN node is the gateway to a large connected network. Full wildcard definitions reduce APPN performance and can cause a variety of network problems. Hence, use of full wildcard definitions should be avoided.

To specify a partial name or full wildcard partner LU, use the following command in APPN partner LU location configuration mode:

Command	Purpose
wildcard	Specify the entry as a partial-name wildcard or a full wildcard.

The following commands allow for the addition, removal, or completion of configuration items within the APPN partner LU location configuration mode.

Command	Purpose
no *command*	Negate or restore the default value for a configuration command.
complete	Complete the APPN partner LU definition, return to global configuration mode, and update the APPN subsystem.

Command	Purpose
no complete	Allow modifications to a previously completed APPN partner LU definition.
exit	Exit APPN partner LU definition dialog without completing the definition and without updating the APPN subsystem.

Start the APPN Subsystem

The APPN subsystem may be started via global configuration mode or privileged EXEC mode.

Command	Purpose
appn routing	Start the APPN subsystem from global configuration mode. Provided this configuration is saved, the APPN subsystem will start each time the router is booted.
appn start	Start the APPN subsystem from privileged EXEC mode without affecting the current configuration.

Stop the APPN Subsystem

The APPN subsystem may be stopped through global configuration mode or privileged EXEC mode commands.

Command	Purpose
no appn routing	Deactivate APPN routing from global configuration mode and remove it from the current configuration.
appn stop	Deactivate APPN routing from privileged EXEC mode without affecting the current configuration.

Start and Stop APPN Ports and Link Stations

APPN port and link station definitions are started automatically when the APPN subsystem starts. However, configuration commands will not take effect on an APPN port or link when it is active. The following privileged EXEC commands allow APPN ports and link stations to be stopped and started when making configuration changes or when resetting the APPN port or link is desired:

Command	Purpose
appn stop link-station *linkname*	Deactivate the specified APPN link.
appn stop port *portname*	Deactivate the specified APPN port.
appn start link-station *linkname*	Activate the specified APPN link.
appn start port *portname*	Activate the specified APPN port.

Tune the APPN Network

Two new APPN scalability enhancement features, Locate Throttling and Negative Caching, allow you to conserve network resources. Locate throttling reduces multiple network broadcasts for the same target resource when a broadcast request is already pending from the network node server (NNS). Negative caching prevents excess searches to unreachable resources. These two features significantly reduce network traffic, particularly in the event of an unexpected resource failure.

Locate Throttling

The locate throttling feature prevents multiple broadcast locate searches that can occur when more than one resource requests sessions with the same destination LU.

When more than one resource requests sessions with the same destination LU, APPN initiates searches for each request. This can consume large amounts of network resources, particularly if APPN broadcast searches are performed.

The locate throttling feature offers a way to regulate, or "throttle," locate searches to the same destination LU. For example, if the response to a locate request is pending, and another search request is issued for the same destination LU that the router has no knowledge of, then the subsequent search request for that LU is queued to wait for the response from the first search. The locate request is withheld only if it is a locate broadcast search. For a locate directed search, no queuing is necessary.

Negative Caching

The negative Caching feature prevents excess searches to unreachable resources.

When a resource becomes unavailable in the network, either temporarily or for an extended period of time, there may be a great number of subsequent requests for that resource. This consumes network resources unnecessarily and quite often adversely affects network performance.

The negative caching feature offers a means of reducing the search broadcast by retaining searches to unreachable resources. If a resource is unreachable in the network, the router rejects requests to the resource. A configurable timer allows you to determine the length of time a resource is considered unreachable. During this period, requests for the resource are rejected. When the timer expires, a full search is performed upon receipt of the first search request for that resource. A configurable threshold allows you to determine the number of searches to be rejected before a full APPN search is performed. When either of the two thresholds expires, a full APPN search is performed.

Each APPN network resource must be defined on the node where the resource exists. When the resource is defined, it can be found through network searches. Optionally, the resource location may be defined in other nodes to optimize directory services search logic.

Registered directory entries are created dynamically in the local directory of the network node. These entries represent local LUs of an adjacent end node for which the network node is providing network node server function.

Cached directory entries are added dynamically and are based on the results of previous searches. A cache entry allows the node to attempt a directed search straight to the destination resource. If a cache entry does not exist, or the entry is incorrect, a broadcast search is issued to query each network node in the network for the destination resource. Each cache entry is verified before use to make sure the resource is still available. If the resource is not found, a broadcast search is attempted.

You can configure the APPN search function to conserve network resources by using either of the following commands in APPN control point configuration mode:

Command	Purpose
locate-queuing	Prevent multiple broadcast locate searches to the same destination LU.
negative-caching [**time**] *time* [**threshold**] *threshold-value*	Prevent multiple locate broadcast searches to unreachable resources.

Monitor the APPN Network

You can monitor the status and configuration of the APPN subsystem by issuing any of the following commands in EXEC mode:

Command	Purpose
show appn class-of-service [**brief** | **detail**]	Display APPN classes of service that are defined to the local node.
show appn connection-network [**brief** | **detail**]	Display APPN connection networks that are defined to the local node.
show appn directory [**name** *cp-name*] [**brief** | **detail**]	Display the contents of the APPN directory database.
show appn dlur-lu [**pu** *pu-name*] [**brief** | **detail**]	Display dependent LUs served by the DLUR function.
show appn dlur-pu [**dlus** *dlus-name*] [**brief** | **detail**]	Display dependent PUs served by the DLUR function.
show appn dlus [**brief** | **detail**]	Display the status of connections to dependent LU servers.
show appn intermediate-session [**pcid** *pcid*] [**name** *lu-name*] [**brief** | **detail**]	Display information about the SNA sessions that are currently being routed through the local node.
show appn link-station [**name** *link-station-name*] [**port** *port-name*] [**brief** | **detail**]	Display information about the APPN link stations that are active on or defined to the local node.
show appn mode	Display information about the APPN modes defined to the local node.
show appn node	Display information about the local APPN control point.
show appn port [**port** *port-name*] [**brief** | **detail**]	Display information about the APPN ports that are active on the local node.
show appn rtp [**connection** *connection-id*] [**class-of-service** *cos-name*] [**name** *cp-name*] [**brief** | **detail**]	Display information about RTP connections.
show appn session [**pcid** *pcid*] [**name** *lu-name*] [**brief** | **detail**]	Display information about the SNA LU6.2 sessions, such as CP-CP sessions, that originate at the local node.
show appn topology [**name** *cp-name*] [**brief** | **detail**]	Display the contents of the APPN topology database.

APPN Configuration Examples

The following sections provide example configurations that show how to configure various aspects of an APPN network:

- Locate Throttling Configuration Example
- Negative Caching Configuration Example
- APPN HPR Configuration Example
- APPN Link over Token Ring Configuration Example
- APPN Link over FDDI Configuration Example
- APPN Link over Frame Relay Configuration Example
- APPN Link over SDLC Configuration Example
- APPN Link over RSRB Using TCP Local Acknowledgment Configuration Example
- APPN Link over DLSw+ Using Virtual Data Link Control Configuration Example
- APPN Connection Network over DLSw+ Using Virtual Data Link Control Configuration Example
- APPN Link over QLLC Configuration Example
- APPN Link over ATM Configuration Example
- APPN Link over PPP Configuration Example
- APPN Link over SMDS Configuration Example
- APPN over Ethernet LAN Emulation Example

These examples specify proper configuration between two Cisco routers. If you are defining an APPN connection to a non-Cisco APPN platform, the configuration for the Cisco IOS software will be similar to those shown here.

Locate Throttling Configuration Example

The following example enables the Locate Throttling feature, which is disabled by default:

```
interface tokenring 0
!
appn control-point neta.router1

 appn port tr0 tokenring 0
  complete

 locate-queuing
  complete
```

Negative Caching Configuration Example

The following example configures the Negative Caching feature to specify that requests for unreachable resources will be retained in the directory database for 90 seconds or until 25 locate search requests have been made:

```
interface tokenring 0
!
appn control-point neta.router1
!
 negative-caching time 90 threshold 25
  complete
```

APPN HPR Configuration Example

The following configuration connects two routers with a Frame Relay link and enables HPR.

Router A

```
interface Serial0
 encapsulation frame-relay IETF
 no keepalive
 clock rate 1000000
 frame-relay map llc2 141
 frame-relay map hpr 141
!
appn control cisco.routera
 hpr
 hpr timers liveness 1200 600 300 60
  complete
!
appn port FRAME0 Serial0
 complete
!
appn link-station routerb
 port FRAME0
 fr-dest-address 141
 effective-capacity 1000000
  complete
```

Router B

```
interface Serial0
 encapsulation frame-relay IETF
 no keepalive
 frame-relay map llc2 141
 frame-relay map hpr 141
!
appn control cisco.routerb
 hpr
 hpr timers liveness 1200 600 300 60
  complete
!
appn port FRAME0 Serial0
  complete
!
appn link-station routera
 port FRAME0
 fr-dest-address 141
 effective-capacity 1000000
  complete
```

APPN Link over Token Ring Configuration Example

The following example illustrates a basic APPN link over Token Ring media. In this example, Router 1 is configured to establish the connection, while Router 2 will wait for the connection from Router 1 and build a dynamic link station when Router 1 connects.

Router 1

```
interface tokenring 0
!
appn control-point neta.router1
  complete
!
appn port tr0 tokenring 0
  complete
!
appn link-station router2
 port tr0
 lan-dest-address 1111.1111.1112
  complete
```

Router 2

```
 ! tokenring 1 mac address is 1111.1111.1112
interface tokenring 1
!
appn control-point neta.router2
  complete
!
appn port tr1 tokenring 0
  complete
```

APPN Link over FDDI Configuration Example

The following example illustrates an APPN link over FDDI. In this example, each router is configured with a defined link station to the other. Both routers are configured to not accept dynamic APPN connection requests on the FDDI port. Router 1 is configured to attempt to connect to Router 2, retrying every minute if the connection is not established. Router 2 is configured to wait for an incoming call from Router 1 and not attempt to establish the connection.

Router 1

```
 ! FDDI0 mac address is 1111.1111.1111
interface Fddi 0
!
appn control-point neta.router1
  complete
!
appn port fd0 Fddi0
 no service-any
 complete
!
appn link-station router2
 port fd0
 lan-dest-address 1111.1111.1112
 retry-limit infinite 60
  complete
```

Router 2

```
 ! FDDI0 mac address is 1111.1111.1112
interface Fddi0
!
appn control-point neta.router1
  complete
!
appn port fd0 Fddi0
 no service-any
  complete
!
appn link-station router2
 port fd0
 lan-dest-address 1111.1111.1111
 no connect-at-startup
  complete
```

APPN Link over Frame Relay Configuration Example

The following example illustrates an APPN link over Frame Relay. Both routers are configured to attempt to establish the connection with the partner.

Router 1

```
interface serial 0
 encapsulation frame-relay IETF
 frame-relay map llc2 22
!
appn control-point neta.router1
  complete
!
appn port framerly serial 0
  complete
!
appn link-station router2
 port framerly
 fr-dest-address 22
  complete
```

Router 2

```
interface serial 3
 encapsulation frame-relay IETF
 frame-relay map llc2 21
!
appn control-point neta.router2
  complete
!
appn port frame serial 3
  complete
!
appn link-station router1
 port frame
 fr-dest-address 21
 complete
```

APPN Link over SDLC Configuration Example

The following example illustrates an APPN link over Synchronous Data Link Control (SDLC). In this example, Router 2 is configured without a link station—it will be built dynamically when contacted by Router 1.

Router 1

```
interface serial 0
 encapsulation sdlc
 sdlc address c1
!
appn control-point neta.router1
  complete
!
appn port sdlc serial 0
 sdlc-sec-addr c1
  complete
!
appn link-station router2
 port sdlc
 sdlc-dest-address c1
  complete
```

Router 2

```
interface serial 3
 encapsulation sdlc
 sdlc address c1
!
appn port sdlc serial 3
 sdlc-sec-addr c1
 complete
```

APPN Link over RSRB Using TCP Local Acknowledgment Configuration Example

The following example illustrates an APPN link using an RSRB virtual port. This configuration allows APPN links to span a routed IP multiprotocol network cloud as well as offering transport over interface encapsulation types not supported natively by APPN. In this example, the interface encapsulation is HDLC, the default for serial interfaces. Both routers are configured to attempt to initiate the connection with the other when their respective link stations are activated.

Router 1

```
source-bridge ring-group 33
source-bridge remote-peer 33 tcp 1.1.1.1
source-bridge remote-peer 33 tcp 1.1.1.2 local-ack
!
interface serial 0
 ip address 1.1.1.1 255.255.255.0
!
appn control-point neta.router1
  complete
!
appn port rsrbport rsrb
 rsrb-virtual-station 1111.1111.1111 13 1 33
  complete
!
appn link-station router2
 port rsrbport
 lan-dest-address 1111.1111.1112
  complete
```

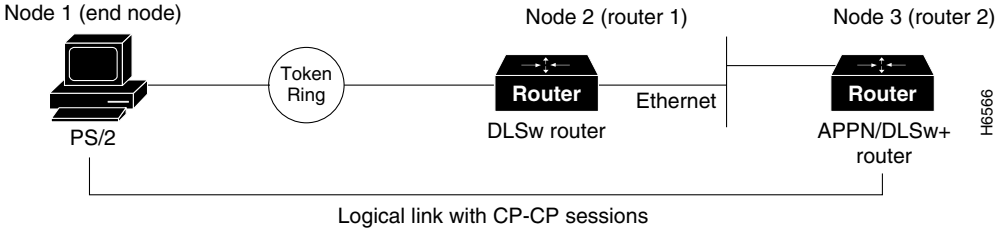
Router 2

```
source-bridge ring-group 33
source-bridge remote-peer 33 tcp 1.1.1.2
source-bridge remote-peer 33 tcp 1.1.1.1 local-ack
!
interface serial 3
 ip address 1.1.1.2 255.255.255.0
!
appn control-point neta.router2
  complete
!
appn port rsrbport rsrb
 rsrb-virtual-station 1111.1111.1112 23 1 33
  complete
!
appn link-station router1
 port rsrbport
 lan-dest-address 1111.1111.1111
  complete
```

APPN Link over DLSw+ Using Virtual Data Link Control Configuration Example

Figure 149 illustrates an example of an APPN link over DLSw+, where Node 1 has a link defined to Node 3. Node 3 merely has an APPN virtual data link control port and will create a dynamic link station when Node 1 starts its link station.

Figure 149 APPN Link over DLSw+ Using Virtual Data Link Control



The following examples provide the relevant portions of the configuration for each node.

Node 3 (Router 2)

```
source-bridge ring-group 100
dlsw local-peer peer-id 172.18.3.111
dlsw remote-peer 0 tcp 172.18.3.133
!
interface ethernet 0
 ip address 172.18.3.111 255.255.255.0
 loopback
 media-type 10BaseT
!
appn control-point NETA.BART
 complete
!
appn port VDLC vdlc
 vdlc 100 vmac 4000.4545.6969
 complete
!
```

Node 2 (Router 1)

```
!
source-bridge ring-group 100
source-bridge ring-group 33
dlsw local-peer peer-id 172.18.3.133
dlsw remote-peer 0 tcp 172.18.3.111
!
interface ethernet 0
 ip address 172.18.3.133 255.255.255.0
 loopback
 media-type 10BaseT
!
interface tokenring 0
 no ip address
 ring-speed 16
 source-bridge 1 1 100
!
```

Node 1 (End Node):

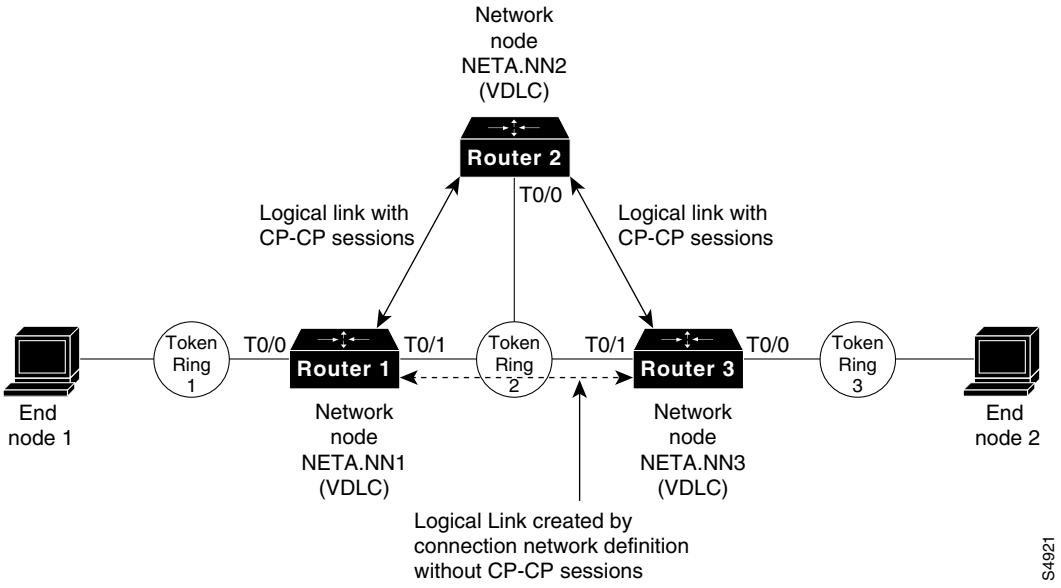
```
DEFINE_LOCAL_CP  FQ_CP_NAME(NETA.APU         )
                   CP_ALIAS(APU )
                   NAU_ADDRESS(INDEPENDENT_LU)
                   NODE_TYPE(EN)
                   NODE_ID(X'05D00000')
                   NW_FP_SUPPORT(NONE)
                   HOST_FP_SUPPORT(YES)
                   MAX_COMP_LEVEL(NONE)
                   MAX_COMP_TOKENS(0);

  DEFINE_LOGICAL_LINK  LINK_NAME(BART )
                       ADJACENT_NODE_TYPE(NN)
                       PREFERRED_NN_SERVER(NO)
                       DLC_NAME(IBMTRNET)
                       ADAPTER_NUMBER(0)
                       DESTINATION_ADDRESS(X'40004545696904')
                       ETHERNET_FORMAT(NO)
                       CP_CP_SESSION_SUPPORT(YES)
                       ACTIVATE_AT_STARTUP(no)
                       LIMITED_RESOURCE(NO)
                       LINK_STATION_ROLE(use_adapter_definition)
                       SOLICIT_SSCP_SESSION(NO)
                       MAX_ACTIVATION_ATTEMPTS(USE_ADAPTER_DEFINITION)
                       USE_PUNAME_AS_CPNAME(NO)
                       EFFECTIVE_CAPACITY(USE_ADAPTER_DEFINITION)
                       COST_PER_CONNECT_TIME(USE_ADAPTER_DEFINITION)
                       COST_PER_BYTE(USE_ADAPTER_DEFINITION)
                       SECURITY(USE_ADAPTER_DEFINITION)
                       PROPAGATION_DELAY(USE_ADAPTER_DEFINITION)
                       USER_DEFINED_1(USE_ADAPTER_DEFINITION)
                       USER_DEFINED_2(USE_ADAPTER_DEFINITION)
                       USER_DEFINED_3(USE_ADAPTER_DEFINITION);
```

APPN Connection Network over DLSw+ Using Virtual Data Link Control Configuration Example

Figure 150 illustrates a connection network, NETA.CONN, over DLSw+ using virtual data link control on the network nodes.

Figure 150 APPN Connection Network over DLSw+ Using Virtual Data Link Control



The following example provides the relevant portions of the configuration for each network node.

End Node 1

```
DEFINE_LOCAL_CP  FQ_CP_NAME(NETA.EN1)
                 CP_ALIAS(EN1)
                 NAU_ADDRESS(INDEPENDENT_LU)
                 NODE_TYPE(EN)
                 NODE_ID(X'05D00000')
                 NW_FP_SUPPORT(NONE)
                 HOST_FP_SUPPORT(YES)
                 MAX_COMP_LEVEL(NONE)
                 MAX_COMP_TOKENS(0);
DEFINE_LOGICAL_LINK  LINK_NAME(TONN1)
                     ADJACENT_NODE_TYPE(NN)
                     PREFERRED_NN_SERVER(NO)
                     DLC_NAME(IBMTRNET)
                     ADAPTER_NUMBER(0)
                     DESTINATION_ADDRESS(X'40001111222204')
                     ETHERNET_FORMAT(NO)
                     CP_CP_SESSION_SUPPORT(YES)
                     ACTIVATE_AT_STARTUP(NO)
                     LIMITED_RESOURCE(NO)
                     LINK_STATION_ROLE(USE_ADAPTER_DEFINITION)
                     SOLICIT_SSCP_SESSION(NO)
                     MAX_ACTIVATION_ATTEMPTS(USE_ADAPTER_DEFINITION)
                     USE_PUNAME_AS_CPNAME(NO)
                     EFFECTIVE_CAPACITY(USE_ADAPTER_DEFINITION)
                     COST_PER_CONNECT_TIME(USE_ADAPTER_DEFINITION)
                     COST_PER_BYTE(USE_ADAPTER_DEFINITION)
                     SECURITY(USE_ADAPTER_DEFINITION)
                     PROPAGATION_DELAY(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_1(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_2(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_3(USE_ADAPTER_DEFINITION);
```

Router 1

```
source-bridge ring-group 113
dlsw local-peer peer-id 10.2.17.1
dlsw remote-peer 0 tcp 10.2.17.2
!
interface TokenRing0/0
 no ip address
 ring-speed 16
!
interface TokenRing0/1
 ip address 10.2.17.1 255.255.255.0
 no ip address
 ring-speed 16
!
appn control-point NETA.NN1
  complete
!
appn port TR0 TokenRing0/0
  complete
!
appn port VDLC vdlc
 vdlc 113 vmac 4000.2222.3333
 source-bridge 1 1 113
  complete
!
appn connection-network NETA.CONN
 port VDLC
  complete
!
appn link-station T0NN2
 port VDLC
 lan-dest-address 4000.3333.4444
  complete
```

Router 2

```
source-bridge ring-group 113
dlsw local-peer peer-id 10.2.17.2
dlsw remote-peer 0 tcp 10.2.17.1
dlsw remote-peer 0 tcp 10.2.17.3
!
interface TokenRing0/0
 ip address 10.2.17.2 255.255.255.0
 no ip address
 ring-speed 16
!
appn control-point NETA.NN2
  complete
!
appn port VDLC vdlc
 vdlc 113 vmac 4000.3333.4444
 source-bridge 1 1 113
  complete
!
```

Router 3

```
source-bridge ring-group 113
dlsw local-peer peer-id 10.2.17.3
dlsw remote-peer 0 tcp 10.2.17.2
!
interface TokenRing0/0
 no ip address
 ring-speed 16
!
interface TokenRing0/1
 ip address 10.2.17.3 255.255.255.0
 no ip address
 ring-speed 16
!
appn control-point NETA.NN3
  complete
!
appn port TR0 TokenRing0/0
  complete
!
appn port VDLC vdlc
 vdlc 113 vmac 4000.4444.5555
 source-bridge 1 1 113
  complete
!
appn connection-network NETA.CONN
 port VDLC
  complete
!
appn link-station T0NN2
 port VDLC
 lan-dest-address 4000.3333.4444
  complete
!
```

End Node 2

```
DEFINE_LOCAL_CP  FQ_CP_NAME(NETA.EN2)
                 CP_ALIAS(EN2)
                 NAU_ADDRESS(INDEPENDENT_LU)
                 NODE_TYPE(EN)
                 NODE_ID(X'05D00000')
                 NW_FP_SUPPORT(NONE)
                 HOST_FP_SUPPORT(YES)
                 MAX_COMP_LEVEL(NONE)
                 MAX_COMP_TOKENS(0);
DEFINE_LOGICAL_LINK  LINK_NAME(TONN3)
                     ADJACENT_NODE_TYPE(NN)
                     PREFERRED_NN_SERVER(NO)
                     DLC_NAME(IBMTRNET)
                     ADAPTER_NUMBER(0)
                     DESTINATION_ADDRESS(X'40005555666604')
                     ETHERNET_FORMAT(NO)
                     CP_CP_SESSION_SUPPORT(YES)
                     ACTIVATE_AT_STARTUP(NO)
                     LIMITED_RESOURCE(NO)
                     LINK_STATION_ROLE(USE_ADAPTER_DEFINITION)
                     SOLICIT_SSCP_SESSION(NO)
                     MAX_ACTIVATION_ATTEMPTS(USE_ADAPTER_DEFINITION)
                     USE_PUNAME_AS_CPNAME(NO)
                     EFFECTIVE_CAPACITY(USE_ADAPTER_DEFINITION)
                     COST_PER_CONNECT_TIME(USE_ADAPTER_DEFINITION)
                     COST_PER_BYTE(USE_ADAPTER_DEFINITION)
                     SECURITY(USE_ADAPTER_DEFINITION)
                     PROPAGATION_DELAY(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_1(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_2(USE_ADAPTER_DEFINITION)
                     USER_DEFINED_3(USE_ADAPTER_DEFINITION);
```

APPN Link over QLLC Configuration Example

The following example illustrates an APPN link over QLLC to an AS400:

```
interface serial 1
 no ip address
 encapsulation x25 dce
 no keepalive
 x25 address 1024
 x25 map qllc 1234
 clockrate 19200
 no cdp enable
!
appn control-point NETA.APPN1
  complete
!
appn port QLLC1 serial 1
  complete
!
appn link-station AS400
 port QLLC1
 x25-dest-address svc 1234
  complete
```

APPN Link over ATM Configuration Example

The following example illustrates an APPN link over ATM:

```
interface ATM2/0
 atm pvc 1 1 12 aal5nlpid
 map-group atm-appn2
!
appn control-point NETA.APPN2
  complete
!
appn port ATM ATM2/0
  complete
!
appn link-station ATMLINK
 port ATM
 atm-dest-address 1
  complete
```

APPN Link over PPP Configuration Example

The following example illustrates an APPN link over PPP:

```
interface serial 1
 ip address 10.1.1.2 255.255.255.0
 encapsulation ppp
 no keepalive
 no fair-queue

appn control-point NETA.APPN2
  complete

appn port PPP serial 1
  complete

appn link-station PPPLINK
 port PPP
  complete
```

APPN Link over SMDS Configuration Example

The following example illustrates and APPN link over SMDS:

```
interface serial 0
 ip address 10.1.1.1 255.255.255.0
 encapsulation smds...

appn control-point NETA.APPN2
  complete

appn port SMDS serial 0
  complete

appn link-station SMDSLINK
 port SMDS
 smds-dest-address c120.0000.0002
  complete
```

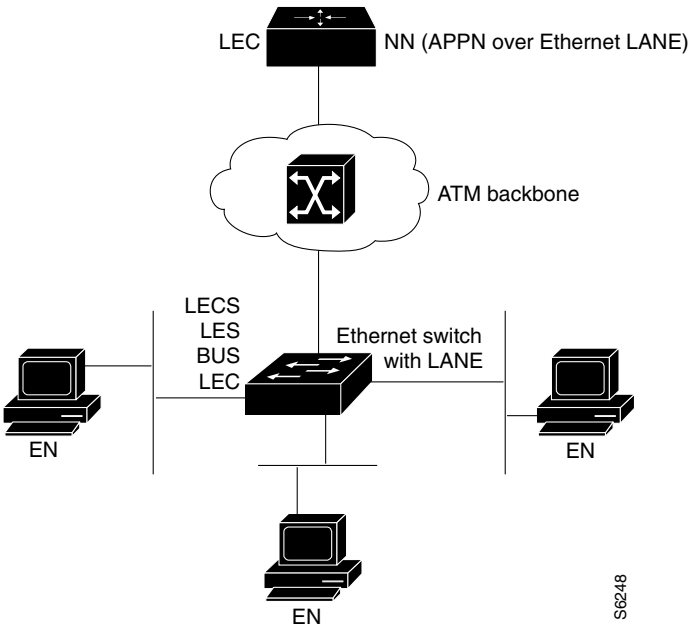
APPN over Ethernet LAN Emulation Example

APPN over Ethernet LAN Emulation (LANE) is an enhancement to Cisco's APPN intermediate session routing (ISR) implementation that allows an APPN router to participate in an emulated LAN.

APPN over Ethernet LANE enables the APPN network node on the router to communicate with an end system on a switched LAN environment.

Figure 151 shows a typical scenario for the support of APPN over Ethernet LANE. The Catalyst 5000 is defined as the LAN Emulation Configuration Server (LECS), LAN Emulation Server (LES), broadcast and unknown server (BUS) and LEC. The network node router is a LEC using the Catalyst 5000 as the server and it is on the same emulated LAN as the Catalyst 5000. This feature allows a workstation that is attached to a legacy Ethernet segment to connect to the network node server, which is directly attached to an ATM network.

Figure 151 Typical Topology Using APPN over Ethernet LANE



In the following example an enterprise is migrating their flat source-route bridged campus network to a switch-based ATM network. The new network has an ATM backbone that consists of ATM LS1010 switches and Catalyst 5000 switches. The campus network's Token Ring ports are replaced with Ethernet. The backbone protocol is TCP and APPN.

The following configuration reflects the network illustrated in Figure 152.

Configuration of the Primary DLUR Router

```
service internal
service udp-small-servers
service tcp-small-servers
!
hostname dlur1
!
!
interface ATM 1/0
 no ip address
 shutdown
!
interface TokenRing 4/0
 ip address 172.22.24.201 255.255.255.0
 ring-speed 16
 multiring all
!
interface ATM 9/0
 mtu 1500
 no ip address
 no ip mroute-cache
 no ip route-cache
 atm clock INTERNAL
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm pvc 223 1 32 aal5nlpid
 atm pvc 224 1 34 aal5nlpid
!
interface ATM 9/0.1 multipoint
 ip address 10.10.10.1 255.255.255.0
 no ip mroute-cache
 no ip route-cache
 lane client ethernet RED
!
interface ATM 9/0.2 multipoint
 ip address 10.10.50.50 255.255.255.0
 no ip redirects
 no ip mroute-cache
 no ip route-cache
 lane client ethernet BLUE
 standby 1 priority 100
 standby 1 preempt
 standby 1 authentication usaa
 standby 1 ip 10.10.50.70
!
interface ATM 10/0
 mtu 1500
 no ip address
 atm clock INTERNAL
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm pvc 60 1 36 aal5nlpid
!
interface ATM 10/0.1 multipoint
 lane client ethernet RED
!
interface ATM 10/0.2 multipoint
 lane client ethernet BLUE
!
!
appn control-point NETA.LATCP3
  dlus NETA.SJMVS1
  dlur
  complete
```

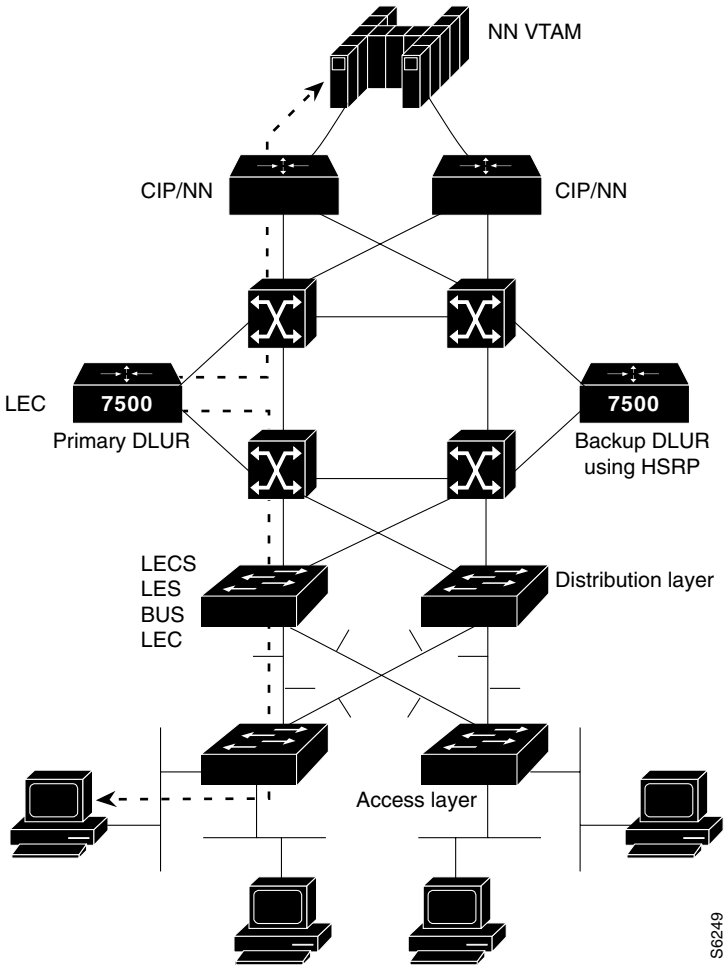
```
!
appn port BACK1483 ATM 10/0
  complete
!
appn port BACK1483 ATM 10/0
  complete
!
appn port REDLANE ATM 10/0.1
  complete
!
appn port BLUELANE ATM 10/0.2
  complete
!
appn port BLUELAN9 ATM 9/0.2
  complete
!
appn port REDLAN9 ATM 9/0.1
  complete
!
appn link-station TOCIP190
  port RFC1483
  atm-dest-address 223
  complete
!
appn link-station TOCIP191
  port RFC1483
  atm-dest-address 224
  complete
!
appn link-station BACKUP
 port BACK1483
 atm-dest-address 60
  complete
!
appn link-station DLUR2
 port BLUELANE
 lan-dest-address 0060.474a.2140
  complete
!
no ip classless
ip route 0.0.0.0 0.0.0.0 172.22.24.1
!
!
line con 0
 exec-timeout 0 0
line aux 0
 transport input all
line vty 0
 password lab
 login
 length 49
 width 126
line vty 1 4
 password lab
 login
!
scheduler heapcheck process
end
```

Configuration of the Secondary DLUR Router

```
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname dlur2
!
!
interface TokenRing 4/0
 ip address 172.22.24.202 255.255.255.0
 no ip mroute-cache
 no ip route-cache
 ring-speed 16
 multiring all
!
interface ATM 9/0
 mtu 1500
 no ip address
 no ip mroute-cache
 no ip route-cache
 atm clock INTERNAL
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm pvc 223 1 33 aal5nlpid
 atm pvc 224 1 35 aal5nlpid
!
interface ATM 9/0.1 multipoint
 no ip mroute-cache
 no ip route-cache
 lane client ethernet RED
!
interface ATM 9/0.2 multipoint
 ip address 10.10.50.60 255.255.255.0
 no ip redirects
 no ip mroute-cache
 no ip route-cache
 lane client ethernet BLUE
 standby 1 priority 10
 standby 1 preempt
 standby 1 authentication usaa
 standby 1 ip 10.10.50.70
!
interface ATM 10/0
 mtu 1500
 no ip address
 atm clock INTERNAL
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm pvc 60 1 36 aal5nlpid
!
interface ATM 10/0.1 multipoint
 lane client ethernet RED
!
interface ATM 10/0.2 multipoint
 lane client ethernet BLUE
!
!
appn control-point NETA.RISCP3
  dlus NETA.SJMVS1
  dlur
  complete
!
appn port RFC1483 ATM9/0
```

```
  complete
!
appn port BACK1483 ATM10/0
  complete
!
appn port REDLANE ATM10/0.1
  complete
!
appn port BLUELANE ATM10/0.2
  complete
!
appn port REDLAN9 ATM9/0.1
  complete
!
appn port BLUELAN9 ATM9/0.2
  complete
!
appn link-station TOCIP190
 port RFC1483
 atm-dest-address 223
  complete
!
appn link-station TOCIP191
 port RFC1483
 atm-dest-address 224
  complete
no ip classless
ip route 0.0.0.0 0.0.0.0 172.22.24.1
!
line con 0
 exec-timeout 0 0
line aux 0
 transport input all
line vty 0
 password lab
 login
 length 49
 width 126
line vty 1 4
 password lab
 login
```

Figure 152 Migrating a Source-Route Bridged Network to a Switch-Based ATM Network



In Figure 152, workstations are attached to an access Catalyst switch. The access Catalyst switch is connected to a distribution layer Catalyst switch over Fast Ethernet. The distribution Catalyst switch has an ATM link to the LS1010 switch. Using LANE, the Dependent LU Requester (DLUR) router and the distribution Catalyst switch appear to be on the same LAN.

No APPN configuration is required for the primary DLUR router in this example. The following examples show the configuration of the primary and secondary DLURs:

Primary DLUR Router Configuration of the Interface

```
interface ATM 9/0.2 multipoint
 ip address 10.10.50.50 255.255.255.0
 no ip redirects
 no ip mroute-cache
 no ip route-cache
 lane client ethernet BLUE
 standby 1 priority 100
 standby 1 preempt
 standby 1 authentication usaa
 standby 1 ip 10.10.50.70
```

Secondary DLUR Configuration of the Interface

```
interface ATM 9/0.2 multipoint
 ip address 10.10.50.60 255.255.255.0
 no ip redirects
 no ip mroute-cache
 no ip route-cache
 lane client ethernet BLUE
 standby 1 priority 10
 standby 1 preempt
 standby 1 authentication usaa
 standby 1 ip 10.10.50.70
```

Priority determines whether the router is primary or secondary. The router that has the higher priority is the primary and the other is the backup.

To access the host, the workstation uses the boundary functions of the DLUR router. The workstations define an Ethernet link to the DLUR router. The DLUR router defines an Ethernet emulated LAN link to the workstation. The advantage of using LANE is that existing LAN-based applications can run over an ATM-switched network without changes.