Configuring Multiprotocol Over ATM

This chapter describes how to configure Multiprotocol over ATM (MPOA) on the Catalyst 5000 series switches.

Note For complete information on installing Catalyst 5000 series ATM modules, refer to the *Catalyst 5000 Series Module Installation Guide*.

Note For complete syntax and usage information for the commands used in this chapter, refer to the *Command Reference* for your switch.

This chapter consists of these sections:

Understanding How MPOA Works

These sections describe how MPOA works:

MPOA Overview

MPOA enables the fast routing of internetwork-layer packets across a nonbroadcast, multiaccess (NBMA) network. MPOA replaces multihop routing with point-to-point routing using a direct virtual channel connection (VCC) between ingress and egress edge devices or hosts. An ingress edge device or host is the point at which an inbound flow enters the MPOA system; an egress edge device or host is the point at which an outbound flow exits the MPOA system.

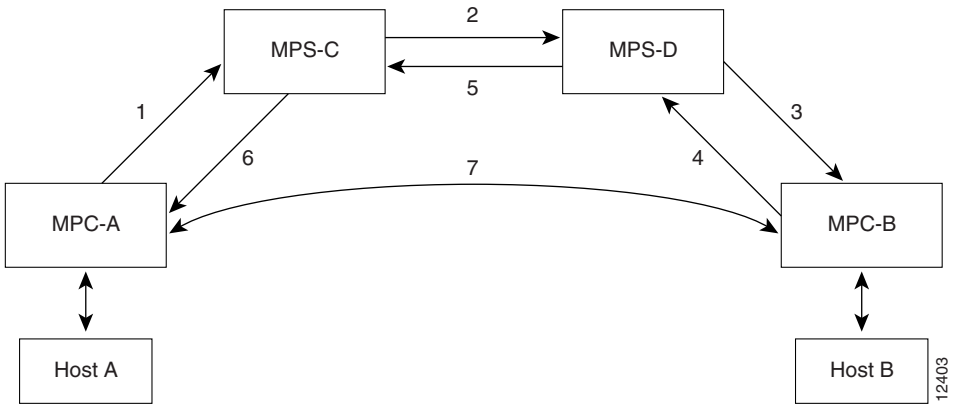
These components are required for using MPOA across an NBMA network:

- MPOA Client (MPC)
- MPOA Server (MPS)
- Catalyst 5000 series ATM module
- LAN Emulation (LANE)
- Next Hop Resolution Protocol (NHRP)

In an NBMA network, intersubnet routing requires that intermediate routers forward packets hop-by-hop. MPOA increases performance and reduces latencies by identifying the edge devices, establishing a direct VCC between the ingress and egress edge devices, and forwarding Layer-3 packets directly over this shortcut VCC, bypassing the intermediate routers. An MPC provides the direct VCCs between the edge devices or hosts whenever possible and forwards Layer-3 packets over these shortcut VCCs. The MPCs must be used with MPSs resident on routers.

Figure 37-1 shows the MPOA message flow sequence between MPCs and MPSs (refer to Table 37-1 for definitions of the MPOA terms used in Figure 37-1).

Figure 37-1 MPOA Message Flow between MPCs and MPSs



The MPOA message flow sequence is summarized as follows:

1 MPOA resolution request sent from MPC-A to MPS-C

2 NHRP resolution request sent from MPS-C to MPS-D

3 MPOA cache-imposition request sent from MPS-D to MPC-B

4 MPOA cache-imposition reply sent from MPC-B to MPS-D

5 NHRP resolution reply sent from MPS-D to MPS-C

6 MPOA resolution reply sent from MPS-C to MPC-A

7 Shortcut VCC established

Table 37-1 MPOA Terminology

MPOA Term	Definition
MPOA resolution request	A request from an MPC to resolve a destination protocol address to an ATM address to establish a shortcut VCC to the egress device.
NHRP resolution request	An MPOA resolution request that has been converted to an NHRP resolution request.
MPOA cache-imposition request	A request from an egress MPS to an egress MPC providing the MAC rewrite information for a destination protocol address.
MPOA cache-imposition reply	A reply from an egress MPC acknowledging an MPOA cache-imposition request.
NHRP resolution reply	An NHRP resolution reply that will eventually be converted to an MPOA resolution reply.
MPOA resolution reply	A reply from the ingress MPS resolving a protocol address to an ATM address.
Shortcut VCC	The path between MPCs over which Layer-3 packets are sent.

Understanding How the MPC Works

The MPC functionality involves ingress/egress cache management, data-plane and control-plane virtual circuit connection (VCC) management, MPOA frame processing, and MPOA protocol and MPOA flow detection. An MPC identifies packets sent to an MPOA-capable router over the NBMA network and establishes a shortcut VCC to the egress MPC, if possible. The MPC routes these packets directly over this shortcut VCC, bypassing the intermediate routers and enabling the fast routing of internetwork-layer packets across an NBMA network. The Catalyst 5000 series switch can be designated as an MPC. A Catalyst 5000 series switch configured with a Route Switch Module (RSM) and a Versatile Interface Processor 2 (VIP2) containing an ATM port adapter can be configured as an MPC or an MPOA Server (MPS).

Typically, a router is designated as an MPS, but can also be designated as an MPC. Configuring an MPC on a router provides router-initiated and router-terminated shortcuts for non-NBMA networks. For this reason, in this publication MPC refers to the Catalyst 5000 series switch, and MPS refers to a router or an RSM/VIP2 with an ATM port adapter in a Catalyst 5000 series switch.

Understanding How the MPS Works

The MPS supplies the forwarding information used by the MPCs. The MPS responds with the information after receiving a query from a client. To support the query and response functions, MPOA uses NHRP. The MPS on the router can also terminate shortcuts.

The MPS software module implements the functionality of the MPS in compliance with the ATM Forum MPOA specification. These sections describe the functions of MPS:

- MPS-NHRP Routing Interaction on page 37-4
- Shortcut Domains on page 37-4

MPS-NHRP Routing Interaction

MPS has to interact with the NHRP module in the router to smoothly propagate MPOA/NHRP packets end to end. MPOA frames are identical to NHRP frames except for some minor modifications and extensions for MPOA.

This process explains the interaction of MPS and NHRP:

1. The MPS converts MPOA resolution requests to NHRP requests and sends it either to the next hop MPS or to the Next Hop Server (NHS) depending on the configuration. The MPS searches for the next hop routing information to determine the interface and sends the packet with correct encapsulation to an MPS or an NHS.
2. The NHS sends resolution requests to the MPS when the next hop is on a LAN Emulation (LANE) cloud or when the NHS is unsure of the packet destination. The MPS may do further processing, such as prompt the NHS to terminate the request or throw away the packet.
3. The NHS sends resolution replies to the MPS when the next hop interface is LANE or when the replies terminate in the router.
4. The MPS sends an MPOA resolution reply to the MPC.

Shortcut Domains

Within a router, you can permit shortcuts between some groups of LAN Emulation Clients (LECs) and deny it between other groups. A network ID is associated with an MPS. By default, all the MPSs in a router get a network ID of 1.

If you want to segregate traffic, you can give MPSs different network IDs, preventing shortcuts between LECs served by different MPSs. You can configure MPS network IDs when you define an MPS database.

If a router has both MPS and NHRP configured, then the same network ID is required to facilitate requests, replies, and shortcuts across the MPS and NHRP. The interface-specific NHRP command (**ip nhrp network-id**) must be the same for an MPS; otherwise, you will have a disjointed network.

MPOA Traffic Flow

Figure 37-1 shows how MPOA messages flow from Host A to Host B. In this figure, an MPC (MPC-A) residing on a host or edge device detects a packet flow to a destination IP address (Host B) and sends an MPOA resolution request. An MPS (MPS-C) residing on a router converts the MPOA resolution request to an NHRP resolution request and passes it to the neighboring MPS/NHS (MPS-D) on the routed path. When the NHRP resolution request reaches the egress point, the MPS (MPS-D) on that router sends an MPOA cache-imposition request to MPC-B. MPC-B acknowledges the request with a cache-imposition reply and adds a tag that allows the originator of the MPOA resolution request to receive the ATM address of MPC-B. As a result, the shortcut VCC between the edge MPCs (MPC-A and MPC-B) is set up.

When traffic flows from Host A to Host B, MPC-A is the ingress MPC and MPC-B is the egress MPC. The ingress MPC contains a cache entry for Host B with the ATM address of the egress MPC. The ingress MPC switches packets destined to Host B on the shortcut VCC with the appropriate tag received in the MPOA resolution reply. Packets traversing through the shortcut VCC do not have any DLL headers. The egress MPC contains a cache entry that associates the IP address of Host B and the ATM address of the ingress MPC to a DLL header. When the egress MPC switches an IP packet through a shortcut path to Host B, it appears to have come from the egress router.

MPOA Interaction with LANE

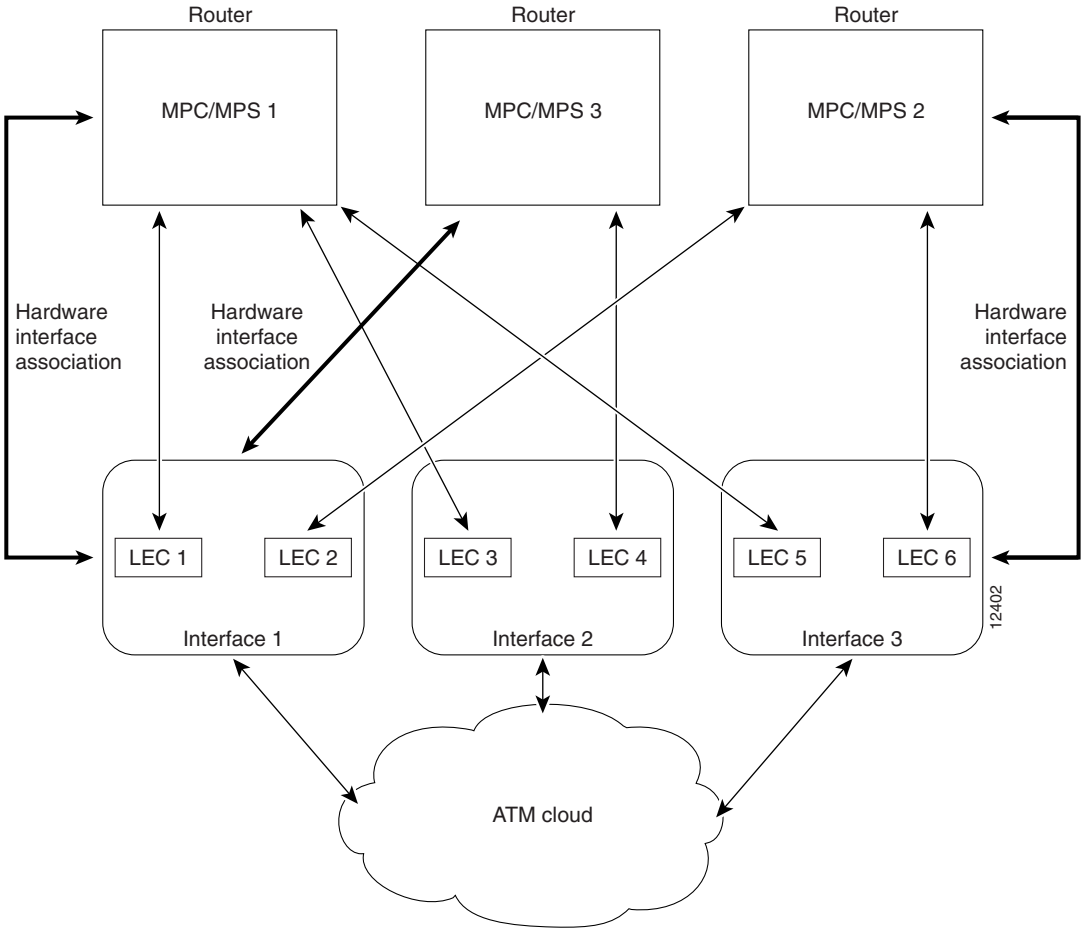
An MPOA network must have at least one MPS, one or more MPCs, and optional intermediate routers implementing NHRP servers. The MPSs and MPCs use LANE control frames to discover one another in the LANE network.

Caution For MPOA to work properly, you must first create an emulated LAN (ELAN) identifier for each ELAN. Use the **lane config database** or the **lane server-bus** ATM LANE commands to create ELAN identifiers. These commands are described in the *Command Reference* for your switch.

An MPC/MPS can serve as one or more LECs. The LEC can be associated with any MPC/MPS in the router or Catalyst 5000 series switch. A LEC can be attached to one MPC and one MPS at a time.

Figure 37-2 shows the relationships between MPC/MPS and LECs.

Figure 37-2 MPC-LEC and MPS-LEC Relationships



MPOA Configuration Guidelines

These guidelines apply when configuring MPOA on the Catalyst 5000 series switches:

- Multiple MPCs or MPSs can run on the same physical interface, each corresponding to a different control ATM address. After an MPC is attached to a single interface for its control traffic, it cannot be attached to another interface unless you break the first attachment. The MPC or MPS is attached to subinterface 0 of the interface.

  Note An MPC or MPS can be attached to a single hardware interface only.

- More than one MPC or MPS can be attached to the same interface. Any LEC running on any subinterface of a hardware interface can be bound to any MPC or MPS. However, after a LEC is bound to a particular MPC, it cannot be bound to another MPC.

  Note After a LEC is bound to an MPC or MPS, you must unbind the LEC from the first MPC or MPS before binding it to another MPC or MPS. Typically, you do not need to configure more than one MPS in a router.

- You must ensure that the hardware interface attached to an MPC or MPS is directly reachable through the ATM network by all the LECs that are bound to it.

  Note If any LEC resides on a different (unreachable) ATM network from the one to which the hardware interface is connected, MPOA does not operate properly.

Configuring the MPC

This section contains information about how you can configure, monitor, and maintain the MPC.

- Associating a LEC to an ELAN on page 37-7
- Configuring the MPC on page 37-7

To obtain the MPC operational parameters, use one of the following methods:

- MPC default parameters from the ATM Forum MPOA specification are loaded automatically as soon as the MPC is named.
- An MPC uses parameters obtained from the LECS. These parameters override the default values.
- CLI commands. After you configure any or all operational parameters using the CLI commands, they override the parameters obtained using either of the above two methods.

Associating a LEC to an ELAN

A LEC must belong to an ELAN that has a defined ELAN ID.

Note To configure an MPC on a Catalyst 5000 series ATM module, you must first establish connection with the ATM module, enter privileged mode, and then enter configuration mode. For information on performing these tasks, see the "ATM Module Command-Line Interface" section on page 2-7.

To obtain an ELAN ID, perform one of these tasks:

Task	Command
• Define an ELAN ID for the LEC (in LANE database configuration mode).	**name** *elan-name* **elan-id** *id*
• Configure the LEC with the ELAN ID (in interface configuration mode).	**lane server-bus ethernet** *elan-name* [**elan-id** *id*]

Caution If an ELAN ID is supplied, make sure both commands use the same elan-id value.

Configuring the MPC

To configure an MPC on your network, perform this task in the appropriate configuration modes:

Task		Command
Step 1	Define an MPC with a specified name.	In global configuration mode—**mpoa client config name** *mpc-name*
Step 2	Specify the ATM interface which the MPC is to be associated with.	In interface configuration mode—**interface atm** {*mod_num/port_num* | *number*}
Step 3	Attach an MPC to the ATM interface.	In interface configuration mode—**mpoa client name** *mpc-name*
Step 4	Specify the ATM interface that contains the LEC to which you will bind the MPC.	In interface configuration mode—**interface** *atm_num.sub_interface_num* **mul**
Step 5	Bind a LANE client to the specified MPC.	In interface configuration mode—**lane client mpoa client name** *mpc-name*
Step 6	Repeat Steps 4 and 5 for every LEC to be served by the MPC/MPS.	

Note In Step 4, you must specify the **mul** keyword when entering a subinterface number. Otherwise, the CLI does not accept the command.

Monitoring and Maintaining the MPC

To monitor and maintain the configuration of an MPC, perform any of these tasks in EXEC mode:

Task	Command
Display information about a specified MPC or all MPCs.	**show mpoa client** [**name** *mpc-name*]
Display ingress and egress cache entries associated with an MPC.	**show mpoa client** [**name** *mpc-name*] **cache** [**ingress** | **egress**] [**ip-addr** *ip-addr*]
Display all the statistics collected by an MPC.	**show mpoa client** [**name** *mpc-name*] **statistics**
Clear cache entries.	**clear mpoa client** [**name** *mpc-name*] **cache** [**ingress** | **egress**] [**ip-addr** *ip-addr*]
Display all the MPOA devices that this MPC has learned.	**show mpoa client** [**name** *mpc-name*] [*remote_device*]

Configuring the MPS

To configure an MPS on your network, perform the following tasks. Only the first two tasks are required; the remaining two tasks are optional.

Configuring the ELAN ID

For MPOA to work properly, a LANE client must have an ELAN ID for all ELANs represented by the LANE clients. To configure an ELAN ID, perform either of the following tasks in lane database configuration mode or in interface configuration mode when starting up the LAN Emulation Client Server (LES) for that ELAN:

Task		Command
Step 1	Configure the ELAN ID in the LECS database to participate in MPOA.	**name** *elan-name* **elan-id** *id*
Step 2	Configure the LES with the ELAN ID to participate in MPOA.	**lane server-bus** {**ethernet** | **tokenring**} *elan-name* [**elan-id** *id*]

Caution If you specify an ELAN ID in steps 1 and 2 of the preceding task, make sure you specify the same ELAN ID in both commands.

Configuring the MPS

The MPS functions only after it is attached to a specific hardware interface. To configure an MPS, perform this task:

Task		Command
Step 1	In global configuration mode, define an MPS with the specified name.	**mpoa server config name** *mps-name*
Step 2	Specify the ATM interface to attach the MPS.	**interface atm** {*slot/port* | *number*}
Step 3	In interface configuration mode, attach the MPS to the ATM interface.	**mpoa server name** *mps-name*
Step 4	Specify the ATM interface to bind the MPS to a LEC.	**interface atm** {*slot/port.subinterface-number* | *number.subinterface-number*}
Step 5	In subinterface configuration mode, bind a LANE client to the specified MPS.	**lane client mpoa server name** *mps-name*

Configuring MPS Variables

You must define an MPS with a specified name before you can change the MPS variables specific to that MPS.

To change MPS variables specific only to a particular MPS, perform this task starting in MPS configuration mode:

Task		Command
Step 1	Define an MPS with the specified name.	**mpoa server config name** *mps-name*
Step 2	(Optional) Specify the control ATM address that the MPS should use (when it is associated with a hardware interface).	**atm-address** *atm-address*
Step 3	(Optional) Specify the network ID of the MPS.	**network-id** *id*
Step 4	(Optional) Specify the keepalive time value for the MPS-p1 variable of the MPS.	**keepalive-time** *time*
Step 5	(Optional) Specify the holding time value for the MPS-p7 variable of the MPS.	**holding-time** *time*

Monitoring and Maintaining the MPS

To monitor and maintain the configuration of an MPS, perform this task in EXEC mode:

Task		Command
Step 1	Display default ATM addresses for an MPS.	**show mpoa default-atm-addresses**
Step 2	Display information about a specified server or all servers depending on the specified name of the required server.	**show mpoa server** [**name** *mps-name*]
Step 3	Display ingress and egress cache entries associated with a server.	**show mpoa server** [**name** *mps-name*] **cache** [**ingress** | **egress**] [**ip-address** *ip-address*]
Step 4	Display all the statistics collected by a server including the ingress and egress cache entry creations, deletions, and failures.	**show mpoa server** [**name** *mps-name*] **statistics**
Step 5	Clear cache entries.	**clear mpoa server** [**name** *mps-name*] **cache** [**ingress** | **egress**] [**ip-addr** *ip-addr*]
Step 6	Originate an MPOA trigger for the specified IP address to the specified client. If a client is not specified, the MPOA is triggered to all the clients.	**mpoa server name** *mps-name* **trigger ip-address** *ip-address* [**mpc-address** *mpc-address*]

MPOA Configuration Examples

This section contains configuration examples for the MPC and MPS. In the examples, the lines beginning with exclamation points (!) are comments explaining the command shown (in boldface font) on the following line. The procedures apply to the configuration shown in Figure 37-1, but can be modified for other MPOA configurations.

- MPC Configuration Example on page 37-10
- MPS Configuration Example on page 37-11

MPC Configuration Example

This example configures the MPC and binds a LEC to the MPC:

```
! Define the MPC "MYMPC"
 mpoa client config name MYMPC
! Leave everything as default
 exit
! Specify the ATM interface to which the MPC is attached
 interface ATM 1/0
! Attach MPC MYMPC to the HW interface
 mpoa client name MYMPC
! Specify the ATM interface that contains the LEC to which you will bind the MPC
 interface atm 1/0.1
! Bind a LANE client to the specified MPC
 lane client mpoa client name MYMPC
! Go back up to global config mode
 exit
```

MPS Configuration Example

This example configures the MPS and attaches the MPS to a hardware interface:

```
! Define the MPS "MYMPS"
 mpoa server config name MYMPS
! Leave everything as default
 exit
! Enter into interface config mode
 interface ATM 1/0
! Attach MPS MYMPS to the HW interface
 mpoa server name MYMPS
! Go back up to global config mode
 exit
```