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MPLS Manager

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DISCOVERY GUIDE SUPPLEMENT

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Contents

Preface

This document provides an overview of the InCharge MPLS Manager discovery process and presents procedures for preparing and initiating MPLS Manager for discovery of Multiprotocol Label Switching (MPLS) topology and Virtual Private Network (VPN) topology in an IP environment. This document is intended as a supplement to the *InCharge IP Discovery Guide.*

Intended Audience

This document is intended to be read by IT managers seeking to understand how the MPLS discovery process works, and by system administrators responsible for the administration, configuration, or use of InCharge applications that provide MPLS discovery over IP networks.

Prerequisites

Readers of this document should have read the *InCharge IP Discovery Guide* first, and be familiar with InCharge discovery concepts.

To perform the procedures in this document, the InCharge MPLS Manager, InCharge IP Availability Manager (Availability Manager), and InCharge Service Assurance Manager (Global Manager) must be installed. The Global Console is also needed to manually invoke discovery.

For information about installing these products, see the *InCharge MPLS Management Suite Installation Guide*, the *InCharge IP Management Suite Installation Guide*, and the *InCharge Service Assurance Management Suite Installation Guide.*

Document Organization

This document consists of the following chapters.

Table 1: Document Organization

1.	DISCOVERY OVERVIEW	Describes the concepts of discovering MPLS and VPN topology using InCharge MPLS Manager.
2.	DISCOVERY PROCESS	Explains how the MPLS Manager discovers and models MPLS and VPN elements.
3.	PREPARING FOR AND INITIATING DISCOVERY	Explains how to prepare and initiate discovery for an MPLS Manager deployment.
4.	INVOKING DISCOVERY MANUALLY	Provides information about how to manually invoke discovery for MPLS Manager and how to view and correct discovery errors.

Documentation Conventions

Several conventions may be used in this document as shown in Table 2.

Table 2: Documentation Conventions

CONVENTION	EXPLANATION
sample code	Indicates code fragments and examples in Courier font
keyword	Indicates commands, keywords, literals, and operators in bold
%	Indicates C shell prompt
#	Indicates C shell superuser prompt
<parameter>	Indicates a user-supplied value or a list of non-terminal items in angle brackets
[option]	Indicates optional terms in brackets
/InCharge	Indicates directory path names in italics
yourDomain	Indicates a user-specific or user-supplied value in bold, italics
File > Open	Indicates a menu path in italics
▼▲	Indicates a command is wrapped over one or more lines. The command must be typed as one line.

Directory path names are shown with forward slashes (/). Users of the Windows operating systems should substitute back slashes (\) for forward slashes.

Also, if there are figures illustrating consoles in this document, they represent the consoles as they appear in Windows. Under UNIX, the consoles appear with slight differences. For example, in views that display items in a tree hierarchy such as the Topology Browser, a plus sign displays for Windows and an open circle displays for UNIX.

Finally, unless otherwise specified, the term InCharge Manager is used to refer to InCharge programs such as Domain Managers, Global Managers, and adapters.

InCharge MPLS Management Suite Installation Directory

In this document, the term **BASEDIR** represents the location where SMARTS software is installed.

- For UNIX, this location is: */opt/InCharge<n>/<productsuite>.*

- For Windows, this location is: *C:\InCharge<n>\<productsuite>.*

The *<n>* represents the SMARTS software platform version number. The *<productsuite>* represents the InCharge product suite to which the product belongs. For example, on UNIX operating systems, MPLS Manager is installed to */opt/InCharge6/MPLS/smarts* by default. On Windows operating systems, this product is installed to *C:\InCharge6\MPLS\smarts* by default. This location is referred to as **BASEDIR***/smarts*.

Optionally, you can specify the root of **BASEDIR** to be something other than */opt/InCharge6* (on UNIX) or *C:\InCharge6* (on Windows), but you cannot change the *<productsuite>* location under the root directory.

For more information about the directory structure of SMARTS software, refer to the *InCharge System Administration Guide.*

MPLS Management Suite Products

The MPLS Management Suite offers the following products:

- MPLS Manager

- InCharge Adapter for Cisco ISC

- Perl API

Additional Resources

In addition to this document, SMARTS provides the following resources.

InCharge Commands

Descriptions of InCharge commands are available as HTML pages. The *index.html* file, which provides an index to the various commands, is located in the **BASEDIR**/smarts/doc/html/usage directory.

Documentation

Readers of this document may find other SMARTS documentation (also available in the **BASEDIR**/smarts/doc/pdf directory) helpful.

InCharge Documentation

The following SMARTS documents are product independent and thus relevant to users of all InCharge products:

- *InCharge Release Notes*

- *InCharge Documentation Roadmap*

- *InCharge System Administration Guide*

- *InCharge ICIM Reference*

- *InCharge Dynamic Modeling Tutorial*

- *InCharge MODEL Reference Guide*

- *InCharge ASL Reference Guide*

- *InCharge Perl Reference Guide*

MPLS Management Suite Documentation

The following SMARTS documents are relevant to users of the MPLS Management Suite product suite:

- *InCharge MPLS Management Suite Installation Guide*

- *InCharge MPLS Manager User's Guide*

- *InCharge MPLS Manager Configuration Guide*

- *InCharge IP Discovery Guide Supplement for MPLS*

- *InCharge MPLS Manager User's Guide for Cisco ISC Adapter*

- *InCharge MPLS Management Suite Release Notes*

Refer to the *InCharge Documentation Roadmap* for documentation resources provided with other SMARTS product suites.

Technical Support

For questions about technical support, call your local sales office or service provider. For service, call one of the following numbers:

United States: 800.782.4362 (SVC.4EMC)

Canada: 800.543.4782 (543.4SVC)

Worldwide: 508.497.7901

EMC Powerlink

EMC Powerlink is EMC's secure extranet for customers and partners. Powerlink is an essential tool for obtaining web-based support from EMC. Powerlink can be used to submit service or information requests (tickets) and monitor their progress, to review the knowledgebase for known problems and solutions, and to download patches and SmartPacks.

From training on EMC products and technologies, to online support, product announcements, software registration, technical white papers, interoperability information, and a range of configuration tools, Powerlink offers resources unavailable elsewhere.

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http://powerlink.emc.com

1

Discovery Overview

The MPLS Manager works with the Availability Manager to discover the logical and physical elements in the transport domain, the MPLS domain, and the VPN domain.

Device Support

The MPLS Manager supports any routing device that supports SNMP MIBs MPLS-LSR and MPLS-VPN, or supports SNMP MIB jnxVpnMIB, or supports Command Line Interface (CLI) commands that discover information comparable to the information contained in these MIBs.

Examples of routing devices supported by MPLS Manager are:

- Cisco routers—ESR10xxx, 76xx, 75xx, 72xx, 45xx, and 36xx; GSR12xxx; and 26xx

- Juniper routers—M-Series, T-Series, ERX, and ERX virtual routers

VPN Support

The MPLS Manager supports MPLS Layer 3 VPNs. An MPLS Layer 3 VPN is a provider-provisioned Layer 3 VPN defined by IETF RFC-2547bis.

Availability Manager Discovery

In the transport domain, the Availability Manager discovers the Layer 2 and Layer 3 network element connectivity to the customer site routers (CE routers, Figure 1). It uses the discovered topology to model the network, and uses SNMP polling and traps to diagnose and pinpoint the root cause of network failures. The Availability Manager sends the analysis results along with topology and event information to the Global Manager, and sends router topology and event information to the MPLS Manager.
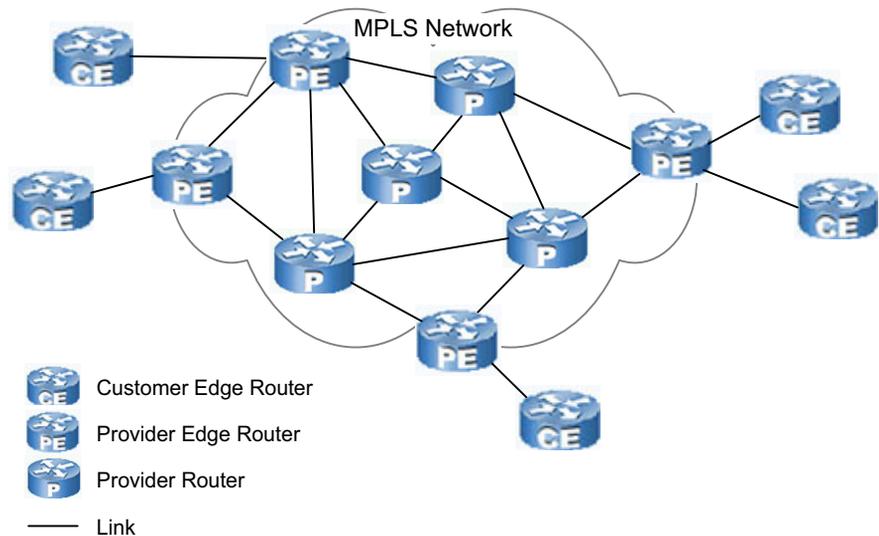
Figure 1: The Transport Domain—Discovered by the Availability Manager

MPLS Manager Discovery

The MPLS Manager discovers the MPLS logical topology (Figure 2) and the VPN logical topology (Figure 3) and models that topology in its repository. It maps the MPLS and VPN topology to the router topology discovered by the Availability Manager.
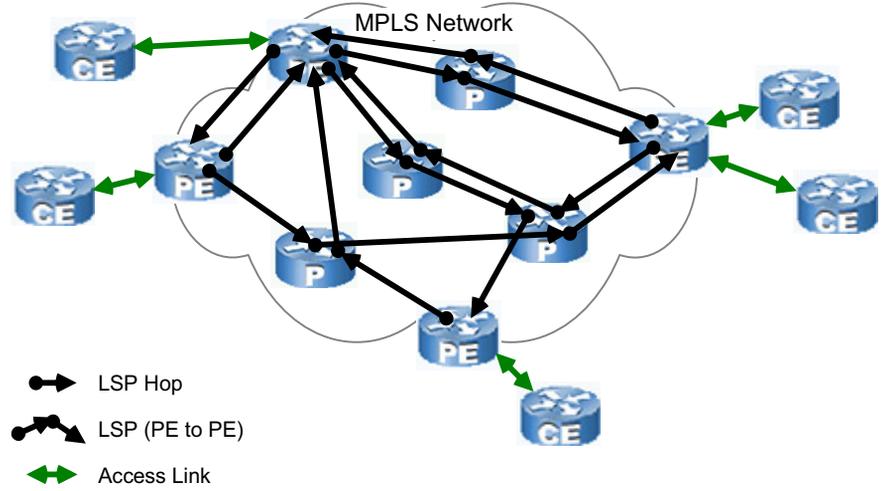
Figure 2: The MPLS Domain—Discovered by the MPLS Manager
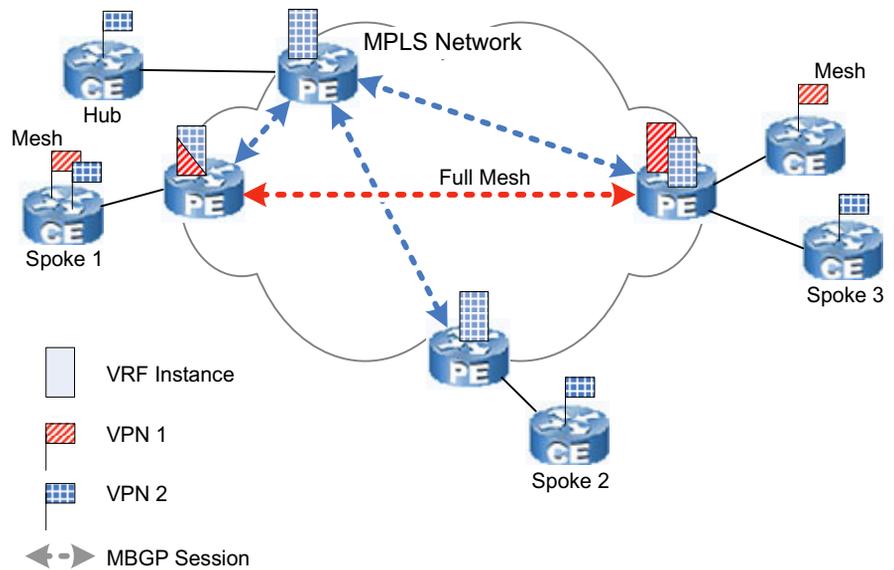
Figure 3: The VPN Domain—Discovered by the MPLS Manager

Imports Routers from Availability Manager

From the Availability Manager, the MPLS Manager imports the initial router topology, receives router topology updates, and receives events relevant to the imported router topology. MPLS Manager imports the router elements along with the following elements associated with the routers:

- Chassis
- Card
- Port
- Interface
- IP
- DuplicateIP
- IPNetwork
- VPNIP
- VPNIPNetwork
- NetworkConnection
- SNMPAgent
- VLAN
- Partition

VPNIP and VPNIPNetwork contain VPN-IP addresses, each of which consists of a *route distinguisher* and an IPv4 address. The route distinguisher is the means by which the PE router and the MPLS Manager keep track of overlapping customer IP address spaces.

Initiates MPLS Discovery

After importing the initial router topology from the Availability Manager, the MPLS Manager uses SNMP polling and/or CLI commands to query the routers for MPLS and VPN information. If SNMP polling fails or is not supported by a routing device, and assuming that CLI discovery is enabled, the MPLS Manager logs in to the routing device (via Telnet) and issues CLI commands to query the router for the required information.

For descriptions of MIB discovery and CLI discovery, see the *InCharge MPLS Manager User's Guide*. For information about configuring CLI-related log-in parameters and enabling CLI discovery, see the *InCharge MPLS Manager Configuration Guide*.

Discovers MPLS and VPN Elements

The MPLS Manager discovers the following MPLS and VPN elements:

- MPLS services
- Label Switched Paths (LSPs)
- LSP hops
- LSP segments
- Virtual Private Networks (VPNs)
- VPN Routing and Forwarding (VRF) instances
- Route targets

The MPLS Manager combines these topology elements with those discovered by the Availability Manager to build a complete model of the MPLS network, the VPNs, and the attached customer sites.

Logs Discovery Messages

Whenever a discovery cycle completes, the MPLS Manager prints a report to its log file identifying the number of elements (MPLS services, LSPs, LSP hops, LSP incoming segments, LSP outgoing segments, VPNs, VRFs, and route targets) and relationships that it created during the discovery. The log file is named *<MPLS manager name>.log* (for example, *INCHARGE-MPLS.log*) and is located in the **BASEDIR**/*smarts/local/logs* directory.

Creates CLI Log Files

During a discovery cycle, the MPLS Manager creates a CLI log file for each candidate routing device that either does not support MPLS MIB discovery or failed MIB discovery. Each CLI log file contains a record of the Telnet session with the particular device; it includes the CLI commands issued by the MPLS Manager and the responses returned by the device. MPLS Manager parses the log file to create topology elements in its repository.

A CLI log file is named *EXPECT-MPLS-<device name>-<timestamp>.txt* (for example, *EXPECT-MPLS-lab-gw.smarts.com-1100666237.txt*). The timestamp is the number of seconds since Epoch 0 (January 1, 1970, 00:00:00 GMT). All CLI log files are located in the **BASEDIR**/*smarts/local/logs* directory.

When Discovery Occurs

The MPLS Manager initiates a discovery cycle of the MPLS and VPN elements whenever:

- The Availability Manager completes a discovery cycle.

  Each time the Availability Manager completes a discovery cycle, MPLS Manager performs a topology synchronization to import router topology information from the Availability Manager. MPLS Manager then writes a detailed report of the topology synchronization to its log file and decides whether to perform its own discovery by comparing the newly imported router topology with the previously imported router topology. Whenever the MPLS Manager finds a new routing device, or finds an already known routing device having a newer discovery timestamp than the one held for the device by MPLS Manager, the MPLS Manager sends SNMP polls and/or CLI commands to that routing device to discover/rediscover its MPLS and VPN elements and adds those elements to its repository.

- The MPLS Manager receives a discovery request from the network administrator.

  A network administrator can manually invoke a discovery at any time, as explained in *Invoking Discovery Manually* on page 17.

2

Discovery Process

During the discovery process, the MPLS Manager discovers MPLS and VPN elements in two phases:

- Per-device element discovery
- Post-processing element discovery

As it discovers the elements, the MPLS Manager uses instances of certain InCharge Common Information Model (ICIM) classes to create a data model representation of the discovered elements within its repository. The data model, shown in Figure 4, represents the MPLS and VPN elements, their relationships, and their connections.
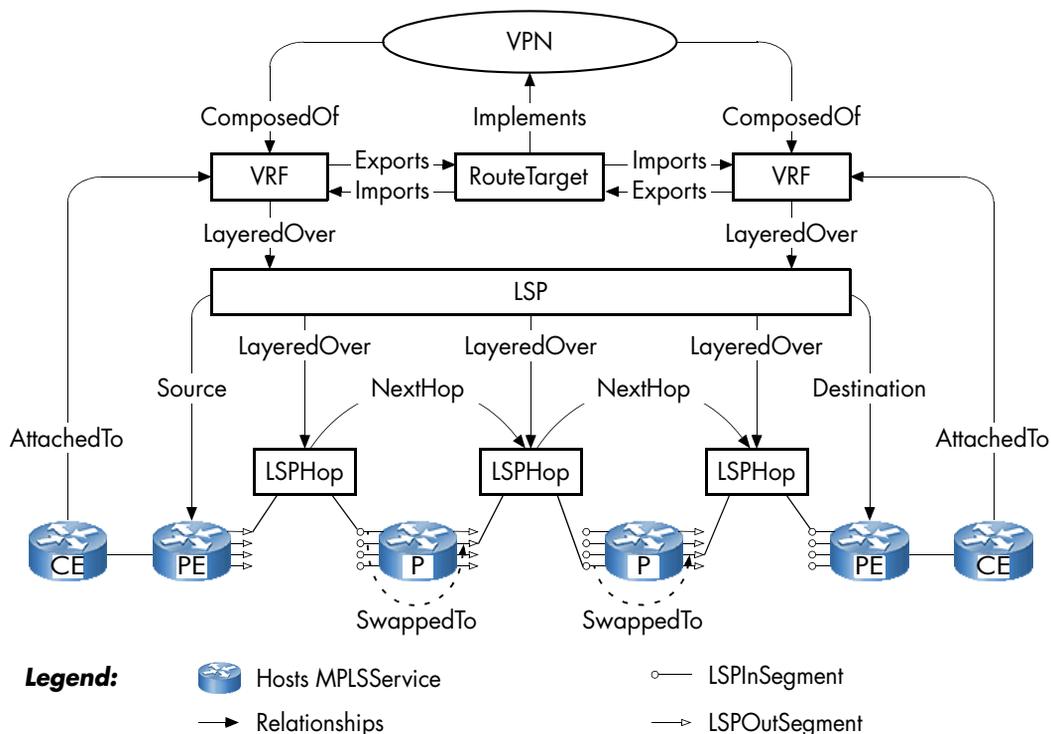
Figure 4: Simplified View of ICIM MPLS and VPN Reference Model

For descriptions of the MPLSService, LSP, LSPHop, LSPInSegment, LSPOutSegment, VPN, VRF, and RouteTarget classes, see the *InCharge MPLS Manager User's Guide*.

Per-Device Element Discovery

Per-device element discovery pertains to discovering MPLS and VPN elements on a per routing device basis. The discovery may run in multiple concurrent threads (the default value is 10).

During this phase of the discovery process, the MPLS Manager creates instances of the following classes for each discovered routing device:

- VRF

- RouteTarget

- LSPInSegment

- LSPOutSegment
- MPLSService

VRF and RouteTarget

The MPLS Manager relates VRFs and RouteTargets through the *Imports/ImportedBy* and *Exports/ExportedBy* relationship sets, and then discovers which interfaces are associated with each VRF.

The *CEs* relationship points from the VRF to the CE routers that are attached to the VRF. The MPLS Manager computes this relationship by traversing the *Peer* relationship of the *Underlying* interfaces, and then the *HostedBy* relationship of those peer network adapters.

Other computed relationships are:

- VRF relationship *SendsRoutesTo*—Points to all VRFs that import the RouteTargets that this VRF *Exports*.

- VRF relationship *ReceivesRoutesFrom*—Points to all VRFs that export the RouteTargets that this VRF *Imports*.

- VRF relationship *VPNPeer*—Points to all VRFs that are related to this VRF by both *SendsRoutesTo* and *ReceivesRoutesFrom*.

LSPInSegment and LSPOutSegment

Each LSPInSegment-LSPOutSegment pair represents an entry in the MPLS routing table of a discovered MPLS-enabled routing device, where the LSPInSegment represents an incoming label, and the LSPOutSegment represents an outgoing label. The two instances are related to each other with the *SwappedTo/SwappedFrom* relationship set (an LSPOutSegment is SwappedFrom an LSPInSegment). Instances of LSPOutSegment that are not *SwappedFrom* an LSPInSegment represent the first label in an ingress LSP.

The MPLS Manager creates an LSPInSegment and LSPOutSegment for an entry in the MPLS routing table *only* if the LSP associated with the entry terminates at a PE router that is already in the MPLS Manager topology.

MPLSService

The MPLS Manager creates an instance of MPLSService for each routing device in the topology. The relationships created for a routing device depend on the type of the device.

For a CE router:

- MPLSService relationship *AttachedTo*—Points to the VRF to which the CE router is attached.

For a PE router:

- MPLSService relationship *VRFs*—Points to the VRFs hosted by the PE router.

- MPLSService relationships *LSPOut* and *LSPIn*—Point to the LSPs for which the PE router is the source or destination (respectively).

- MPLSService relationship *VRFInterfaces*—Points to all the interfaces that are associated with VRFs on the PE router.

For a PE or P router:

- MPLSService relationship *MPLSInterfaces*—Points to all interfaces that are MPLS-enabled.

Post-Processing Element Discovery

During this phase of the discovery process, which starts after per-device element discovery completes, the MPLS Manager creates instances of the following classes by combining the information collected during per-device element discovery:

- VPN

- LSP

- LSPHop

VPN

The MPLS Manager infers VPNs from VRF and RouteTarget instances and the relationships between the instances. The MPLS Manager creates the following types of VPN:

- Full-mesh

- Hub-and-spoke

Full-Mesh VPN

The MPLS Manager creates a full-mesh VPN for each RouteTarget (R1, for example) that has the same set of VRFs in its *ImportedBy* and *ExportedBy* relationship sets. The VPN is *ImplementedBy* R1 and is *ComposedOf* the VRFs that are *ExportedBy* (and *ImportedBy*) R1.

Hub-and-Spoke VPN

The MPLS Manager creates a hub-and-spoke VPN for each pair of RouteTargets (R2 and R3, for example) that has the following characteristics:

- The R2 relationship *ImportedBy* is identical to the R3 relationship *ExportedBy*.

- The set of VRFs that export R2 but do not import R2 is identical to the set of VRFs that import R3 but do not export R3.

- The R2 relationship *ExportedBy* is not identical to the R3 relationship *ImportedBy*, or at least one VRF exists that both *Imports* and *Exports* R2, or both conditions are true.

The VPN is *ImplementedBy* the two RouteTargets. The VPN is *ComposedOf* all the VRFs in the R2 relationship *ImportedBy* and the R2 relationship *ExportedBy*. VPN relationship *Spokes* is the set of VRFs in the R2 relationship *ExportedBy* but not in the R2 relationship *ImportedBy*. VPN relationship *Hubs* includes the rest of the VRFs.

LSP

The MPLS Manager scans all VRFs in the topology and examines the *Accesses* relationship. If this relationship includes an LSPOutSegment, MPLS Manager creates an LSP *between* the PE router that hosts the LSPOutSegment *and* the PE router to which the LSP of this LSPOutSegment refers. The *Source* and *Destination* relationships of the LSP are set appropriately.

LSPHop

For each LSP that the MPLS Manager creates, it also creates the LSPHop instances along the path of the LSP. An LSPHop is *ConnectedTo* an LSPOutSegment and an LSPInSegment. If the LSPHop is the last one for an LSP, it is only *ConnectedTo* an LSPOutSegment (which has a label=3).

The MPLS Manager computes the *NextHop* and *PreviousHop* relationships of LSPHop instances. To compute the *NextHop* relationship, the MPLS Manager traces the *ConnectedTo* relationship to the LSPInSegment, then the *SwappedTo* relationship to an LSPOutSegment, and then the *ConnectedVia* relationship to an LSPHop.

3

Preparing for and Initiating Discovery

Configuring an MPLS Manager deployment for discovery requires configuring the MPLS Manager, Availability Manager, and Global Manager applications in the deployment. Initiating discovery for the deployment requires initiating discovery for each Availability Manager application that is to serve as a source to MPLS Manager.

Preparing for Discovery

To prepare your MPLS Manager deployment for discovery, follow these steps:

1 Configure each Availability Manager for discovery as instructed in the *InCharge IP Discovery Guide*.

2 Configure the MPLS Manager for discovery as instructed in the *InCharge MPLS Manager Configuration Guide*. The configuration consists of three basic tasks:

- Configuring environment variables for CLI-based discovery

- Configuring CLI-based discovery for specific routing devices

- Adding one or more Availability Managers as sources to MPLS Manager

3 Configure the Global Manager for discovery as instructed in the *InCharge MPLS Manager Configuration Guide*. For general instructions on configuring the Global Manager, see the *InCharge Service Assurance Manager Configuration Guide*.

Initiating Discovery

After configuring your MPLS Manager deployment for discovery, initiate discovery for each Availability Manager as instructed in the *InCharge IP Discovery Guide*.

Then, initiate discovery for the MPLS Manager by starting the MPLS Manager. Whether or not you registered the MPLS Manager as a service during installation, you can manually start and stop the MPLS Manager from the command line.

To start the MPLS Manager as a process named INCHARGE-MPLS, go to the **BASEDIR**/smarts/bin directory in the MPLS Manager installation area and enter the following command on one line:

```
./sm_server --name=INCHARGE-MPLS --config=mpls-vpn
   --output --daemon
```

An MPLS Manager instance named INCHARGE-MPLS registers with the InCharge Broker for the deployment, reads the *LOCAL.import* file in the **BASEDIR**/smarts/local/conf/mpls-vpn directory, and imports the router topology discovered by each of the Availability Manager sources listed in the *LOCAL.import* file. In addition, the MPLS Manager instance creates a log file named *INCHARGE-MPLS.log* in the **BASEDIR**/smarts/local/logs directory.

After the initial import of router topology from Availability Manager, MPLS Manager sends its own SNMP polls and/or CLI commands to the routers to discover the MPLS and VPN information that it needs to build the MPLS and VPN topology. Thereafter, MPLS Manager imports the router topology from Availability Manager whenever Availability Manager completes a discovery cycle.

Each time that MPLS Manager imports the router topology, it compares the router topology with the previously imported router topology. Whenever MPLS Manager finds a new routing device, or finds an already known routing device having a newer discovery timestamp than the one held for the device by MPLS Manager, the MPLS Manager sends SNMP polls and/or CLI commands to the routing device to discover/rediscover the device's MPLS and VPN elements and adds those elements to the MPLS and VPN topology.

4

Invoking Discovery Manually

After initial discovery, you can manually invoke discovery for MPLS Manager at any time. You perform this function through a Domain Manager Administration Console attached to the MPLS Manager or from the command line.

Opening the Domain Manager Administration Console

Attaching the Global Console to a Domain Manager such as MPLS Manager requires an InCharge user account with the following privileges and permissions:

- *All* privileges, specified in the *serverConnect.conf* file (or its equivalent) read by the Domain Manager.

- Permission to use the console operation *Configure Domain Manager Admin Console*. Through the Global Manager Administration Console, this permission is specified in the Console Operations section of the user profile.

For information about configuring access privileges, see the *InCharge System Administration Guide*. For information about configuring permissions to perform specific console operations, see the *InCharge Service Assurance Manager Configuration Guide*.

To open the Domain Manager Administration Console, follow these steps:

1 Start the Global Console.

- On a Windows system, choose *Start > Programs > InCharge 6 > InCharge Global Console*.

- On a UNIX system, go to the **BASEDIR**/*smarts/bin* directory in the Global Manager installation area and invoke `./sm_gui`.

The InCharge Manager attach dialog box opens.

2 In the dialog box,

- Ensure that the InCharge Broker for your deployment appears in the Broker text box.

- Select the MPLS Manager application in your deployment as the InCharge Manager to which you want to connect.

- Enter your login user name and password.

- Click **OK**.

The Topology Browser Console opens.

3 In the Console, choose *Configure > Domain Manager Administration Console*. The Domain Manager Administration Console opens, an example of which is shown in Figure 5.

In the example display, the Domain Manager Administration Console is attached to an MPLS Manager named INCHARGE-MPLS.
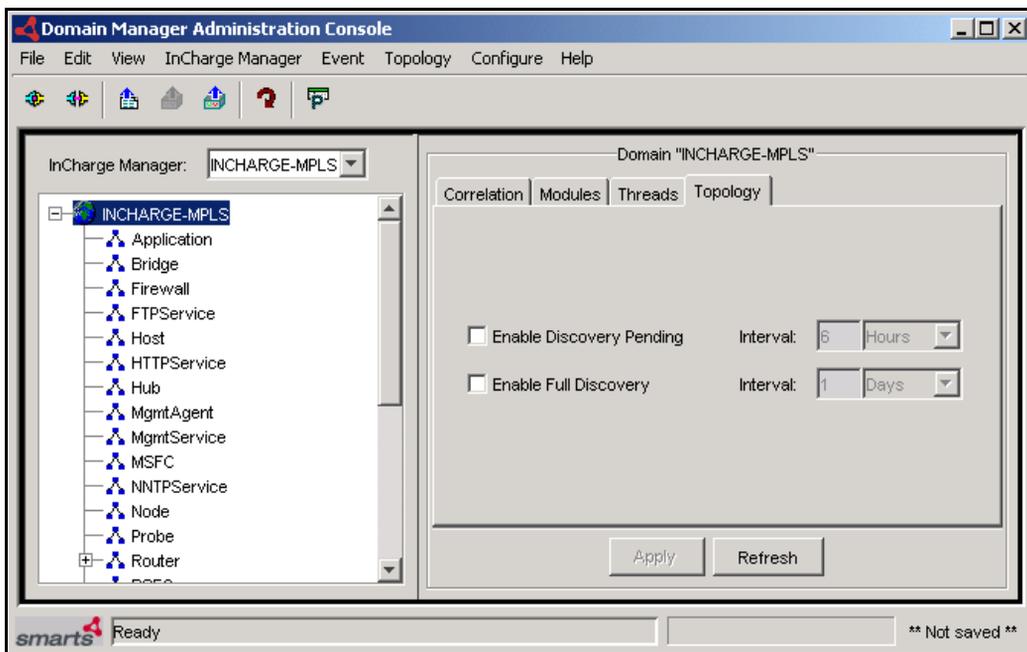
Figure 5: Domain Manager Administration Console—Example

Because MPLS Manager imports its topology and topology updates from Availability Manager, the following features are either not available to MPLS Manager or should not be performed for MPLS Manager:

- Manual discovery and autodiscovery

  The menu options to initiate these features are not available (are grayed-out). All other administration capabilities normally available through the Domain Manager Administration Console are available to administrators and operators of MPLS Manager.

- Enabling and scheduling automatic discovery

  Because the MPLS Manager performs discovery whenever the source Availability Manager performs discovery, automatic discovery, if used, should be enabled and scheduled for the Availability Manager.

Invoking Discovery

There are several methods for manually invoking a discovery from the Domain Manager Administration Console, including:

- Choose an element and then select *Topology > Rediscover* to initiate a discovery of the selected element. You can also rediscover an element by right-clicking it and selecting **Rediscover** from the drop-down menu.

- Select *Topology > Discover All* to initiate a discovery of all managed elements.

During a discovery cycle initiated from the Domain Manager Administration Console, a Discovery Progress window opens and displays progress messages. When you see *Last discovery completed* near the end of the progress report in the Discovery Status section, the probing of topology information is complete. If any errors occur during the discovery process, see *Resolving Discovery Errors* on page 20. Click **Close** to close the Discovery Progress window.

You can also invoke a full discovery using the *dmctl* utility. Invoke this command from the **BASEDIR***/smarts/bin* directory in the MPLS Manager installation area:

```
▼ % ./dmctl -s <MPLS manager name> invoke
ICF_TopologyManager::ICF-TopologyManager discoverAll ▲
```

▼▲   Indicates that the command must be typed as one line.

Resolving Discovery Errors

When the MPLS Manager attempts to discover the MPLS and VPN elements for a routing device, one of the following results occurs:

- Discovery successfully completes, and the MPLS and VPN elements associated with the routing device are added to the managed topology.

- Discovery starts but communication is lost between the MPLS Manager and the routing device.

- Discovery starts but the routing device does not respond to SNMP polls and/or CLI commands.

- Discovery starts but one or more of the MPLS Manager probes encounters an error during the discovery process.

- Discovery is unable to start or successfully complete.

When a discovery error occurs, follow these basic steps:

1 Check the messages in the Discovery Status section of the Discovery Progress window.

2 Check the log file named *<MPLS manager name>.log* in the **BASEDIR**/*smarts/local/logs* directory. The discovery process writes an error to this log each time that it encounters an error and discovery is not successful.

Note: MPLS Manager does not notify discovery errors.

For descriptions and resolutions of common discovery errors, see the *InCharge IP Discovery Guide.*

Index