

# *InCharge*<sup>TM</sup>

## Routing Protocol Services Manager User's Guide

Version 1.0

December 2003



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# Preface

This guide provides detailed information about InCharge Routing Protocol Services Manager (RPSM). InCharge RPSM, in conjunction with InCharge IP Availability Manager, automatically diagnoses failures in Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP) sessions, and sends the results of its analysis to InCharge Service Assurance Manager.

## Intended Audience

This guide is intended to be read by IT managers seeking to better understand the value of InCharge RPSM, and by system administrators configuring and using InCharge RPSM.

## Prerequisites

It is assumed that both InCharge IP Availability Manager and InCharge Service Assurance Manager are installed. The Global Console is required to configure Polling Groups and Threshold Groups, when applicable. For information on installing these products, refer to the *InCharge Installation Guide*.

# Document Organization

This guide consists of the following chapters:

<b>1. INTRODUCTION</b>	Provides brief introductions to routing protocols, and provides an overview of the InCharge RPSM.
<b>2. ROUTING PROTOCOL ELEMENTS AND THEIR FAILURES</b>	Describes the elements monitored by the InCharge RPSM, and the faults diagnosed.
<b>3. RPSM MAPS AND VIEWS</b>	Provides a brief discussion on how to use the InCharge RPSM maps and views.
<b>A. MIBS POLLED BY RPSM</b>	Identifies the MIBs used by the InCharge RPSM Manager to diagnose connectivity problems.
<b>B. DEPLOYING RPSM</b>	Discusses the installation, configuration, and use of the InCharge RPSM Manager.

**Table 1:** Document Organization

# Documentation Conventions

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

CONVENTION	EXPLANATION
<code>sample code</code>	Indicates code fragments and examples in Courier font
<b>keyword</b>	Indicates commands, keywords, literals, and operators in bold
<code>%</code>	Indicates C shell prompt
<code>#</code>	Indicates C shell superuser prompt
<code>&lt;parameter&gt;</code>	Indicates a user-supplied value or a list of non-terminal items in angle brackets
<code>[option]</code>	Indicates optional terms in brackets



CONVENTION	EXPLANATION
<i>/InCharge</i>	Indicates directory path names in italics
<b><i>yourDomain</i></b>	Indicates a user-specific or user-supplied value in bold, italics
<i>File &gt; Open</i>	Indicates a menu path in italics
▲ ▼	Indicates a command that is formatted so that it wraps over one or more lines. The command must be typed as one line.

**Table 2:** Documentation Conventions

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.

## Additional Resources

In addition to this manual, 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 manual 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 Installation Guide*
- *InCharge System Administration Guide*
- *InCharge Global Console Guide*

### **InCharge IP Management Documentation**

The following SMARTS documents are relevant to users of the InCharge IP Management product suite.

- *InCharge IP Availability Manager User's Guide*
- *InCharge IP Performance Manager User's Guide*
- *InCharge IP Adapters User's Guide*
- *InCharge IP Discovery Guide*

### **InCharge Service Assurance Manager Documentation**

The following SMARTS documents are relevant to users of the InCharge Service Assurance Management product suite.

- *An Introduction to InCharge Service Assurance Manager*
- *InCharge Service Assurance Manager Configuration Guide*
- *InCharge Service Assurance Manager Failover System User's Guide*
- *InCharge Service Assurance Manager User's Guide for Business Impact Manager*

The following SMARTS documents are relevant to InCharge Service Assurance Manager adapters.

- *InCharge Service Assurance Manager Notification Adapters User's Guide*
- *InCharge Service Assurance Manager Adapter Platform User's Guide*
- *InCharge XML Adapter User's Guide*
- *InCharge Service Assurance Manager User's Guide for Remedy Adapter*

- *InCharge Service Assurance Manager User's Guide for Concord eHealth Adapter*
- *InCharge Service Assurance Manager User's Guide for InfoVista Adapter*

## Abbreviations and Acronyms

The following lists common abbreviations and acronyms that are used in this InCharge guide.

ABR	Area Border Router
AS	Autonomous System
ASBR	Autonomous System Border Router
BDR	Backup Designated Router
BGP	Border Gateway Protocol
DR	Designated Router
EBGP	External Border Gateway Protocol
EGP	Exterior Gateway Protocol
IBGP	Internal Border Gateway Protocol
IGP	Interior Gateway Protocol
IP	Internet Protocol
MIB	Management Information Base
NBMA	Non-Broadcast, Multi-Access
OSPF	Open Shortest Path First
RIB	Routing Information Base
RR	Route Reflector (BGP Speaker)
VPN	Virtual Private Network



## Introduction

This chapter provides brief introductions to routing protocols within and between independent networks, also called Autonomous Systems. It also provides an overview of the InCharge Routing Protocol Services Manager (RPSM), describes its processes, and lists the features of the application.

## The Routing Protocol Domain

The flow of data across IP networks depends upon two factors: the physical connectivity between the network devices, and the routing protocols that run on those devices. Physical connectivity between network devices is, of course, required for the exchange of data, but, by itself, does not ensure the exchange of data. Routing protocols are needed to dictate the paths across which packets flow within and between independent networks.

Routing protocols differ according to their use. The differing protocols include:

- Interior Gateway Protocols (IGP)—Protocols that are used to exchange routing information within independent networks, or Autonomous Systems. These are usually used by business enterprises. Open Shortest Path First (OSPF) is a prominent interior gateway protocol
- Exterior Gateway Protocols (EGP)—Protocols that are used to exchange routing information between independent networks, or Autonomous Systems. These are usually used by multi-division enterprises and network service providers. Border Gateway Protocol (BGP) is a prominent exterior gateway protocol.

### Open Shortest Path First (OSPF)

OSPF is an Interior Gateway Protocol (IGP) which discovers and propagates routing information within an Autonomous System. It is a link-state protocol: each router generates a full model of the area (within the Autonomous System) of which it is a part. The model includes all IP subnets and routers in the area. Each router then executes a Shortest Path First algorithm on this model to determine the best route to each IP subnet in the model.

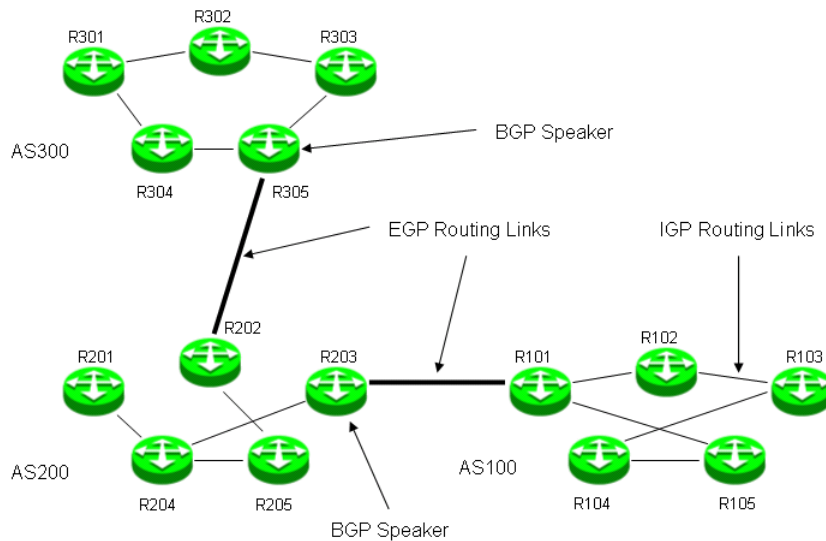
### Border Gateway Protocol (BGP)

BGP is an Exterior Gateway Protocol (EGP). It is used to exchange routing information between any two independently administered networks or Autonomous Systems. To accomplish the exchange of information, BGP advertises summary information about the subnetworks within an Autonomous System to neighboring systems so that the neighbors know what IP subnetworks are supported by the Autonomous System.

Thus, BGP is commonly used by service providers and by business enterprises which are “multi-homed” (have more than one path to the Internet), and need to control how routes to their networks are advertised to the Internet at large.

### Routing Protocols and Their Links

Figure 1 illustrates the differing protocols and their links.



**Figure 1: IGP and EGP Links**

The figure depicts three Autonomous Systems: AS100, AS200, and AS300. Each consists of five routers: R101 to R105, R201 to R205, and R301 to R305. The links between the routers within an Autonomous System are referred to as IGP links. The links between routers in different Autonomous Systems are referred to as EGP links.

The IGP links exchange detailed routing information within a given Autonomous System. The EGP links summarize information about the subnetworks within an Autonomous System and communicate those summaries to other systems.

In the figure, AS300 and AS100 advertise their respective networks to AS200 by way of BGP. Any router that forms a BGP link with any other router is called a BGP Speaker.

# InCharge Routing Protocol Services Manager

InCharge Routing Protocol Services Manager (RPSM) is an InCharge solution that, along with InCharge IP Availability Manager and InCharge Service Assurance Manager (release 6.0 and later), provides management capabilities to pinpoint root-cause failures in the Routing Protocol domains of IP networks. It also provides for the mapping and correlation among the protocol domains and the underlying transport domain by means of cross-domain correlation and cross-domain impact analysis.

## InCharge RPSM Architecture and Processes

InCharge RPSM must be implemented in conjunction with InCharge IP Availability Manager and InCharge Service Assurance Manager. Figure 2 illustrates its position within the framework of a total solution, as well as the flow of information between the components of the solution.

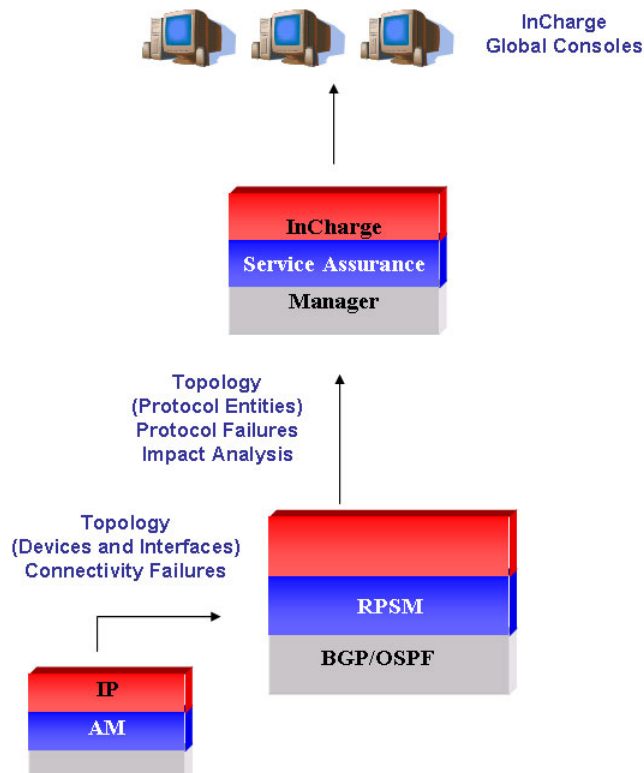


Figure 2: InCharge RPSM Solution Architecture



In the figure:

- The InCharge RPSM servers (BGP and OSPF) discover and manage the Routing Protocol domains, and perform cross-domain correlation to pinpoint root-cause failures and their impacts.
- InCharge IP Availability Manager (AM) discovers and manages the connectivity of the underlying transport domain.
- InCharge Service Assurance Manager (SAM) consolidates information from the managed domains, correlates and aggregates notifications from the underlying analysis servers, and provides end-to-end impact analysis.
- The Global Consoles offer comprehensive graphical presentations of all network elements and their relationships.

### InCharge RPSM Features

Along with InCharge IP Availability Manager and InCharge Service Assurance Manager, the features of InCharge RPSM include:

- Auto-discovery of the managed Routing Protocol domain—InCharge RPSM uses SNMP probing to obtain topological information from the network elements.
- Abstract representation of the Routing Protocol domain—InCharge RPSM uses the InCharge Common Information Model (ICIM) to represent the Routing Protocol domain in its object-oriented repository.
- Automatic processing of events generated by the network elements—InCharge RPSM monitors the network elements for failures.
- Real time monitoring of protocol status information—InCharge RPSM automatically monitors protocol-related entities using a combination of ICMP pinging and SNMP polling, in addition to syslog and trap processing.
- Automatic root-cause analysis—InCharge RPSM automatically performs root-cause analysis on alarms that occur at different layers of the Routing Protocol domain, and pinpoints the root cause.
- Automatic cross correlation with network connectivity failures—InCharge RPSM automatically correlates network infrastructure failures with routing protocol failures, diagnosing the physical network failure as the root cause, and routing protocol failures as an impact of those failures.



# Routing Protocol Elements and Their Failures

This chapter describes the routing protocol elements discovered and managed by InCharge RPSM and the failures diagnosed for each element. The diagnosis identifies root-cause failures in the Routing Protocol domain, indicating problems that require immediate attention. InCharge RPSM correlates the apparent failures of other elements reached through the failed element to the root cause and only notifies you of the problem origin.

The chapter also describes the elements that InCharge RPSM uses when it monitors the managed elements and diagnoses failures, and, where applicable, lists their attributes.

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**Note:** In addition to the processes that InCharge RPSM performs, InCharge IP Availability Manager discovers and monitors the underlying network infrastructure elements, and diagnoses connectivity failures between those elements. See the *InCharge IP Availability Manager User's Guide* for information about the elements that it monitors, along with descriptions of their failures.

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## Summary of Elements Monitored and Faults Diagnosed

The following table summarizes the routing protocol elements monitored and faults diagnosed.

ELEMENT	DIAGNOSIS	EXPLANATION
BgpService	Down	The BGP network service is down and has lost all of its sessions.
BgpAdjacency	Disconnected	The BGP Session is not established.
	Down	The BGP Session is not established, and no other known root cause can explain this fact.
BgpNeighbor-EndPoint	RemoteAsMismatch	The actual AS number of the remote system does not match the configuration on the local router.
	RemoteSystemNot-RunningBGP	The remote system is not running BGP.
	RemoteSpeakerNot-Configured	The remote system is not configured to speak to this system.
	IBGPPeerMissing	The IBGP Peer is not present in the topology.
OspfService	ABRNotInBackbone	This is an Area Border Router but it has no interfaces in the backbone area.
OspfNetwork	DRElectionFailure	No Designated Router was elected on this broadcast or NBMA network.
	AllRouterPriorities-Zero	All interfaces on this broadcast or NBMA network have the router priority set to 0.
OspfInterface	Down	All neighbor relationships that this interface participates in are down.
	HelloIntervalMismatch	The hello interval on this interface does not match the hello interval on the neighboring interfaces.
	DeadIntervalMismatch	The dead interval on this interface does not match the dead interval on the neighboring interfaces.
	AuthTypeMismatch	The authentication type on this interface does not match the authentication type on the neighboring interfaces.

ELEMENT	DIAGNOSIS	EXPLANATION
OspfInterface	AuthenticationFailure	The authentication key on this interface does not match the authentication key on the neighboring interfaces.
	AreaIDMismatch	The area ID on this interface does not match the area ID on the neighboring interfaces.
	AreaTypeMismatch	The area type on this interface does not match the area type on the neighboring interfaces.
	NetmaskMismatch	The netmask on this interface does not match the netmask on the neighboring interfaces.
	MTUMismatch	The MTU on this interface does not match the MTU on the neighboring interfaces.
	Disabled	This interface is administratively down.

ELEMENT	DIAGNOSIS	EXPLANATION
OspfNeighbor-Relationship	Down	This OSPF neighbor relationship is not progressing to the "two way" or "full" state as appropriate, and there are no connectivity or OSPF configuration problems that can explain this symptom.
	AreaIDMismatch	The area ID on the two neighboring interfaces do not match. This is preventing a neighbor relationship from forming between the two interfaces.
	AreaTypeMismatch	The area type on the two neighboring interfaces do not match. This is preventing a neighbor relationship from forming between the two interfaces.
	HelloIntervalMismatch	The hello interval on the two neighboring interfaces do not match.
	DeadIntervalMismatch	The dead interval on the two neighboring interfaces do not match.
	AuthTypeMismatch	The authentication type on the two neighboring interfaces do not match.
	NetmaskMismatch	The IP netmask on the two neighboring interfaces do not match. This is preventing a neighbor relationship from forming between the two interfaces.
	MTUMismatch	The MTU on the two neighboring interfaces do not match.
	AuthenticationFailure	The authentication key on the two neighboring interfaces do not match.
	DuplicateRouterID	The two neighboring interfaces have the same OSPF Router ID.
OspfNeighbor-Endpoint	NeighborStateAlarm	This OSPF neighbor relationship is not progressing to the "two way" or "full" state as appropriate.
	NeighborMissing-Authentication	This OSPF interface is configured with Authentication, but the neighbor is not.
	UnknownNbma-Neighbor	The permanent NBMA neighbor is unknown in the topology, and the neighbor relationship is down.

**Table 3:** Summary of Elements Monitored and Faults Diagnosed

# BGP Routing Protocol Elements

The following BGP routing protocol elements are used by InCharge RPSM when it monitors the managed elements and diagnoses failures.

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**Note:** The term session(s) as used in this guide refers to the logical connection(s) between elements.

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## BgpService

This class represents the BGP software process which implements the BGP protocol on a router. Each device which is a BGP Speaker will contain a single BGPService.

### Attributes

- Identifier: This is the unique BGP Identifier for this Speaker.
- VersionVector: The BGP Version supported by this speaker
- AS: The identifier for the Autonomous System of which this Speaker is a member.

### Failure Diagnosed

- Down: The BGP software process is down and has lost all of its sessions. The underlying device seems to be operating properly and no other connectivity problem can explain this failure.

## BgpAdjacency

This class represents a BGP session between two different BGP speakers.

### Failures Diagnosed

- Disconnected: The BGP session is not established. This is a symptomatic event that is explained by a problem in either the BGP or AM domains.
- Down: The BGP session is not established, and no other known root cause can explain this fact. Thus, the session failure itself is considered to be the root cause.

### BgpNeighborEndpoint

This class represents the status of a single BGP session from the point of view of the BGP peers. Each properly configured BGPAdjacency will connect two BGP NeighborEndpoint objects. A BGPService will be AccessedBy one BgpNeighborEndpoint for each session established by the BGPService.

#### Attributes

- RemoteAddress: The IP address of BGP peer.
- PeerState: The current state of the BGP session.
- PeerIdentifier: The BGP identifier of the peer.
- PeerNegotiatedVersion: The BGP version running between the two peers.
- LocalAddress: The local IP address used to establish the BGP session.
- LocalPort: The local port used to establish the BGP session.
- RemotePort: The port on the peer system used to establish this BGP session.
- RemoteAS: The Autonomous System number of the peer as determined by the configuration on the local system.
- InUpdates: The number of BGP UPDATE messages received on this connection.

#### Failures Diagnosed

- RemoteAsMismatch: The actual AS number of the remote system does not match the configuration on the local router. This mis-configuration prevents the BGP Session from being established.
- RemoteSystemNotRunningBGP: The remote system is not running BGP so no session can be established with it.
- RemoteSpeakerNotConfigured: The remote system is not configured to speak to this system, so no session can be established.
- IBGPPeerMissing: The IBGP peer is not present in the topology and the session cannot be established. It may be that the peer IP is misconfigured and is pointing to a non-existent system.

### BgpAS

This class represents a BGP AutonomousSystem which contains one or more BgpServices.



**Attributes:**

- AS: The Autonomous System number of this AS.

## OSPF Routing Protocol Elements

The following OSPF routing protocol elements are used by InCharge RPSM when it monitors the managed elements and diagnoses failures.

### OspfArea

This class represents an OSPF Area.

**Attributes**

- ArealD: The ID for this area. The root area has ArealD 0.0.0.0.
- AreaType: The type for this area. Legal values are normal, NSSA, and stub.
- PropagateSummaries: This is set to FALSE for totally stub and totally NSSA areas which do not propagate summary routes from the backbone area.

### OspfService

The OSPF protocol service is the process that runs on this system and manages the protocol exchanges with its counterparts.

**Attributes**

- AdminStatus: The administrative status of OSPF on this system (down or up).
- RouterID: The routerID of this OSPF router.
- IsABR: TRUE if this router is an Area Border Router.
- IsASBR: TRUE if this router is an Autonomous System Border Router.

**Failure Diagnosed**

- ABRNotInBackbone: This router is an Area Border Router but has no interfaces in the backbone area.

### OspfAreaConfiguration

This class represents an OSPF Area as seen from the viewpoint of one of the router's OspfService in the area. Each router has its own view of the area's attributes and parameters.

#### Attributes

- ArealD: The ID for this area. The root area has ArealD 0.0.0.0.
- AreaType: The type for this area. Legal values are normal, NSSA, and stub.
- PropagateSummaries: This is set to FALSE for totally stub and totally NSSA areas which do not propagate summary routes from the backbone area.

### OspfNetwork

This is an IP network which is running OSPF as its IGP.

#### Attributes

- NetworkType: The OSPF network type. Legal values are broadcast, NBMA (non-broadcast multi-access), point-to-point, and point-to-multipoint.

#### Failures Diagnosed

- DRElectionFailure: No Designated Router was elected on this broadcast or NBMA network. This prevents full neighbor relationships from forming between neighbors on this network.
- AllRouterPrioritiesZero: All interfaces on this broadcast or NBMA network have their router priority set to 0. This prevents a DR from being elected.

### OspfInterface

This is an interface which participates in the OSPF protocol.

#### Attributes

- IfType: The type of interface. Legal values are broadcast, NBMA (non-broadcast multi-access), point-to-point, and point-to-multipoint.
- TransitDelay: The estimated number of seconds it takes to transmit a link state update packet over this interface.

- **RetransmitInterval:** The number of seconds between link-state advertisement retransmission for adjacencies belonging to this interface. This value is also used when retransmitting database description and link-state request packets.
- **HelloInterval:** The length of time, in seconds, between the Hello packets that the router sends on the interface. This value must be the same for all routers attached to a common network.
- **DeadInterval:** The number of seconds that a router Hello packets have not been seen before its neighbors declare the router down. This should be some multiple of the Hello interval. The value must be the same for all routers attached to a common network.
- **AuthKey:** The Authentication Key for simple password Authentication
- **AuthType:** The type of authentication used by this interface. Legal values are none, simple password, md5, or other.
- **RouterPriority:** The priority of this interface. It is used in multi-access networks for the designated router election algorithm. The value 0 signifies that the router is not eligible to become the designated router on this particular network. In the event of a tie in this value, routers will use their Router ID as a tie breaker.
- **PollInterval:** The larger time interval, in seconds, between the Hello packets sent to an inactive non-broadcast multiaccess neighbor.
- **MulticastForwarding:** The way in which multicasts should forwarded on this interface: not forwarded, forwarded as data link multicasts, or forwarded as data link unicasts. Data link multicasting is not meaningful on point to point and NBMA interfaces, and setting `ospfMulticastForwarding` to 0 effectively disables all multicast forwarding.
- **DemandInterface:** Indicates whether Demand OSPF procedures (hello suppression to FULL neighbors and setting the `DoNotAge` flag on propagated LSAs) should be performed on this interface.
- **AdminStatus:** The current administrative state of the interface.
- **IfState:** The current state of this OSPF interface. Legal values are UNKNOWN, DOWN, LOOPBACK, WAITING, POINT\_TO\_POINT, DESIGNATED\_ROUTER, BACKUP\_DESIGNATED\_ROUTER and OTHER\_DESIGNATED\_ROUTER
- **IfEventCount:** The number of times this OSPF interface has changed its state, or an error has occurred.

### Failures Diagnosed

- **Down:** All neighbor relationships in which this interface participates are down and there are no connectivity or OSPF configuration problems that can explain these symptoms.
- **HelloIntervalMismatch:** The hello interval on this interface does not match the hello interval on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **DeadIntervalMismatch:** The dead interval on this interface does not match the dead interval on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **AuthTypeMismatch:** The authentication type on this interface does not match the authentication type on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **AuthenticationFailure:** The authentication key on this interface does not match the authentication key on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **ArealDMismatch:** The area ID on this interface does not match the area ID on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **AreaTypeMismatch:** The area type on this interface does not match the area type on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **NetmaskMismatch:** The netmask on this interface does not match the netmask on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **MTUMismatch:** The MTU on this interface does not match the MTU on the neighboring interfaces. This prevents any neighbor relationships from forming with this interface.
- **Disabled:** This interface is administratively down and prevents neighbor relationships from forming.

## OspfNeighborRelationship

This class represents an OSPF neighbor relationship between two OSPF interfaces.

**Failures Diagnosed**

- **Down:** This OSPF neighbor relationship is not progressing to the "two-way" or "full" state as appropriate, and there are no connectivity or OSPF configuration problems that can explain this symptom.
- **AreaIDMismatch:** The area ID on the two neighboring interfaces do not match. This is preventing a neighbor relationship from forming between the two interfaces.
- **AreaTypeMismatch:** The area type on the two neighboring interfaces do not match. This is preventing a neighbor relationship from forming between the two interfaces.
- **HelloIntervalMismatch:** The hello interval on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **DeadIntervalMismatch:** The dead interval on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **AuthTypeMismatch:** The authentication type on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **NetmaskMismatch:** The IP netmask on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **MTUMismatch:** The MTU on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **AuthenticationFailure:** The authentication key on the two neighboring interfaces do not match. This prevents a neighbor relationship from forming between the two interfaces.
- **DuplicateRouterID:** The two neighboring interfaces have the same OSPF Router ID. This prevents the neighbor relationship from proceeding to the Full state.
- **NeighborStateAlarm:** This OSPF neighbor relationship is not progressing to the "two-way" or "full" state as appropriate.

### OspfNeighborEndpoint

This class represents the status of a single OSPF Neighbor Relationship from the point of view of one of the OSPF Interfaces. Each complete OSPFRelationship will connect two OSPF NeighborEndpoint objects.

#### Attributes

- HelloSuppressed: This indicates whether Hellos are being suppressed to the neighbor
- NeighborState: The current state of this session. Legal values are UNKNOWN, DOWN, ATTEMPT, INIT, TWO\_WAY, EXCHANGE\_START, EXCHANGE, LOADING, FULL.
- NeighborEventCount: The number of times this neighbor relationship has changed state, or an error has occurred.
- RetransmitQueueLength: The current length of the retransmission queue.
- NbmaNeighborPermanence: This variable displays the status of the entry. 'dynamic' and 'permanent' refer to how the neighbor became known.
- NeighborRouterID: A 32-bit integer (represented as a type IpAddress) uniquely identifying the neighboring router in the Autonomous System.

#### Failure Diagnosed

- NeighborMissingAuthentication: This OSPF interface is configured with Authentication, but the neighbor is not, and this prevents the neighbor relationship from progressing past the "attempt" state.
- UnknownNbmaNeighbor: The permanent NBMA neighbor is unknown in the topology, and the neighbor relationship is down.

## RPSM Maps and Views

This chapter briefly describes how to use the RPSM maps and views that can be displayed on the Global Console to learn more about the source, impact and causes of routing protocol events.

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**Note:** See the *InCharge Operator's Guide* for detailed information about the use of the Global Console.

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### Using the RPSM Maps

Maps provide a graphical representation of your topology. As you monitor your managed domain, you might need to examine the elements of your maps and investigate the active events that affect them.

Maps for RPSM display AS elements, BGP elements, and OSPF elements. On the maps, dashed lines denote membership, and solid lines denote the logical connections using the routing protocol.

There are several ways to launch maps that display RPSM topology elements from the Global Console. For example:

- Use the **Show Map** option to access a map from any existing console. **Show Map** opens the Map Console and displays the default map for the selected element.
- Use the **Show Map** button in the Find Instance and Find System dialog boxes. (The button is activated when you select a row in the table.)

- Use the **Show Map** option in the Event menu or, if you right-click on a selected notification, the pop-up menu.

The following sections provide examples of the available RPSM maps.

## Autonomous System (AS) Map

The Autonomous System map (Figure 3) shows the member systems (using dashed lines) of the autonomous system, along with the BGP adjacencies that connect them (solid lines).

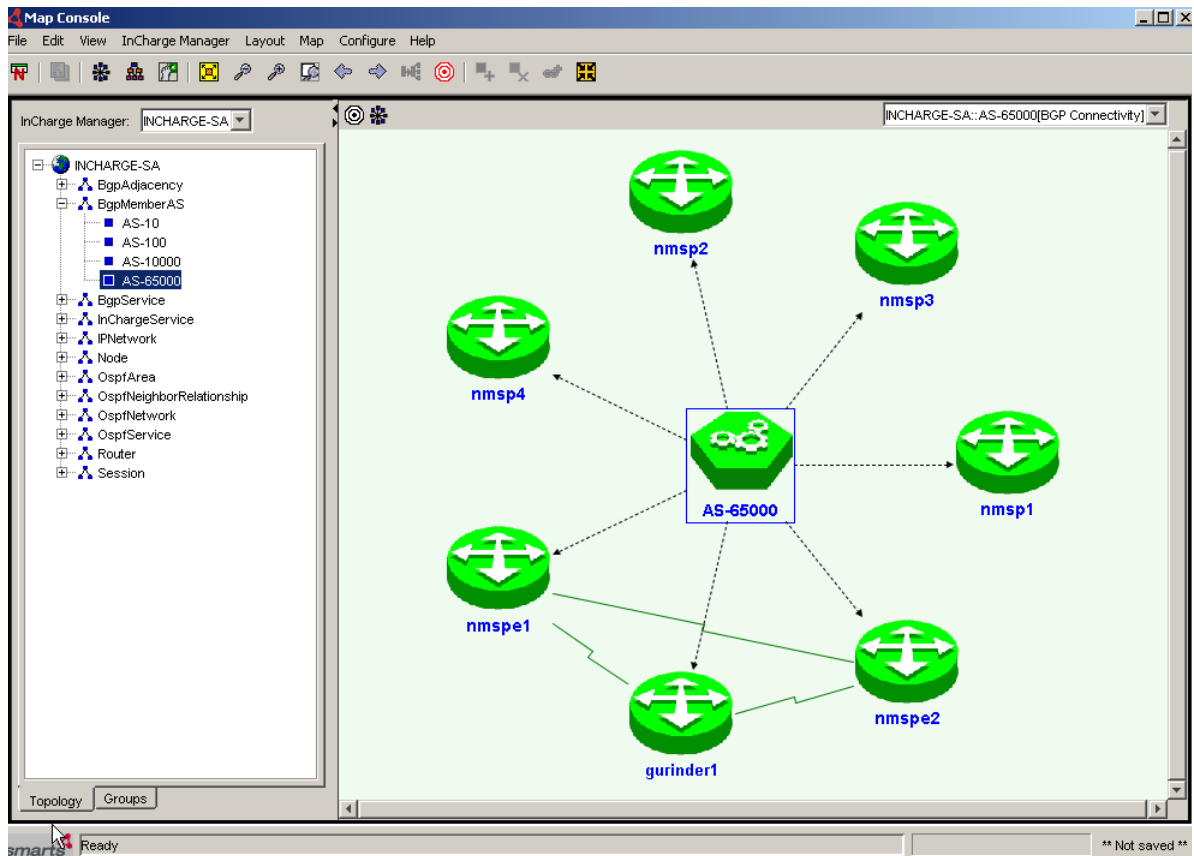


Figure 3: Autonomous System Map



## BGP Service Map

The BGP Services map (Figure 4) shows the hosting system, its Autonomous System, and the adjacent BGP systems.

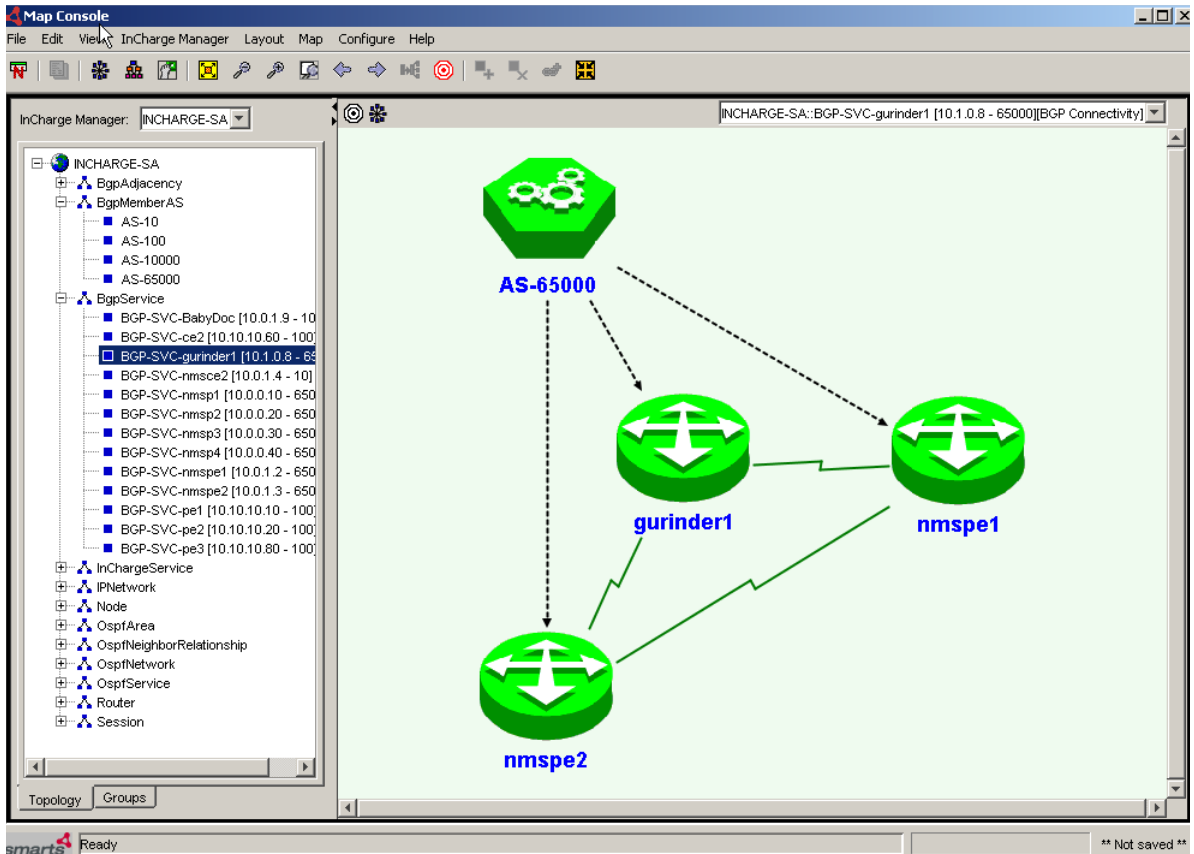


Figure 4: BGP Service Map

## OSPF Network Map

The OSPF network map (Figure 5) shows the selected OSPF network, along with the connected systems and OSPF Area. The solid lines represent the OSPF Neighboring Relationship.

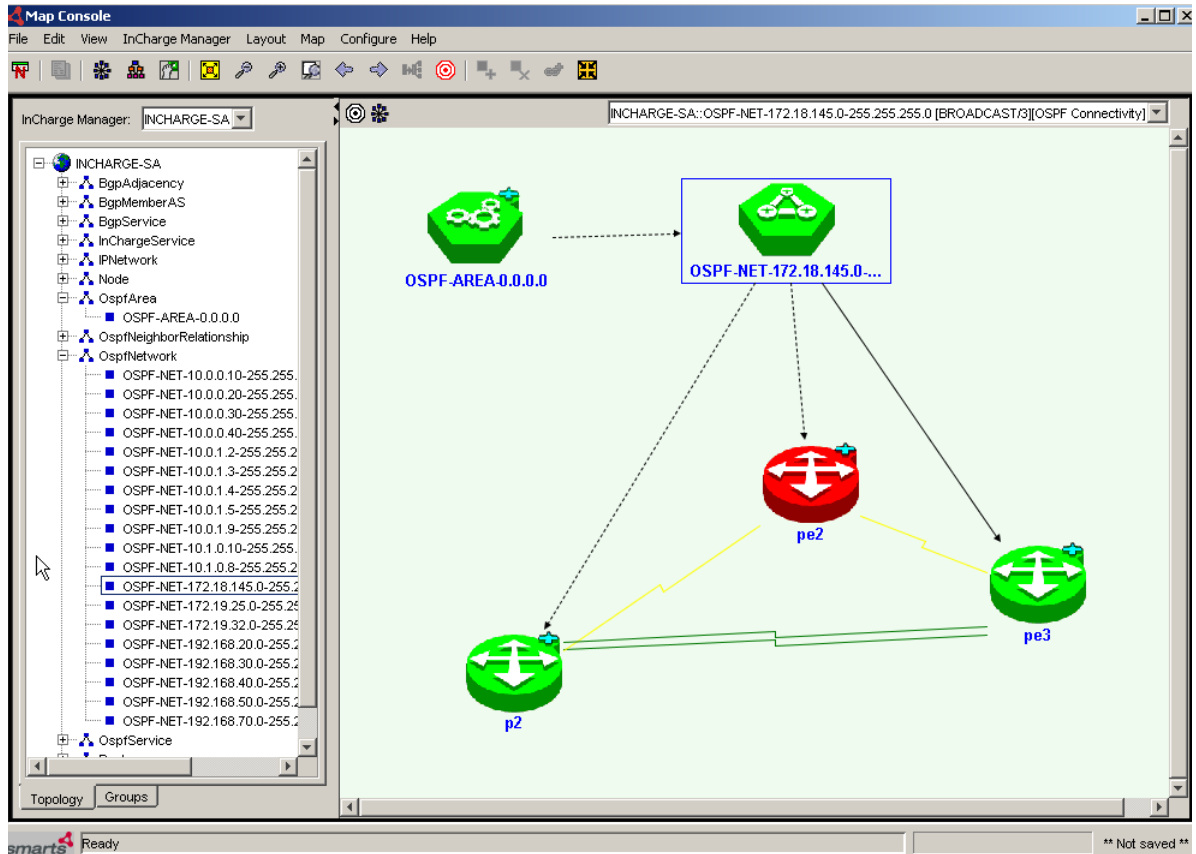


Figure 5: OSPF Network Map

## OSPF Service Map

The OSPF Service map (Figure 6) shows the selected device along with its neighboring devices, connected networks, and its OSPF area.

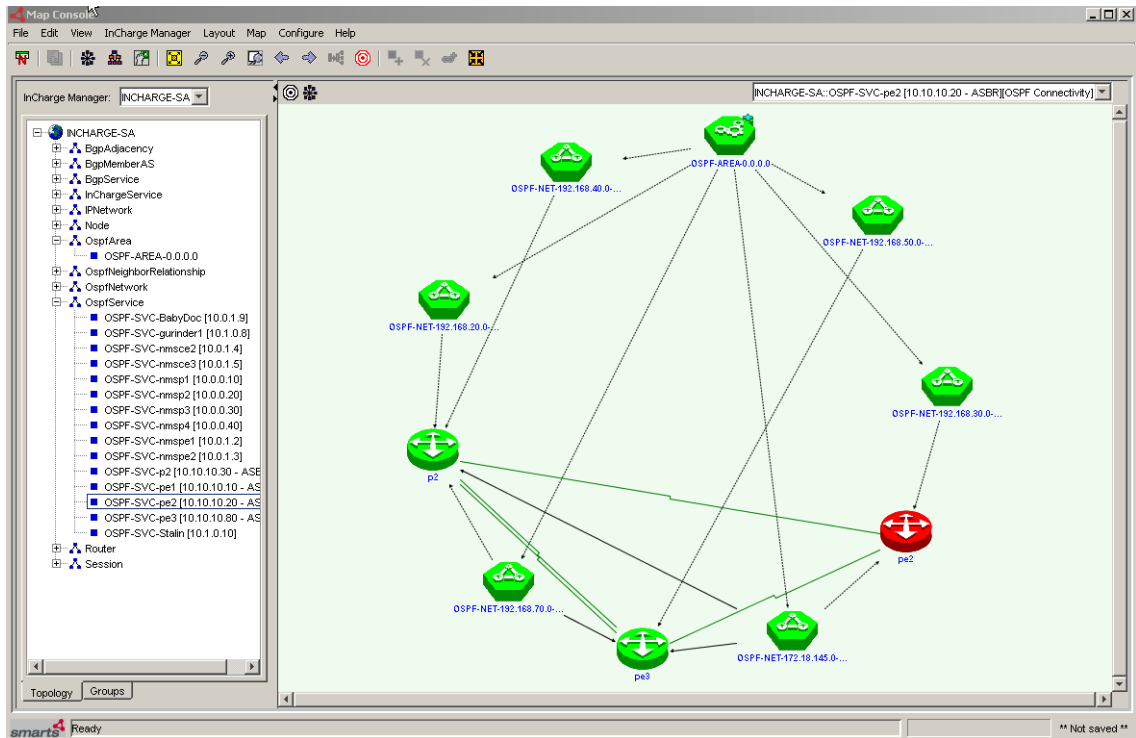


Figure 6: OSPF Service Map

## OSPF Area Map

The OSPF Area map (Figure 7) shows the member devices and networks. To display another perspective of the devices and OSPF connectivity, consider filtering out the OSPF area and OSPF network.

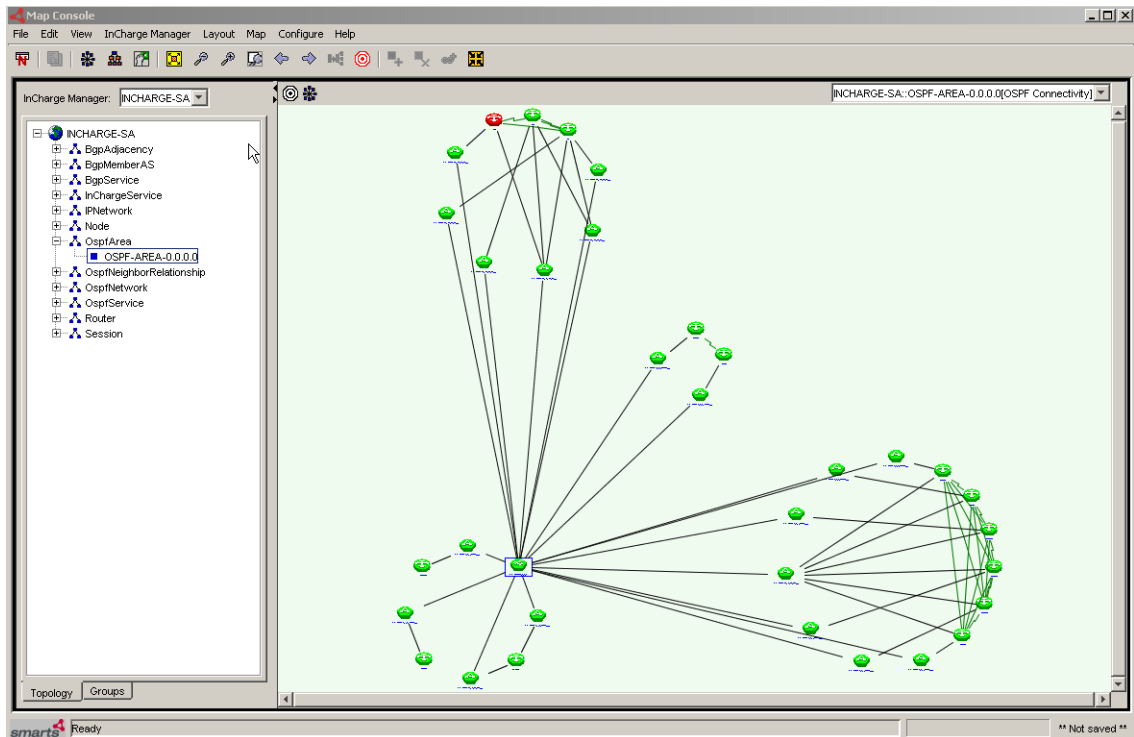


Figure 7: OSPF Area Map

## Notification Views

Once any console is opened, there are alternative methods for accessing notification information:

- Add a Notification Log view to any console.
- Check the Events tab of the Topology Browser for any available notifications.

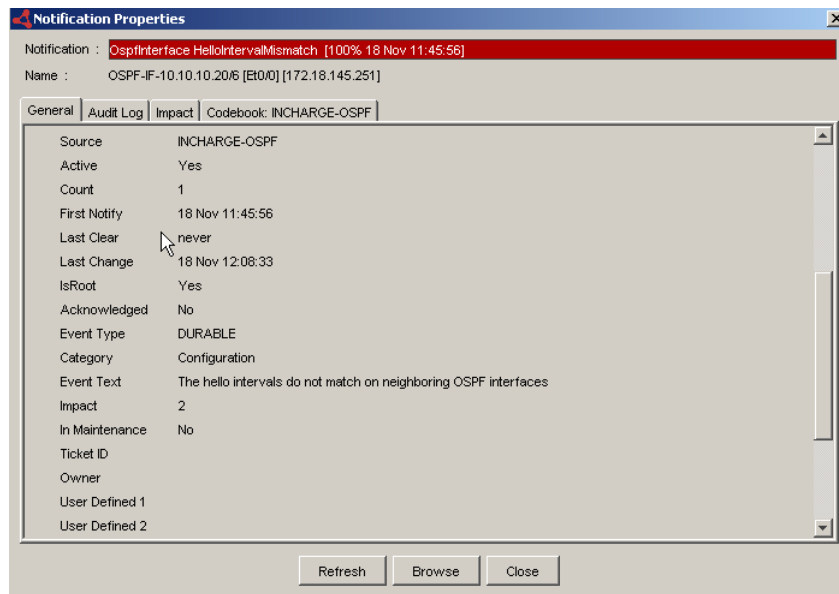
- Display notification properties by double-clicking an affected node in a map or on a selected notification.

## Notification Properties

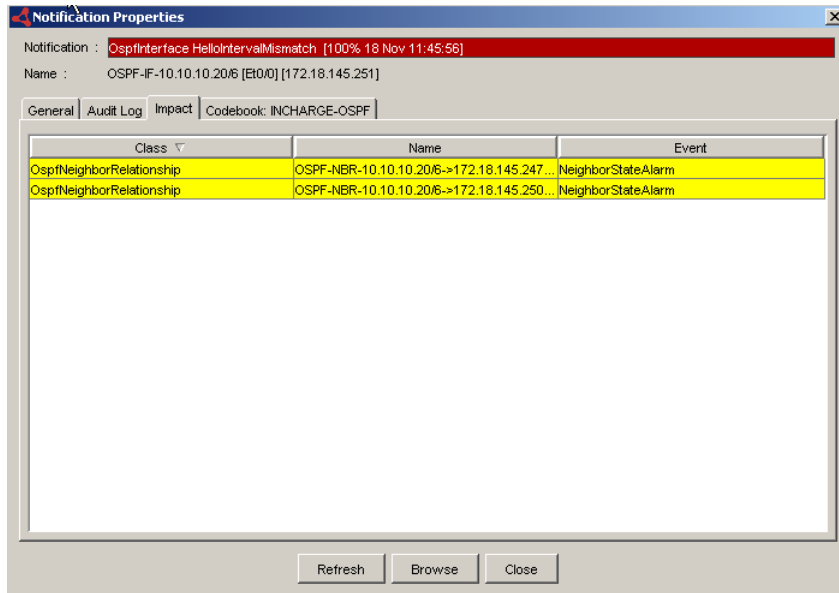
To obtain detailed information about individual notifications, you can open the Notification Properties dialog box. To do so:

- Double-click on a notification in the Notification Log view
- Select a notification and click the Properties toolbar button
- Select Event > Properties
- Right-click a selected notification and select the Properties option in the pop-up menu
- Double-click on a map icon if it is affected by active events. Or, right-click a selected map icon and select the Notification Properties option in the pop-up menu

The following figures (Figure 8 and Figure 9) provide examples of detailed mismatch information as displayed in the Notification Properties dialog.



**Figure 8:** Notification Properties, Mismatch



**Figure 9:** Notification Properties, Mismatch Impact

Note that the impact tab identifies the elements that are impacted by a failure. In the figure above, two OSPF neighbor relationships are impacted by the misconfiguration of the hello interval.

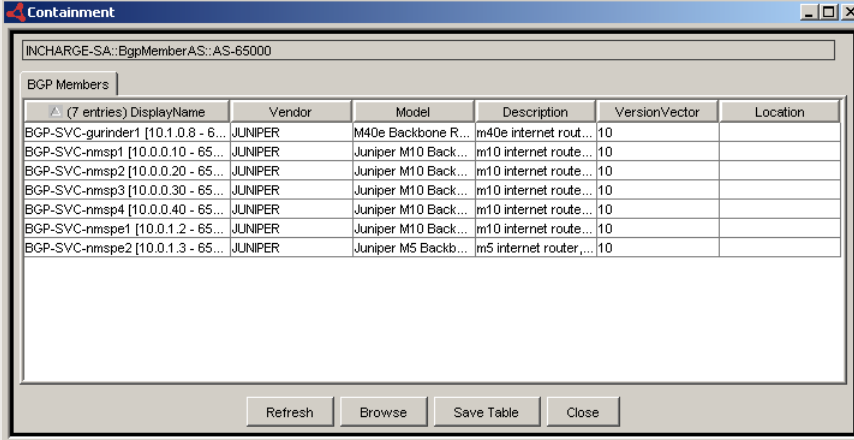
## Containment View

The Containment dialog box displays information about an element's containment in tabular format. It provides information and components for a selected element.

Several methods exist to display a Containment dialog box:

- From the map tree, select an instance in the map tree, right-click and select Containment in the pop-up menu.
- In a map, right-click on a node and select Containment in the pop-up menu.
- From Find Instance or Find System dialog boxes, click Containment.
- In the Event menu or the pop-up menu, right-click on a selected notification and select Containment in the menu.

The following figures (Figure 10, Figure 11, and Figure 12) provide examples of RPSM Containment views.



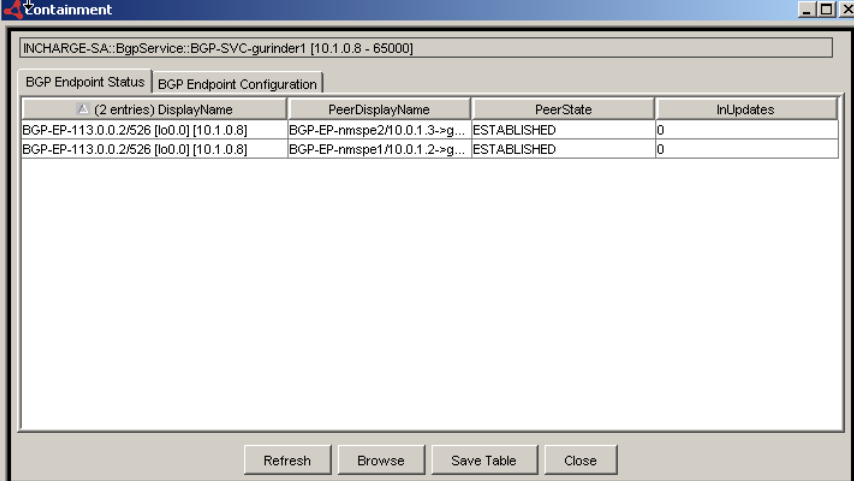
INCHARGE-SA::BgpMemberAS::AS-65000

BGP Members

(7 entries) DisplayName	Vendor	Model	Description	VersionVector	Location
BGP-SVC-gurinder1 [10.1.0.8 - 65...	JUNIPER	M40e Backbone R...	m40e internet rout...	10	
BGP-SVC-nmsp1 [10.0.0.10 - 65...	JUNIPER	Juniper M10 Back...	m10 internet route...	10	
BGP-SVC-nmsp2 [10.0.0.20 - 65...	JUNIPER	Juniper M10 Back...	m10 internet route...	10	
BGP-SVC-nmsp3 [10.0.0.30 - 65...	JUNIPER	Juniper M10 Back...	m10 internet route...	10	
BGP-SVC-nmsp4 [10.0.0.40 - 65...	JUNIPER	Juniper M10 Back...	m10 internet route...	10	
BGP-SVC-nmspe1 [10.0.1.2 - 65...	JUNIPER	Juniper M10 Back...	m10 internet route...	10	
BGP-SVC-nmspe2 [10.0.1.3 - 65...	JUNIPER	Juniper M5 Backb...	m5 internet router,...	10	

Refresh Browse Save Table Close

Figure 10: AS Containment View



INCHARGE-SA::BgpService::BGP-SVC-gurinder1 [10.1.0.8 - 65000]

BGP Endpoint Status BGP Endpoint Configuration

(2 entries) DisplayName	PeerDisplayName	PeerState	InUpdates
BGP-EP-113.0.0.2/526 [10.0.0] [10.1.0.8]	BGP-EP-nmspe2/10.0.1.3->g...	ESTABLISHED	0
BGP-EP-113.0.0.2/526 [10.0.0] [10.1.0.8]	BGP-EP-nmspe1/10.0.1.2->g...	ESTABLISHED	0

Refresh Browse Save Table Close

Figure 11: BGP Service Containment View

INCHARGE-SA::OsptService::OSPF-SVC-pe2 [10.10.10.20 - ASBR]

OSPF Areas | OSPF Endpoints | OSPF Interfaces

(5 entries) DisplayName	IfType	IfState	NeighborState	NeighborIpAddress	IfIndex
OSPF-EP-10.10.10.20/1 [AT3/0]	POINT_TO_POINT	POINT_TO_POINT	FULL	0.0.0.0	1
OSPF-EP-10.10.10.20/21 [Tu1] [trevor]	POINT_TO_POINT	POINT_TO_POINT	FULL	0.0.0.0	21
OSPF-EP-10.10.10.20/6 [Et0/0] [172.1...	BROADCAST	POINT_TO_POINT	FULL	172.18.145.247	0
OSPF-EP-10.10.10.20/6 [Et0/0] [172.1...	BROADCAST	POINT_TO_POINT	FULL	172.18.145.250	0
OSPF-EP-10.10.10.20/8 [Fa2/0] [192...	BROADCAST	POINT_TO_POINT	FULL	192.168.30.1	0

Refresh | Browse | Save Table | Close

**Figure 12: OSPF Service Containment View**





# MIBs Polled by RPSM

This appendix lists the MIBs polled by InCharge RPSM.

## BGP MIBs

The BGP solution uses the following MIBs:

- RFC 1269 (SNMP V1)
- RFC 1657/BGP4-MIB (SNMP V2)

Discovery walks the following OIDs and tables.

bgpIdentifier 1.3.6.1.2.1.15.4.0

bgpLocalAs 1.3.6.1.2.1.15.2.0

bgpVersion 1.3.6.1.2.1.15.1.0

bgpPeerTable 1.3.6.1.2.1.15.3

Polling polls the following tables columns in the bgpPeer table.

bgpPeerIdentifier 1.3.6.1.2.1.15.3.1.1

bgpPeerState 1.3.6.1.2.1.15.3.1.2

bgpPeerNegotiatedVersion 1.3.6.1.2.1.15.3.1.4

bgpPeerLocalAddr 1.3.6.1.2.1.15.3.1.5

bgpPeerLocalPort 1.3.6.1.2.1.15.3.1.6

bgpPeerRemotePort 1.3.6.1.2.1.15.3.1.8

bgpPeerRemoteAS 1.3.6.1.2.1.15.3.1.9

bgpPeerInUpdates 1.3.6.1.2.1.15.3.1.10

bgpPeerLastError 1.3.6.1.2.1.15.3.1.14

The BGP solution handles the following traps.

SNMP v1:

bgpEstablished 1.3.6.1.2.1.15 specificTrapID: 1

bgpBackwardTransition 1.3.6.1.2.1.15 specificTrapID: 2

SNMP v2:

bgpEstablished 1.3.6.1.2.1.15.7.1

bgpBackwardTransition 1.3.6.1.2.1.15.7.2

SNMP MIB support is required. SNMP traps are recommended, but not required, because the BGP solution polls for BGP Session status. If SNMP traps are not available, then the response time of the BGP solution will be limited to the polling interval, since immediate asynchronous notification of BGP symptoms is only available through SNMP traps.

## OSPF MIBs

The OSPF solution uses the following mibs:

- RFC 1253 (SNMP V1) or OSPF-MIB
- RFC 1850 OSPF-TRAP-MIB (SNMP V2).

Discovery walks the following OIDs and tables.

ospfRouterId 1.3.6.1.2.1.14.1.1.0

ospfAdminStat 1.3.6.1.2.1.14.1.2.0

ospfVersionNumber 1.3.6.1.2.1.14.1.3.0

ospfAreaBdrRtrStatus 1.3.6.1.2.1.14.1.4.0

ospfASBdrRtrStatus 1.3.6.1.2.1.14.1.5.0

ospfAreaTable 1.3.6.1.2.1.14.2

ospfflTable 1.3.6.1.2.1.13.7

---

ospfVirtIfTable 1.3.6.1.2.1.13.9  
ospfNbrTable 1.3.6.1.2.1.13.10  
ospfVirtNbrTable 1.3.6.1.2.1.13.11

Polling polls the following table columns.

In the ospfIfTable:

ospfIfAdminStat 1.3.6.1.2.1.14.7.1.5  
ospfIfState 1.3.6.1.2.1.14.7.1.12  
ospfIfDesignatedRouter 1.3.6.1.2.1.14.7.1.13  
ospfIfBackupDesignatedRouter 1.3.6.1.2.1.14.7.1.14  
IfEventCount 1.3.6.1.2.1.14.7.1.15

In the ospfVirtIfTable:

ospfVirtIfState 1.3.6.1.2.1.14.9.1.7  
IfEventCount 1.3.6.1.2.1.14.9.1.8

In the ospfNbrTable:

ospfNbrRtrId 1.3.6.1.2.1.14.10.1.3  
ospfNbrState 1.3.6.1.2.1.14.10.1.6  
NeighborEventCount 1.3.6.1.2.1.14.10.1.7  
RetransmitQueueLength 1.3.6.1.2.1.14.10.1.8

In the ospfVirtNbrTable:

ospfVirtNbrIpAddr 1.3.6.1.2.1.14.11.1.3  
ospfNbrState 1.3.6.1.2.1.14.11.1.5  
NeighborEventCount 1.3.6.1.2.1.14.11.1.6  
RetransmitQueueLength 1.3.6.1.2.1.14.11.1.7

The OSPF solution handles the following OSPF traps.

ospfVirtIfStateChange 1.3.6.1.2.1.14.16.2.1  
ospfNbrStateChange 1.3.6.1.2.1.14.16.2.2  
ospfVirtNbrStateChange 1.3.6.1.2.1.14.16.2.3  
ospfIfConfigError 1.3.6.1.2.1.14.16.2.4  
ospfVirtIfConfigError 1.3.6.1.2.1.14.16.2.5

ospflfAuthFailure 1.3.6.1.2.1.14.16.2.6

ospfVirtIfAuthFailure 1.3.6.1.2.1.14.16.2.7

ospflfStateChange 1.3.6.1.2.1.14.16.2.16

Cisco devices do not support the OSPF traps. In lieu of the SNMP traps, the OSPF solution will process the following Cisco Syslog messages:

- %OSPF-5-ADJCHG: This syslog message is sent when there is a neighbor relationship state change. This login is enabled via the "ospf log-adjacency-changes" command.
- Mismatch Authentication Key: This syslog message is sent when there is an authentication failure. It can be enabled via the command "debug ip ospf adj". Note that this will message will only be enabled at the debug level and that many other messages will be enabled. Enabling this debug message may therefore cause an unwanted increase in management traffic.

SNMP MIB support is required. SNMP traps or Cisco syslog messages are recommended, but not required, because the OSPF solution polls for OSFP interface and neighbor relationship status. If SNMP traps are not available, then the response time of the SNMP solution will be limited to the polling interval, since immediate asynchronous notification of SNMP symptoms is only available through SNMP traps. However, if neither OSPF traps nor Cisco OSPF adjacency debug syslog message are available, then MD5 authentication failures cannot be detected.

## BGP and OSPF

Both the BGP and OSPF solutions parse the Cisco configuration traps to indicate that a device may need to be rediscovered for updated OSPF or BGP configuration:

- ciscoConfigManEvent 1.3.6.1.4.1.9.9.43.2 specific Trap ID: 1
- ciscoConfigManEvent 1.3.6.1.4.1.9.9.43.2.0.1 (SNMP V2)

# B

## Deploying RPSM

This appendix outlines the basic steps to follow when deploying InCharge RPSM.

### Installation

The PSM installation file is a compressed tar file (zip and winzip compatible) that is ready to be unzipped, configured, and executed.

The installation file is a patch that is installed on top of an InCharge 6.0 installation. Hence, first install InCharge 6.0, and then install the patch.

To extract the patch, place the installation file in the directory containing the InCharge IP and SAM directories and unzip it. The files will be extracted directly into the installation tree.

### Configuration

Two of the RPSM files may need to be configured: LOCAL.import and ics.conf.

- The LOCAL.import files are located in the InCharge IP directories *local/conf/bgp* and *local/conf/ospf*. The files may be edited to override the default server names. At the bottom of the files you will notice references to INCHARGE-AM and INCHARGE-SA as objects. These server names may be customized to match your AM and SAM server names. If you are running multiple AM or SAM servers, add additional entries.

You can also set the receiving trap port number and syslog file name used to accept unsolicited messages. To specify the incoming trap port, use the TrapPort parameter. To specify the syslog file to be tailed, use the SyslogName variable.

- The ics.conf file is located in the SAM directory. The file needs to be augmented with domain definitions for the bgp and ospf servers. In the recommended example below, the minimum certainty was set to the same value as set for AM (or PM).

```
DomainType {
    ConfFile          = "dxa-bgp-ics.conf";
    MinimumCertainty = 0.24;
    SmoothingInterval = 0;
    Name              = "INCHARGE-BGP";
}
DomainType {
    ConfFile          = "dxa-ospf-ics.conf";
    MinimumCertainty = 0.24;
    SmoothingInterval = 0;
    Name              = "INCHARGE-OSPF";
}
```

## Starting the Servers

To start the bgp and ospf servers (when installed as services), use the sm\_service facility. (See the *InCharge System Administration Guide* for detailed information about the sm\_service facility.) The command to launch the bgp server is, for example:

```
% BASEDIR/smarts/bin/sm_service start INCHARGE-BGP
```

For the ospf server, you need to execute the command with the environmental variable SM\_SNMP\_ALWAYS\_ABLE\_TO\_POLL set to Y. An example of the service installation is as follows:

```
% BASEDIR/smarts/bin/sm_service install --startmode=manual
--env=SM_SNMP_ALWAYS_ABLE_TO_POLL=Y
INCHARGE-OSPF
/opt/smarts/InCharge6/IP/smarts/bin/sm_server
--config=ospf
--output
--daemon
```

If you invoke it from a shell script enter:

```
export SM_SNMP_ALWAYS_ABLE_TO_POLL=Y
/opt/smarts/InCharge6/IP/smarts/bin/sm_server
--config=ospf
--output
--daemon
```

For InCharge Service Assurance Manager, you need to load additional libraries (models). Use the following command to load the libraries:

```
sm_server --Name=INCHARGE-SA
--config ics -M sm_bgp_ext -M sm_ospf_ext
--daemon
--output
```

## Using RPSM

An enhanced version of the Global Console is provided with this patch. The enhanced version makes bgp and ospf maps available to you.

During installation, a new masterpiece.jar is installed in the SAM directory *local/classes*. This file can be copied to your InCharge 6.0 SAM Windows 2000 installation for use with the Global Console.

