SSE-F3548S/SSE-F3548SR

PIM

User's Guide

Revision 1.0

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03/2/2020	1.0	Initial document.

Contents

1 PIM Configuration

IP Multicast Overview

IP communication is of three types:
- Unicast: Host sends packets to a single host
- Broadcast: Host sends packets to all hosts
- Multicast: Host sends packets to a subset of hosts simultaneously

IP Multicast Routing enables efficient usage of network resources for bandwidth intensive services including video and audio. A multicast group is a set of receivers that want to receive a particular data stream. An IP *Multicast Group Address* in the range 224.0.0.0 to 239.0.0.0 is selected for receivers of a multicast group. Senders transmit IP data using the Multicast Group address as the destination address to multicast to all group members. Receivers interested in receiving data of a particular group must join the group by signaling a router/switch on their subnet. IGMP is used as the signaling protocol for conveying *group membership*. Network devices along the path from Source to Receivers forward data only on ports leading to the receivers, rather than flooding on all ports.

Membership in a multicast group is dynamic as hosts can join and leave at any time. There is no restriction on the location or number of members in a multicast group. A host can be a member of more than one multicast group at a time.

Supermicro switches can send and receive Multicast traffic by supporting the following Multicast features:

- **IGMP** at the access end of the network that processes hosts announcing their participation in a Multicast group(s).

- **Multicast Routing Protocol's (MRP's)** at the enterprise and core of the network for maintaining the senders/receivers database and forwarding data from Senders to Receivers.

Figure PIM-1: IP Multicast Routing
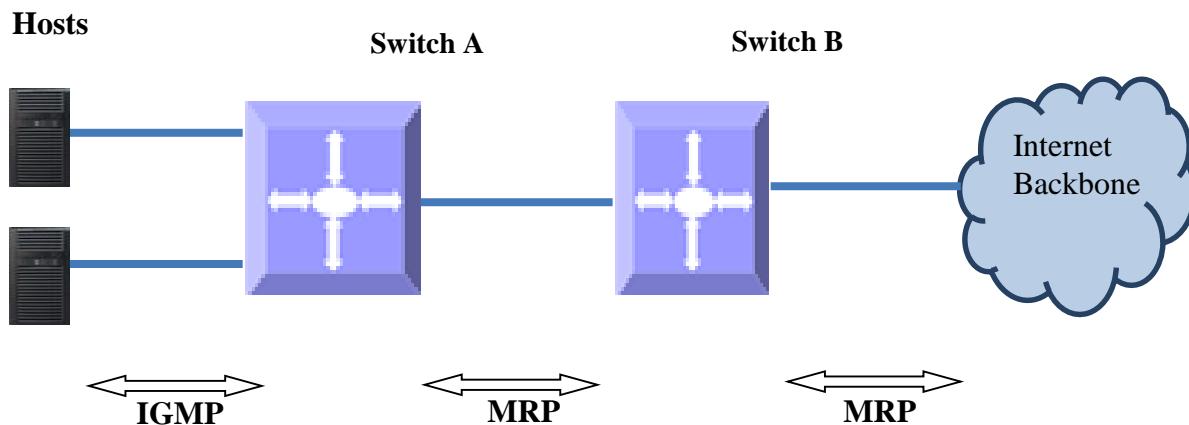
2 PIM

Protocol Independent Multicast (PIM) is a Multicast Routing Protocol (MRP) to maintain the Multicast distribution tree and forward Multicast data across the tree. PIM is protocol independent since it works with any unicast routing protocols like RIP, OSPF etc to get route information towards RP and Source. PIM *neighbors* are established by exchanging periodic Hello messages. A *Designated Router (DR)* is chosen in the subnet connected to the receivers and this is the *Last-hop DR.* A DR is chosen in the subnet connected to the Source, this is the *First-hop DR*.
The path from receivers to Source or RP is called *upstream.* The path from Source or RP towards receivers is called *downstream-*.
There are two modes of PIM: Sparse (PIM-SM) and Dense (PIM-DM).

2.1 PIM-SM Basics

PIM Sparse mode operates on basis that very few or sparse receivers intend to receive Multicast data from each source. In PIM-SM Multicast data is forwarded only on branches with at least one interested receiver.

Figure PIM-2: Multicast Forwarding with PIM-SM
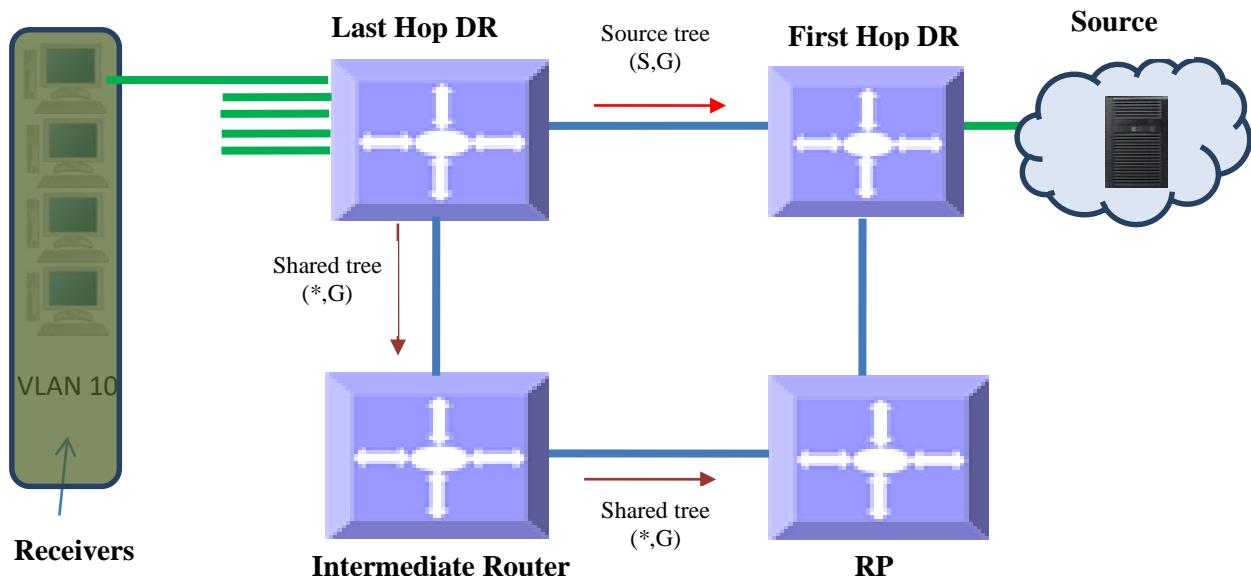
PIM-SM uses unicast routing protocol like OSPF, RIP etc to perform *reverse-path forwarding (RPF) check* to determine upstream neighbor to source and/or RP. RPF check helps to eliminate loops in Multicast tree formation wherein the forwarding decision for a received packet is done based on the source address in the packet rather than destination address – If router has a route entry to the source address in the packet i.e. upstream router, the packet is forwarded, as RPF check passes; otherwise packet is dropped as RPF check failure.

PIM Sparse mode builds a *shared tree or RPT* with a root called as *Rendezvous Point (RP)*. A *Candidate RP (CRP)* is configured for every group, then by using *Bootstrap router (BSR)* mechanism CRP is populated as a *RP-set* across the domain. After receiving RP set, every router performs a uniform hashing to elect one RP for every group, from the RP-set.

Receivers interested in particular Multicast group data from any source send a (*, G) join to upstream neighbor towards the router elected as RP for the particular group. The last-hop DR can choose to receive Multicast data directly from each source for that group, instead of from the RP. In this case, the last-hop DR sends (S, G) join to upstream towards source and this is called *Source-specific tree or Shortest Path Tree (SPT)*. PIM-SM is typically used in WAN environment.

2.2 PIM-DM Basics

PIM Dense mode operates on basis that almost all possible subnets have at least one interested receiver. Hence in PIM-DM Multicast data is flooded on all possible branches, and then pruned when branches do not want Multicast data from a particular Group and/or source. PIM-DM is typically used in LAN environment.

Figure PIM-3: Multicast Forwarding with PIM-DM
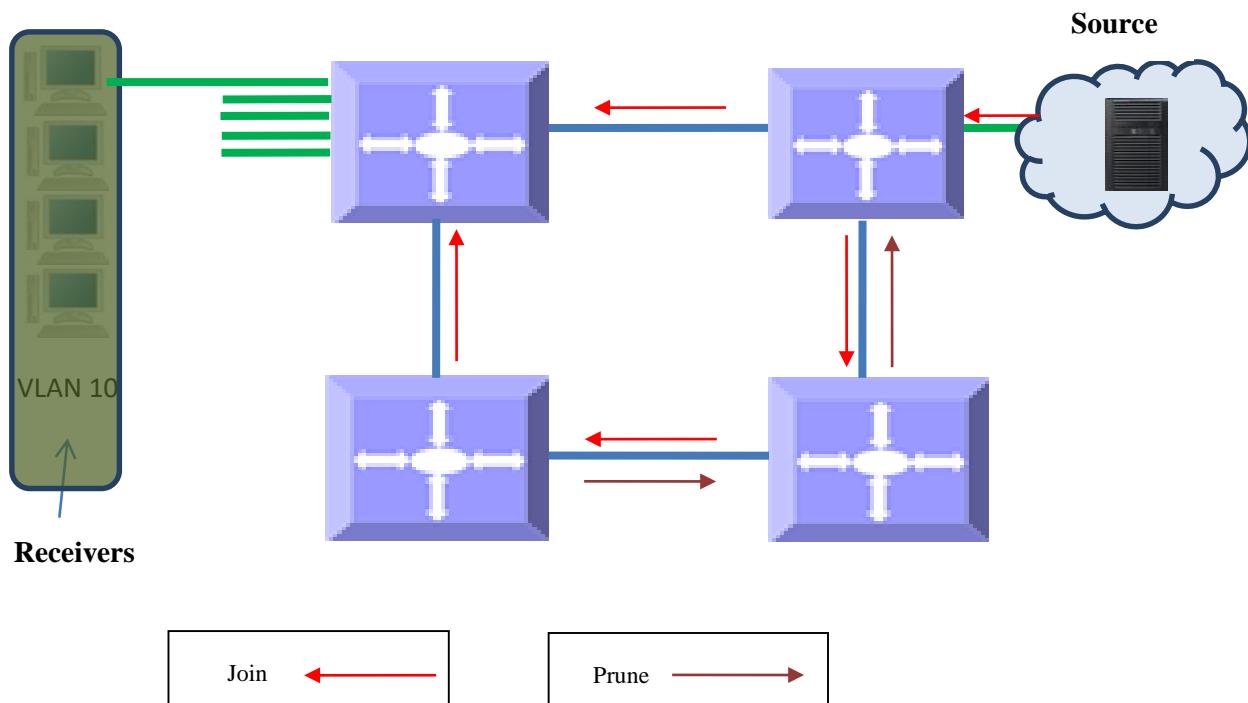
3 PIM Support

Supermicro switches support both PIM-SM and PIM-DM.
IP Multicast routing table can hold 2550 entries, which includes 255 Groups and 10 sources per group.

> PIM requires a unicast routing protocol such as RIP or OSPF to learn the routes to Source, CRP, and CBSR. PIM uses this information for RPF check.

4 PIM Defaults

Parameter	Default Value
PIM-SM global status	Disabled
Component Identifier	1
Static RP status	Disabled
PMBR status	Disabled
Shortest Path Tree (SPT) threshold	0 packets
RP threshold	0 packets
Shortest Path Tree (SPT) switchover period	0 seconds
RP switchover period	0 seconds
Register stop Rate limit period	5 seconds

PIM Component defaults

Parameter	Default Value
PIM Component Mode	Sparse
CRP hold time	70 seconds
CRP priority	192
Static RP	None

PIM interface defaults

Parameter	Default Value
Hello interval	30 seconds
DR priority	1
Override interval	0
LAN Prune Delay status	Enabled
LAN Prune Delay	0
Hello hold time	3.5 x Hello interval
CBSR preference	-1

5 Enabling PIM

PIM is disabled by default in Supermicro switches.
PIM needs to be enabled globally for IP Multicast operation. Follow the steps below to enable PIM.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim enable**	Enables PIM globally. PIM creates the default PIM Component Identifier 1, once PIM is enabled.
Step 3	**end**	Exits the configuration mode.
Step 4	**show ip pim component**	Displays the PIM information.
Step 5	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

> If PIM is enabled globally, all PIM components are also automatically PIM enabled. All PIM configuration and display commands operate only when PIM is enabled.

The example below shows the commands to enable PIM.
SMIS# **configure terminal**
SMIS(config)# **set ip pim enable**
SMIS(config)# **end**

SMIS# **show ip pim component**

PIM Component Information

Component-Id: 1
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

6 PIM Component and Interface

Supermicro switch provides multiple instances of PIM in a router. The PIM instances are referred as *PIM component*. Every component can be associated with one or more layer3 VLAN interface(s) and is identified by a *component Identifier*.

Follow the steps below to create PIM component(s).

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**ip pim component <ComponentId (1-255)>**	Creates the PIM component and enters the Component mode. The Component Identifier value can be any number from 1-255. Default is 1.
Step 3	**interface *<interface-type> <interface-id>*** or **interface range** *<interface-type> <interface-id>* ***....***	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **Int vlan range 1-10** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10, 20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 4	**ip pim componentId <value(1-255)>**	Configures Interface Component Identifier value. The Component Identifier value can be any number from 1-255. Default is 1.
Step 5	**end**	Exits the configuration mode.
Step 6	**show ip pim interface [{ Vlan <vlan-id>	<interface-type> <interface-id>	detail }]** **show ip pim component [ComponentId <1-255>]**	Displays the component information for the given interface.

| Step 7 | **write startup-config** | Optional step – saves this PIM configuration to be part of the startup configuration. |

Component can be created only if PIM is enabled. An interface can be associated with Component Identifier, only if Component Identifier has been created already.

The '**no ip pim component <ComponentId>**' command deletes the component and its associated details.

The example below shows the commands to configure PIM component.
SMIS# **configure terminal**
SMIS(config)# **ip pim component 50**
SMIS(pim-comp)# **end**

SMIS# **configure terminal**
SMIS(config)# **vlan 100**
SMIS(config-vlan)# **ports fx 0/22 untagged**
SMIS(config-vlan)# **end**

SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip address 100.100.100.1 255.0.0.0**
SMIS(config-if)# **ip pim componentId 50**
SMIS(config-if)# **end**

SMIS# **show ip pim component**

PIM Component Information

Component-Id: 1
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

Component-Id: 50
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

SMIS# **show ip pim interface detail**

vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled

PIM : Enabled
PIMv6 : Disabled
  PIM version : 2, mode: Sparse
  PIM DR : 100.100.100.1
  PIM DR Priority : 1
  PIM Neighbour Count : 0
  PIM Hello/Query Interval : 30
  PIM Message Interval : 60
  PIM Override Interval : 0
  PIM Lan Delay : 0
  PIM Lan-Prune-Delay : Disabled
  PIM Component Id : 50
  PIM domain border : disabled

7 PIM Mode

PIM operates in sparse mode by default in Supermicro switches. PIM mode can be changed at anytime per component. All routers in a PIM domain must have same PIM mode.
Follow the steps below to set PIM mode in components.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**ip pim component <ComponentId (1-255)>**	Enters the PIM component configuration mode. Component Identifier may be any value from 1 to 255. Default is 1.
Step 3	**set mode {sparse | dense}**	Configures Sparse or dense PIM mode for the component.
Step 4	**end**	Exits the configuration mode.
Step 5	show ip pim component [ComponentId <1-255>]	Displays the PIM mode for the given component.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure PIM mode.
SMIS# **configure terminal**
SMIS(config)# **ip pim component 50**
SMIS(pim-comp)# **set mode dense**
SMIS(pim-comp)# **end**

SMIS# **show ip pim component**

PIM Component Information

Component-Id: 1
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

Component-Id: 50
  PIM Mode: dense,   PIM Version: 2
  Graft Retry Count: 1

8 PIM neighbor

PIM routers exchange periodic Hello message with directly connected routers. These directly connected routers are the PIM neighbors. PIM Hello message contains different configurable options.

8.1 DR Priority

DR priority is used to determine the *Designated Router* in the subnet. The *Designated Router* in the subnet is the router with highest DR priority. As a last-hop router, the DR is responsible for forwarding joins to upstream. As a first-hop router, the DR is responsible for forwarding data to downstream. The default DR priority is 1.
Supermicro switches provide flexibility for user to configure DR priority for individual interfaces. User can configure different DR priority on different interfaces.
Follow the steps below to change Hello interval on any interface.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface <*interface-type*> <*interface-id*>** or **interface range** <*interface-type*> <*interface-id*> **….**	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20**

		OR **interface range vlan 1,5,10**
		To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10, 20**
		If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 3	**ip pim dr-priority <priority(1-65535)>**	Configures PIM DR priority value. The DR priority value can be any number from 1-65535. Default is 1.
Step 4	**end**	Exits the configuration mode.
Step 5	**show ip pim interface [{ Vlan <vlan-id>	<interface-type> <interface-id>	detail }]**	Displays the DR priority information for the given interface.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

> The '**no ip pim dr-priority**' command resets the DR priority to its default value of 1.

The example below shows the commands to configure PIM DR priority.
Configure PIM DR priority for layer3 VLAN 100
SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip pim dr-priority 500**
SMIS(config-if)# **end**

SMIS# **show ip pim interface detail**
vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
   PIM version : 2, mode: Sparse
   PIM DR : 100.100.100.1
   PIM DR Priority : 500
   PIM Neighbour Count : 0
   PIM Hello/Query Interval : 30
   PIM Message Interval : 60

PIM Override Interval : 0
PIM Lan Delay : 0
PIM Lan-Prune-Delay : Disabled
PIM Component Id : 50
PIM domain border : disabled

8.2 Hello interval

PIM router sends Hello messages periodically to all its neighbors to maintain information about directly connected upstream router(s) towards Source(s) or RP(s) and downstream routers towards receivers. This periodic time interval is called the *Hello interval*.
The default Hello interval is 30 seconds.
Supermicro switches provide flexibility for user to configure Hello interval for individual interfaces. User can configure different Hello interval on different interfaces.
Follow the steps below to change Hello interval on any interface.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface *<interface-type> <interface-id>*** or **interface range** *<interface-type> <interface-id>* **....**	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10, 20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 3	**ip pim query-interval <Interval (0-65535)secs**	Configures PIM Hello interval value.

		The Hello interval value can be any number from 0-65535. Default is 30seconds.
Step 4	**end**	Exits the configuration mode.
Step 5	**show ip pim interface [{ Vlan <vlan-id> | <interface-type> <interface-id> | detail }]**	Displays the Hello interval information for the given interface.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The '**no ip pim query-interval** ' command resets the query interval to its default value of 30.

The example below shows the commands to configure PIM query-interval.
Configure PIM query-interval for layer3 VLAN 100
SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip pim query-interval 75**
SMIS(config-if)# **end**

SMIS# **show ip pim interface detail**

vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
   PIM version : 2, mode: Sparse
   PIM DR : 100.100.100.1
   PIM DR Priority : 1
   PIM Neighbour Count : 0
   PIM Hello/Query Interval : 75
   PIM Message Interval : 60
   PIM Override Interval : 0
   PIM Lan Delay : 0
   PIM Lan-Prune-Delay : Disabled
   PIM Component Id : 50
   PIM domain border : disabled

8.3 Hold time

Hold time is the neighbor timeout set for every neighbor on a PIM interface. If a PIM hello message is not received from a neighbor router for the period of the Hold time, then the neighbor will be deleted from the list of neighbors. Hold time value is sent as an option in the PIM hello message to neighbors.

The default Hold time is 3.5 x Hello Interval (i.e. 3.5 * 30 = 105 seconds).
The show command in example shows PIM Hello hold time.
SMIS# show ip pim interface detail
vlan100 146 is up
 Internet Address is 10.1.2.2
 Muticast Switching : Enabled
 PIM : Enabled
 PIMv6 : Disabled
 PIM version : 2, mode: Sparse
 PIM DR : 10.1.2.2
 PIM DR Priority : 1
 PIM Neighbour Count : 1
 PIM Hello/Query Interval : 30
 Hello-Holdtime : 105
 PIM Message Interval : 60
 PIM Override Interval : 0
 PIM Lan Delay : 0
 PIM Lan-Prune-Delay : Disabled
 PIM Component Id : 1
 PIM domain border : disabled

9 Multicast Routing Table

The Multicast routing table contains information about active Multicast trees. This table lists both forwarding and non-forwarding entries i.e. Multicast entries which have data flowing and entries which do not have data flow.
Every entry in the Multicast routing table has one Incoming Interface (IIF) and one or more Outgoing Interfaces (OIF's). The entry can be (*.G) or (S,G). (*,G) entries have W and R bit set, while (S,G) entries have Shortest Path Tree (SPT) bit set. The RP and RPF neighbor are also listed.

> The route to BSR, RP and Source must be reachable via any unicast protocol. Otherwise Multicast routing table is not formed due to RPF check failure.

Below example shows the PIM Multicast routing table display output.
SMIS# **show ip pim mroute**

IP Multicast Routing Table

Route Flags S: SPT Bit W: Wild Card Bit R: RPT Bit
Timers: Uptime/Expires
Interface State: Interface, State/Mode

PIM Multicast Routing Table For Component 50
(*, 225.1.1.1) ,00:00:02/--- ,RP : 100.100.100.1
  Incoming Interface : vlan100 ,RPF nbr : NULL ,Route Flags : WR
  Outgoing InterfaceList :
    vlan100, Forwarding/Sparse ,00:00:02/---

10 PMBR

PIM multicast border routers (PMBR) is the border between two or more PIM domains running different MRP's like PIM-SM, PIM-DM or DVMRP. PMBRs connect each PIM domain to the rest of the Internet. The PMBR forwards multicast packets across different domains, hence receivers in one domain receive packets from sources in another domain. In a PMBR, different interfaces can be configured as DVMRP, PIM-SM or PIM-DM interfaces.

PMBR is disabled by default in Supermicro switches.

Follow the steps below to enable PMBR.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim pmbr enable**	Enables or disables PMBR.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The **'set ip pim pmbr disable'** command disables PMBR functionality.

The example below shows the commands to configure PIM PMBR.
SMIS# **configure terminal**
SMIS(config)# **set ip pim pmbr enable**
SMIS(config)# **end**

SMIS# **show ip pim interface detail**

vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
   PIM version : 2, mode: Sparse
   PIM DR : 100.100.100.1
   PIM DR Priority : 1
   PIM Neighbour Count : 0
   PIM Hello/Query Interval : 30
   PIM Message Interval : 60
   PIM Override Interval : 0
   PIM Lan Delay : 0
   PIM Lan-Prune-Delay : Disabled
   PIM Component Id : 50
   PIM domain border : enabled

11 Disabling PIM

PIM is disabled by default in Supermicro switches.
After enabling PIM, if user needs to disable it, it has to be disabled globally.
Follow the steps below to disable PIM.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim disable**	Disables PIM globally.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands used to disable PIM.
SMIS# **configure terminal**
SMIS(config)# **set ip pim disable**
SMIS(config)# **end**

12 PIM-SM Specific Configuration

This section covers Supermicro switch commands that are applicable only in PIM-SM mode.

12.1   PIM Join/Prune

12.1.1   Join-Prune Interval

PIM router sends Join messages periodically to upstream router towards RP or Source to keep the Multicast tree active. Periodic Prune messages are sent when existing receivers do not want Multicast data. This periodic time interval for sending Join/Prune is called the *Join-Prune interval*.
The default Join-Prune interval is 60 seconds.
Supermicro switches provide flexibility for user to configure Join-Prune interval for individual interfaces. User can configure different Join-Prune interval on different interfaces.
Follow the steps below to change Join-Prune interval on any interface.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface <*interface-type*> <*interface-id*>** or **interface range** <*interface-type*> <*interface-id*> **….**	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10, 20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.

Step 3	**ip pim message-interval <Interval(1-65535)>**	Configures PIM Join prune interval value. The Join prune interval value can be any number from 1-65535. Default is 60.
Step 4	**end**	Exits the configuration mode.
Step 5	**show ip pim interface [{ Vlan <vlan-id> | <interface-type> <interface-id> | detail }]**	Displays the Join prune interval information for the given interface.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The '**no ip pim message-interval**' command resets the Join-prune interval to its default value of 60.

The example below shows the commands to configure PIM Join-Prune interval.
Configure PIM Join-Prune interval for layer3 VLAN 100

SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip pim message-interval 300**
SMIS(config-if)# **end**

SMIS# **show ip pim interface detail**

vlan100 504 is up
 Internet Address is 100.100.100.1
 Muticast Switching : Enabled
 PIM : Enabled
 PIMv6 : Disabled
  PIM version : 2, mode: Sparse
  PIM DR : 100.100.100.1
  PIM DR Priority : 1
  PIM Neighbour Count : 0
  PIM Hello/Query Interval : 30
  PIM Message Interval : 300
  PIM Override Interval : 0
  PIM Lan Delay : 0
  PIM Lan-Prune-Delay : Disabled
  PIM Component Id : 50
  PIM domain border : disabled

12.1.2   LAN Prune delay

LAN Prune Delay option is used in Multi-Access network to delay processing of prune messages received at upstream routers. This ensures in a multi-access LAN there is no flapping of Multicast data due to Join by some routers and prune by some other routers.

When an upstream router in a multi-access LAN receives prune message from a downstream router, it does not prune the tree immediately, instead maintains the tree for the LAN prune delay interval. The tree is maintained only if a '*Join override*' message is received from another downstream router in the multi-access LAN. Otherwise the tree is pruned after 'LAN Prune Delay interval'.

The default 'LAN delay' flag is 'Disabled' state. Default value of LAN prune delay is 0 seconds. Supermicro switches provide flexibility for user to configure LAN Prune Delay for individual interfaces. User can configure different LAN Prune Delay on different interfaces.

Follow the steps below to change LAN Prune Delay on any interface.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface *<interface-type> <interface-id>*** or **interface range** *<interface-type> <interface-id> ….*	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10,20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 3	**set ip pim lan-prune-delay { enable | disable }**	Configures LAN prune delay value. LAN prune-delay is disabled by default.

	ip pim lan-delay <value(0-65535)>	The LAN prune delay value can be any number from 0-65535. Default is 0.
Step 4	**end**	Exits the configuration mode.
Step 5	**show ip pim interface [{ Vlan <vlan-id>	<interface-type> <interface-id>	detail }]**	Displays the LAN prune delay information for the given interface.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The '**no ip pim lan-delay**' command resets the LAN delay to its default value of 0.

The example below shows the commands to configure PIM LAN delay.
Configure PIM LAN delay for layer3 VLAN 100
SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **set ip pim lan-prune-delay enable**
SMIS(config-if)# **ip pim lan-delay 200**
SMIS(config-if)#**end**

SMIS# **show ip pim interface detail**

vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
   PIM version : 2, mode: Sparse
   PIM DR : 100.100.100.1
   PIM DR Priority : 1
   PIM Neighbour Count : 0
   PIM Hello/Query Interval : 30
   PIM Message Interval : 60
   PIM Override Interval : 0
   PIM Lan Delay : 200
   PIM Lan-Prune-Delay : Enabled
   PIM Component Id : 50
   PIM domain border : disabled

12.1.3   Override Interval
The Join/prune override interval is used in a Multi-Access network by downstream routers. The downstream router in a multi-access LAN waits for a period of *override interval* after sending a prune message, to send a second Prune message if it still continues to receive data due to other routers in

multi-access LAN that still want to receive Multicast data.
Override interval ensures in a multi-access LAN, Multicast data is forwarded only if there is at least one router with receivers interested in a particular group and so data is not flooded unnecessarily in the multi-access LAN.
The default Override interval is 0 seconds.
Supermicro switches provide flexibility for user to configure Join/prune override interval for individual interfaces. User can configure different Join/prune override interval on different interfaces.
Follow the steps below to configure Override interval.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface <*interface-type*> <*interface-id*>** or **interface range** <*interface-type*> <*interface-id*> ….	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10,20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 3	**ip pim override-interval <interval(0-65535)>**	Configures PIM override interval value. The override interval value can be any number from 0-65535. Default is 0.
Step 4	**end**	Exits the configuration mode.

Step 5	**show ip pim interface [{ Vlan <vlan-id> | <interface-type> <interface-id> | detail }]**	Displays the override interval information for the given interface.
Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

i   The '**no ip pim override-interval**' command resets the override interval to its default value of 0.

The example below shows the commands to configure PIM override interval.
Configure PIM override interval for layer3 VLAN 100
SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip pim override-interval 500**
SMIS(config-if)# **end**

SMIS# **show ip pim interface detail**

vlan100 504 is up
  Internet Address is 100.100.100.1
  Muticast Switching : Enabled
 PIM : Enabled
 PIMv6 : Disabled
  PIM version : 2, mode: Sparse
  PIM DR : 100.100.100.1
  PIM DR Priority : 1
  PIM Neighbour Count : 0
  PIM Hello/Query Interval : 30
  PIM Message Interval : 60
  PIM Override Interval : 500
  PIM Lan Delay : 0
  PIM Lan-Prune-Delay : Disabled
  PIM Component Id : 50
  PIM domain border : disabled

12.2   Shared Tree (RPT)

An RP is used as the central information exchange point in PIM domain as it reduces the amount of state in non-RP routers. No network flooding is required to provide non-RP routers information about active sources. All routers in a PIM domain must have same RP information for a particular group.

RP's in a PIM domain can be learnt by Bootstrap Router (BSR) mechanism or Static RP.

12.2.1 Bootstrap Router (BSR)

BSR distributes PIM RP information for all groups within the domain. Each PIM domain can have only 1 elected BSR. Several routers are configured as candidate BSRs, the BSR is elected as the router with highest preference. The elected RP's send their information to the BSR and BSR maintains RP-to-group mapping as the RP-set.

Supermicro switches provide flexibility for user to configure BSR for individual interface.

Follow the steps below to configure Bootstrap router (BSR)

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**interface <interface-type> <interface-id>** **or** **interface range <interface-type> <interface-id> ….**	Enters the interface configuration mode. *interface-type* – may be any of the following: vlan *interface-id* is the VLAN identifier for VLAN interfaces. To configure multiple interfaces, use the "**interface range** …" command. To provide a range use a hypen (-) between the start and end interface numbers. E.g.: **interface range vlan 10-20** To provide multiple interfaces or ranges, use separate with a comma (,). E.g.: **int range vlan 1-10,20** If multiple interfaces are provided, the next step will perform the particular PIM configuration on all these interfaces.
Step 3	**ip pim bsr-candidate <value (0-255)>**	Configures PIM BSR candidate. The BSR candidate preference value can be any number from -1 to 255. Default is -1.
Step 4	**end**	Exits the configuration mode.
Step 5	**show ip pim bsr** **[Component-Id (1-255)]**	Displays the BSR candidate information for the given interface.

Step 6	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

> ⓘ The '**no ip pim bsr-candidate**' command deletes the BSR information of the particular interface.

The example below shows the commands to configure PIM Candidate BSR.
Configure PIM Candidate BSR for layer3 VLAN 100
SMIS# **configure terminal**
SMIS(config)# **interface vlan 100**
SMIS(config-if)# **ip pim bsr-candidate 155**
SMIS(config-if)# **end**

SMIS# **show ip pim bsr**

PIMv2 Bootstrap Configuration For Component 1

Elected BSR for Component 1
  BSR Address : 0.0.0.0
  BSR Priority : 0, Hash Mask Length : 30

This system is the PIMv4 Bootstrap Router (BSR)
  BSR Address : 100.100.100.1
  BSR Priority : 155, Hash Mask Length : 30

12.2.2   Candidate RP (CRP)

The RP is the central convergence point of sources and receivers. In a PIM spars e domain, there are multiple Candidate-RP's but only one elected RP per group. The elected RP is the candidate RP with highest IP address. The elected RP's send their information to the BSR and BSR maintains RP-to-group mapping as the RP-set.
Supermicro switches provide flexibility for user to configure CRP for individual components. User can configure different CRP on different component.
Follow the steps below to configure Candidate RP (CRP).

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**ip pim component <ComponentId (1-255)>**	Enters the PIM component configuration mode. Component Identifier may be any value from 1 to 255. Default is 1.
Step 3	**rp-candidate rp-address <Group Address> <Group Mask> <IP address>**	Configures Candidate RP value.

		Group Address/Group Mask: This combination can specify any IP Multicast address from 224.0.0.0 to 239.255.255.255.
		IP Address should be any interface IP address of the component.
Step 4	**rp-candidate holdtime <Holdtime value (0-255)>**	Optional. Configures Candidate RP Hold time value. The hold time value can be any number from 0-255. Default is 70 seconds.
Step 5	**end**	Exits the configuration mode.
Step 6	**show ip pim rp-candidate [ComponentId <1-255>]**	Displays the Candidate RP information for the given interface.
Step 7	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The '**no ip pim rp-candidate**' command deletes the candidate RP information of the particular PIM component.

The example below shows the commands to configure PIM Candidate RP.
Configure PIM Candidate RP for PIM component 50
SMIS# **configure terminal**
SMIS(config)# **ip pim component 50**
SMIS(pim-comp)# **rp-candidate holdtime 180**
SMIS(pim-comp)# **rp-candidate rp-address 228.0.0.0 255.0.0.0 100.100.100.1**
SMIS(pim-comp)# **end**

SMIS# **show ip pim rp-candidate**

```
CompId   GroupAddress   Group Mask    RPAddress/Priority
------   ------------   ----------    ---------- -------
  50        228.0.0.0     255.0.0.0     100.100.100.1/192
```

12.2.3   Static RP

An RP for a group range can be configured statically on a router, instead of using BSR mechanism. However using this mechanism requires configuring static RP on all routers in the PIM domain. This configuration can be useful to specify a backup RP for a particular group.
Supermicro switches provide flexibility for user to configure Static RP for individual components. User

can configure different Static RP on different component.
Follow the steps below to configure Static RP.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**ip pim component <ComponentId (1-255)>**	Enters the PIM component configuration mode. Component Identifier may be any value from 1 to 255. Default is 1.
Step 3	set ip pim static-rp enable	Static RP is disabled by default. Use the 'enable' form of this command to enable Static RP.
Step 4	rp-static rp-address <Group Address> <Group Mask> <IP address>	Configures static RP value. *Group Address/Group Mask*: This combination can specify any IP Multicast address from 224.0.0.0 to 239.255.255.255. *IP Address* should be any interface IP address of the component.
Step 5	**end**	Exits the configuration mode.
Step 6	show ip pim rp-static [ComponentId <1-255>]	Displays the static RP information for the given interface.
Step 7	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The '**no ip pim rp-static**' command deletes the static RP information of the particular component.

The example below shows the commands to configure PIM Static RP.
Configure PIM Static RP for PIM component 50
SMIS(config)# **set ip pim static-rp enable**
SMIS# **configure terminal**
SMIS(config)# **ip pim component 50**
SMIS(pim-comp)# **rp-static rp-address 230.0.0.0 255.0.0.0 100.100.100.1**
SMIS(pim-comp)# **end**

SMIS# **show ip pim rp-static**

Static-RP Enabled

CompId   GroupAddress   Group Mask   RPAddress

```
  ------        ------------      ----------      ---------
    50          230.0.0.0         255.0.0.0       100.100.100.1
```

12.2.4   Register- Stop Rate-limit

When first-hop DR receives multicast packet, it encapsulates it in a Register message and unicasts it to the RP for that group. The RP de-encapsulates each Register message and forwards the extracted data packet to downstream members on the RPT. If there are no receivers on RP, it then sends Register stop to First-hop DR as long as there are no receivers. Register-Stop rate limit is used at RP to limit the number of register-stop messages sent per second to the First-hop DR.

The default Register-stop rate limit is 0.

Follow the steps below to configure Register-Stop Rate limit.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim regstop-ratelimit-period <0-2147483647(in secs)>**	Sets the Register-Stop rate limit for Group and Source. The Register-Stop rate limit interval can be any number from 0 – 2147483647 seconds. Default is 0 seconds.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure PIM Register rate limit.

SMIS# **configure terminal**
SMIS(config)# **set ip pim regstop-ratelimit-period 100**
SMIS(config)# **end**

SMIS# **show ip pim thresholds**

PIM SPT Threshold Information

 Group Threshold : 0
 Source Threshold : 0
 Switching Period : 0

PIM SPT-RP Threshold Information

 Register Threshold   : 0
 RP Switching Period   : 0
 Register Stop rate limit : 100

12.3 Shortest Path Tree (SPT)

12.3.1 SPT at RP

When first-hop DR receives multicast packet, it encapsulates it in a Register message and unicasts it to the RP for that group. The RP de-encapsulates each Register message and forwards the extracted data packet to downstream members on the RPT.

The RP then sends an (S, G) Join to the first-hop DR to build the *Source-tree or Shortest Path Tree (SPT)* back to the source. This mechanism of RP building a SPT is called *SPT switchover at RP*.

Typically, the SPT switchover occurs when a data-rate threshold is reached which is configurable in Supermicro switches using:

- RP switch period
- RP threshold

RP switch period

RP switch period is used together with RP threshold to specify the time when the RP can switch over to Shortest Path Tree (SPT). Multicast data packet count is checked every RP-switch-period' interval and if the count exceeds RP threshold, the RP switches from RP tree to Shortest Path Tree (SPT).

RP switch period is disabled by default in Supermicro switches i.e. RP's switch to SPT immediately upon receipt of Multicast data packet.

Follow the steps below to configure RP switch period.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim rp-switchperiod <0-2147483647(in secs)>**	Sets the RP switch period at RP. The RP switch period can be any number from 0 – 2147483647 seconds. Default is 0 seconds.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure PIM RP switch period.

SMIS# **configure terminal**
SMIS(config)# **set ip pim rp-switchperiod 300**
SMIS(config)# **end**

SMIS# **show ip pim thresholds**

PIM SPT Threshold Information

 Group Threshold : 0
 Source Threshold : 0
 Switching Period : 0

PIM SPT-RP Threshold Information

  Register Threshold   : 0
  RP Switching Period   : 300
  Register Stop rate limit : 5

   RP threshold
RP threshold is used together with RP switch period to specify the time when the RP can switch over to Shortest Path Tree (SPT). Multicast data packet count is checked every RP-switch-period' interval and if the count exceeds RP threshold, the RP switches from RP tree to Shortest Path Tree (SPT).
RP threshold is disabled by default in Supermicro switches i.e. RP's switch to SPT immediately upon receipt of Multicast data packet.
Follow the steps below to configure RP threshold.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim rp-threshold < number of packets(0-2147483647)>**	Sets the SPT threshold for Group and Source. The Number of packets can be any number from 0 – 2147483647. Default is 0 packets.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure PIM RP threshold.
SMIS# **configure terminal**
SMIS(config)# **set ip pim rp-threshold 50**
SMIS(config)# **end**

SMIS# **show ip pim thresholds**

PIM SPT Threshold Information

  Group Threshold : 0
  Source Threshold : 0
  Switching Period : 0

PIM SPT-RP Threshold Information

  Register Threshold   : 50
  RP Switching Period   : 0
  Register Stop rate limit : 5

12.3.2   SPT at Last-hop DR

When last-hop DR receives multicast packet from *Shared tree or RP tree*, it sends an (S, G) Join to the first-hop DR to build the *Source-tree or Shortest Path Tree (SPT)* back to the source. This mechanism of last-hop DR building a SPT is called *SPT switchover at Last-hop DR*. Once SPT is established at last-hop DR, the RPT is pruned and data is then received by SPT only.

Typically, the SPT switchover occurs when a data-rate threshold is reached which is configurable in Supermicro switches using:

- SPT switch period
- SPT threshold

SPT switch period

Shortest Path Tree (SPT) switch period is used together with SPT threshold to specify the time when the last-hop router can switch over to Shortest Path Tree (SPT). Multicast data packet count is checked every 'SPT-switch-period' interval and if the count exceeds SPT threshold, the last-hop router switches from RP tree to Shortest Path Tree (SPT).

Shortest Path Tree (SPT) switch period is disabled by default in Supermicro switches i.e. last-hop routers switch to SPT immediately upon receipt of Multicast data packet.

Follow the steps below to configure Shortest Path Tree (SPT) switch period.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim spt-switchperiod <0-2147483647(in secs)>**	Sets the Shortest Path Tree (SPT) threshold for Group and Source. The Number of packets can be any number from 0 – 2147483647. Default is 0 packets.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure SPT switch period.

SMIS# **configure terminal**
SMIS(config)# **set ip pim spt-switchperiod 30**
SMIS(config)# **end**

SMIS# **show ip pim thresholds**

PIM SPT Threshold Information

 Group Threshold : 0
 Source Threshold : 0
 Switching Period : 30

PIM SPT-RP Threshold Information

```
-------------------------------
  Register Threshold      : 0
  RP Switching Period     : 0
  Register Stop rate limit : 5
```

SPT threshold

Shortest Path Tree (SPT) threshold is used together with SPT switch period to specify the time when the last-hop router can switch over to SPT. Multicast data packet count is checked every SPT-switch-period' interval and if the count exceeds SPT threshold, the last-hop router switches from RP tree to SPT. Shortest Path Tree (SPT) threshold is disabled by default in Supermicro switches i.e. last-hop routers switch to SPT immediately upon receipt of Multicast data packet.

Follow the steps below to configure Shortest Path Tree (SPT) threshold.

Step	Command	Description
Step 1	**configure terminal**	Enters the configuration mode.
Step 2	**set ip pim threshold { spt-grp | spt-src } < number of packets(0-2147483647)>**	Sets the Shortest Path Tree (SPT) threshold for Group and Source. The Number of packets can be any number from 0 – 2147483647. Default is 0 packets.
Step 3	**end**	Exits the configuration mode.
Step 4	**write startup-config**	Optional step – saves this PIM configuration to be part of the startup configuration.

The example below shows the commands to configure PIM SPT threshold.

SMIS# **configure terminal**
SMIS(config)# **set ip pim threshold spt-grp 100**
SMIS(config)# **set ip pim threshold spt-src 200**
SMIS(config)# **end**

SMIS# **show ip pim thresholds**

PIM SPT Threshold Information
```
-----------------------------
  Group Threshold  : 100
  Source Threshold : 200
  Switching Period : 0
```

PIM SPT-RP Threshold Information
```
-------------------------------
  Register Threshold      : 0
  RP Switching Period     : 0
  Register Stop rate limit : 5
```

13 PIM Configuration Example
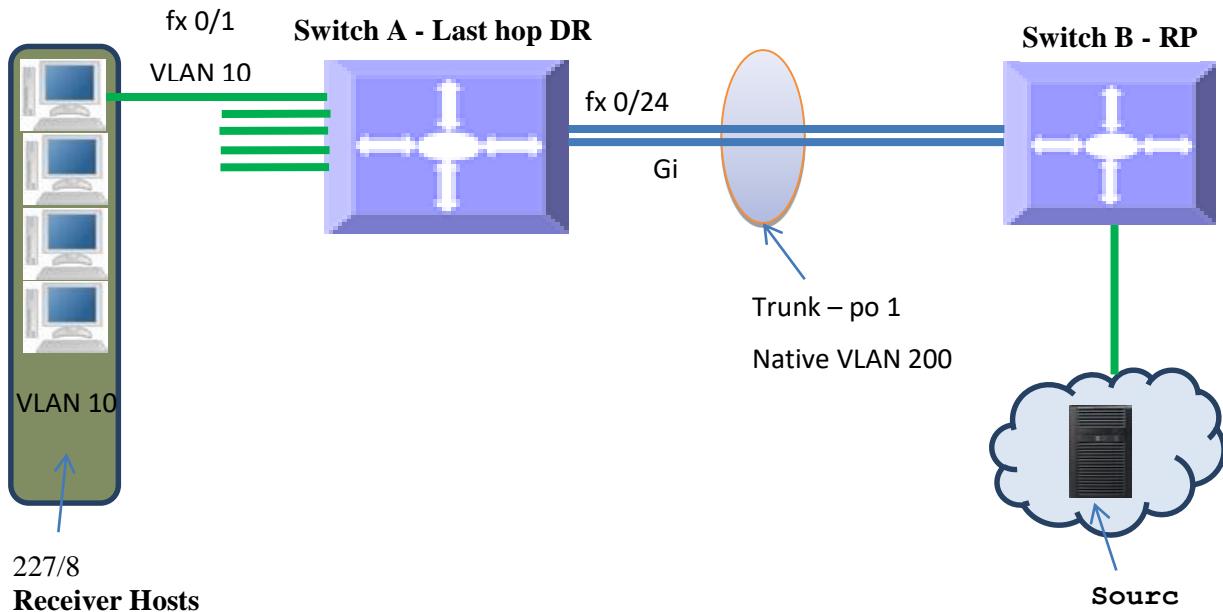
On switch A
1) Enable PIM and IGMP globally
2) Configure PIM component 110
3) Create layer 3 VLAN interfaces 10 and 200
4) Configure PIM Component Identifier as 110 for both layer3 VLANs 10 and 200
5) Configure static RP on Component Identifier 110
6) Configure static IGMP groups on Layer 3 VLAN interface 10

On switch B
1) Enable PIM and IGMP globally
2) Configure PIM component 100
3) Create layer 3 VLAN interface 200
4) Configure PIM Component Identifier as 100 for layer3 VLAN 200
5) Configure static RP on Component Identifier 100

Configuration on switch A

```
#configure Layer3 VLAN
SMIS# configure terminal
SMIS(config)# vlan 10
```

```
SMIS(config-vlan)# ports fx 0/1 untagged
SMIS(config-vlan)# exit
SMIS(config)# vlan 200
SMIS(config-vlan)# ports fx 0/24 untagged
SMIS(config-vlan)# end

SMIS# configure terminal
SMIS(config)# interface vlan 200
SMIS(config-if)# ip address 200.200.200.5 255.255.255.0
SMIS(config-if)# exit
SMIS(config)# interface vlan 10
SMIS(config-if)# ip address 10.10.10.10 255.255.255.0
SMIS(config-if)# end

#Enable PIM and IGMP
SMIS# configure terminal
SMIS(config)# interface vlan 10
SMIS(config-if)# set ip igmp enable
SMIS(config-if)# exit

SMIS(config)# set ip igmp enable
SMIS(config)# set ip pim enable
SMIS(config)# end

#configure Component
SMIS# configure terminal
SMIS(config)# ip pim component 110
SMIS(pim-comp)# end

SMIS# configure terminal
SMIS(config)# interface vlan 200
SMIS(config-if)# ip pim componentId 110
SMIS(config-if)# end

SMIS# configure terminal
SMIS(config)# interface vlan 10
SMIS(config-if)#  ip pim componentId 110
SMIS(config-if)# end

#configure Static RP
SMIS# configure terminal
SMIS(config)# set ip pim static-rp enable
SMIS(config)# ip pim component 110
SMIS(pim-comp)# rp-static rp-address 227.0.0.0 255.0.0.0 200.200.200.1
SMIS(pim-comp)# end

#configure Static Group membership
```

SMIS# configure terminal
interface vlan 10
ip igmp static-group 227.1.1.1

Save this PIM configuration.
SMIS# **write startup-config**
Building configuration, Please wait. May take a few minutes ...
[OK]
SMIS#

Check the running-configuration for accuracy
SMIS# show running-config

Building configuration...
Switch ID   Hardware Version   Firmware Version

ip address dhcp
vlan 1
  ports fx 0/2-23 untagged
 ports fx 0/25-48 untagged
 ports ex 0/1-4 untagged
exit
vlan 10
  ports fx 0/1 untagged
exit
vlan 200
 ports fx 0/24 untagged
exit

snmp view restricted 1 excluded nonvolatile

interface vlan 1
 ip address dhcp

interface vlan 200
 ip address 200.200.200.5 255.255.255.0

interface vlan 10
 ip address 10.10.10.10 255.255.255.0
 set ip igmp enable
 ip igmp static-group 227.1.1.1

exit
set ip igmp enable

set ip pim enable
set ip pim static-rp enable

ip pim component 1
exit
ip pim component 110
 rp-static rp-address 227.0.0.0 255.0.0.0 200.200.200.1
exit
interface vlan 200
 ip pim componentId 110
exit
interface vlan 10
 ip pim componentId 110
exit

#Display PIM neighbor information
SMIS# show ip pim neighbor

Neighbour Address	IfName/Idx	Uptime/Expiry Interval	Ver	DRPri/Mode	CompId	Override Delay	Lan
200.200.200.1	vlan200/910	00:24:17/90	v2	1/S	110	0	

#Display PIM interface information
SMIS# show ip pim interface detail

vlan200 910 is up
  Internet Address is 200.200.200.5
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
    PIM version : 2, mode: Sparse
    PIM DR : 200.200.200.5
    PIM DR Priority : 1
    PIM Neighbour Count : 1
    PIM Hello/Query Interval : 30
    PIM Message Interval : 60
    PIM Override Interval : 0
    PIM Lan Delay : 0
    PIM Lan-Prune-Delay : Disabled
    PIM Component Id : 110
    PIM domain border : disabled

vlan10 912 is up
  Internet Address is 10.10.10.10
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled

PIM version : 2, mode: Sparse
PIM DR : 10.10.10.10
PIM DR Priority : 1
PIM Neighbour Count : 0
PIM Hello/Query Interval : 30
PIM Message Interval : 60
PIM Override Interval : 0
PIM Lan Delay : 0
PIM Lan-Prune-Delay : Disabled
PIM Component Id : 110
PIM domain border : disabled

#Display PIM component
SMIS# show ip pim component

PIM Component Information

Component-Id: 1
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

Component-Id: 110
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

#Display IGMP static group membership
SMIS# show ip igmp groups

I - Include Mode, E - Exclude Mode
S - Static Mbr,   D - Dynamic Mbr

GroupAddress   Flg Iface   UpTime   ExpiryTime   LastReporter
---------------   --- -------   ---------------   ----------------   ---------------
227.1.1.1   S   vlan10 [0d 00:23:17.94] [0d 00:00:00.00] 10.10.10.10
227.5.5.5   S   vlan10 [0d 00:12:30.67] [0d 00:00:00.00] 0.0.0.0
SMIS# show ip igmp interface
vlan10, line protocol is up
 Internet Address is 10.10.10.10/8
 IGMP is enabled on interface
 Current IGMP router version is 2
 IGMP query interval is 125 seconds
 Last member query response interval is 10 seconds
 IGMP max query response time is 100 seconds
 Robustness value is 2
 IGMP querying router is 10.10.10.10 (this system)

Fast leave is disabled on this interface
Number of multicast groups joined 2

#Display PIM static RP
SMIS# show ip pim rp-static

Static-RP Enabled

CompId	GroupAddress	Group Mask	RPAddress
110	227.0.0.0	255.0.0.0	200.200.200.1

#Display Multicast routing table
SMIS# show ip pim mroute

IP Multicast Routing Table

Route Flags S: SPT Bit W: Wild Card Bit R: RPT Bit
Timers: Uptime/Expires
Interface State: Interface, State/Mode

PIM Multicast Routing Table For Component 110
(*, 227.1.1.1) ,00:14:20/--- ,RP : 200.200.200.1
  Incoming Interface : vlan200 ,RPF nbr : 200.200.200.1 ,Route Flags : WR
  Outgoing InterfaceList :
    vlan10, Forwarding/Sparse ,00:14:20/---

(*, 227.5.5.5) ,00:12:48/--- ,RP : 200.200.200.1
  Incoming Interface : vlan200 ,RPF nbr : 200.200.200.1 ,Route Flags : WR
  Outgoing InterfaceList :
    vlan10, Forwarding/Sparse ,00:12:48/---

Configuration on switch B

#configure Layer3 VLAN
SMIS# configure terminal
SMIS(config)# vlan 200
SMIS(config-vlan)# ports fx 0/24 untagged
SMIS(config-vlan)# end

SMIS# configure terminal
SMIS(config)# interface vlan 200
SMIS(config-if)# ip address 200.200.200.1 255.255.255.0
SMIS(config-if)# end

#Enable PIM and IGMP

```
SMIS# configure terminal
SMIS(config)# set ip pim enable
SMIS(config)# end

#configure Component
SMIS# configure terminal
SMIS(config)# ip pim component 100
SMIS(pim-comp)# end

SMIS# configure terminal
SMIS(config)# interface vlan 200
SMIS(config-if)# ip pim componentId 100
SMIS(config-if)# end

#configure Static RP
SMIS# configure terminal
SMIS(config)# set ip pim static-rp enable
SMIS(config)# ip pim component 100
SMIS(pim-comp)# rp-static rp-address 227.0.0.0 255.0.0.0 200.200.200.1
SMIS(pim-comp)# end

# Save this PIM configuration.
SMIS# write startup-config
Building configuration, Please wait. May take a few minutes ...
[OK]
SMIS#

# Check the running-configuration for accuracy
SMIS# show running-config

Building configuration...

ip address dhcp
vlan 1
  ports fx 0/1-23 untagged
 ports ex 0/1-3 untagged
exit
vlan 100
 exit
vlan 200
 ports fx 0/24 untagged
exit

interface vlan 200
 ip address  200.200.200.1 255.255.255.0

interface vlan 100
```

```
exit
set ip pim enable
set ip pim static-rp enable
ip pim component 1
exit
ip pim component 100
 rp-static rp-address 227.0.0.0 255.0.0.0 200.200.200.1
exit
interface vlan 200
 ip pim componentId 100
exit


#Display PIM component
SMIS# show ip pim component

PIM Component Information
---------------------------
Component-Id: 1
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

Component-Id: 100
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 0.0.0.0
  Candidate RP Holdtime: 0

#Display Static RP
SMIS# show ip pim rp-static

Static-RP Enabled

CompId    GroupAddress     Group Mask      RPAddress
------          ------------         ----------       ---------
   100            227.0.0.0         255.0.0.0     200.200.200.1

#Display PIM neighbor information
SMIS# show ip pim neighbor

Neighbour     IfName/Idx      Uptime/Expiry Ver DRPri/Mode CompId Override  Lan
Address                                                                              Interval   Delay
---------        ----------         ------------      --- ----------        ------      --------  ------
200.200.200.5  vlan200/504  00:21:19/84     v2     1/S      100      0            0


#Display PIM Interface information
```

SMIS# show ip pim interface detail

vlan200 504 is up
  Internet Address is 200.200.200.1
  Muticast Switching : Enabled
  PIM : Enabled
  PIMv6 : Disabled
    PIM version : 2, mode: Sparse
    PIM DR : 200.200.200.5
    PIM DR Priority : 1
    PIM Neighbour Count : 1
    PIM Hello/Query Interval : 30
    PIM Message Interval : 60
    PIM Override Interval : 0
    PIM Lan Delay : 0
    PIM Lan-Prune-Delay : Disabled
    PIM Component Id : 100
    PIM domain border : disabled

#Display Multicast routing table
SMIS# show ip pim mroute

IP Multicast Routing Table

Route Flags S: SPT Bit W: Wild Card Bit R: RPT Bit
Timers: Uptime/Expires
Interface State: Interface, State/Mode

PIM Multicast Routing Table For Component 100
(*, 227.1.1.1) ,00:11:02/--- ,RP : 200.200.200.1
  Incoming Interface : vlan200 ,RPF nbr : NULL ,Route Flags : WR
  Outgoing InterfaceList :
    vlan200, Forwarding/Sparse ,00:11:02/00:00:00

(*, 227.5.5.5) ,00:09:29/--- ,RP : 200.200.200.1
  Incoming Interface : vlan200 ,RPF nbr : NULL ,Route Flags : WR
  Outgoing InterfaceList :
    vlan200, Forwarding/Sparse ,00:09:29/00:00:00

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