Objective

This tech note outlines the main differences in multicast protocol support between Cisco® NX-OS Software and Cisco IOS® Software. Sample configurations are included for Cisco NX-OS and Cisco IOS Software to demonstrate the similarities and differences. Please refer to the NX-OS documentation on Cisco.com on Cisco.com for a complete list of supported features.

Multicast Overview

Multicast transmission (one-to-many) provides the capability for a source host to forward IP packets to an interested group of destination hosts , as opposed to using unicast transmission (one-to-one) or broadcast transmission (one-to-everyone in the broadcast domain). Multicast functionally is typically enabled using multiple protocols. This tech note includes the following Cisco NX-OS protocols: Protocol Independent Multicast (PIM), Internet Group Membership Protocol (IGMP) and Multicast Source Discovery Protocol (MSDP).

Important Cisco NX-OS and Cisco IOS Software Differences

In Cisco NX-OS:

- PIM and MSDP protocols require a LAN Enterprise Services license.
- The global **ip multicast-routing** command does not exist and is not required to enable multicast forwarding/routing. (It is required in Cisco IOS Software to enable multicast forwarding/routing)
- PIM command-line interface (CLI) configuration and verification commands are not available until you enable the PIM feature with the **feature pim** command.
- MSDP CLI configuration and verification commands are not available until you enable the MSDP feature with the **feature msdp** command.
- IGMP versions 2 and 3 are supported. IGMP version 1 and Version 3 Lite are not supported.
- An IGMP Snooping Querier is configured under the layer-2 VLAN with the **ip igmp snooping querier** CLI command (Physical L3 interfaces cannot be configured as IGMP Snooping Queriers). In Cisco IOS Software, an IGMP Snooping Querier is configured under the layer-3 interface.
- IGMP Snooping performs a layer-3 (IP) look-up by default, as opposed to a layer-2 (MAC) look-up performed in Cisco IOS Software on a Catalyst 6500 with a Sup720. However, a Catalyst 6500 with a Sup2T performs a layer-3 (IP) look-up by default. IP based look-up/forwarding is more efficient than MAC based look-up/forwarding.
- PIM version 2 Sparse Mode is supported. Cisco NX-OS does not support PIM version 1 Sparse Mode or Dense Mode. The NX-OS cannot fallback to Dense Mode operation.
- When configuring a PIM Auto-RP Candidate or BSR RP-Candidate the NX-OS requires a configured group-list (i.e. x.x.x.x/x), whereas Cisco IOS Software defaults to 224.0.0.0/4. An optional standard ACL can be configured to specify multicast groups in Cisco IOS Software.
- When configuring PIM Auto-RP Mapping-Agent's or Candidate-RP's, Cisco NX-OS uses a default scope of 32, whereas Cisco IOS Software requires it to be specified with the **scope** option (1-255).
- When configuring PIM Auto-RP, Cisco NX-OS multicast devices must be enabled to listen and/or forward RP advertisements with the **ip pim auto-rp forward listen** global CLI configuration command. Cisco IOS Software has to be configured for Sparse-Dense Mode or Sparse Mode with the global **ip pim autorp listener** CLI configuration command.
- When configuring PIM BSR, Cisco NX-OS multicast devices must be enabled to listen and/or forward RP advertisements with the **ip pim bsr forward listen** global CLI configuration command. Cisco IOS Software doesn?t require additional configuration, but does not have the ability to enable/disable RP forwarding and listening capabilities.

- BSR-Candidate routers have a default priority of 64. Cisco IOS Software defaults to 0. The priority value can be configured between 0 ? 255 in both operating systems using the **priority** option. A higher numeric value is preferred when comparing priorities.
- BSR RP-Candidate routers have a default priority of 192. Cisco IOS Software defaults to 0. The priority value can be configured between 0 ? 255 in both operating systems using the **priority** option. The lower numeric value is preferred when comparing priorities.
- When configuring a Static-RP, NX-OS releases prior to version 5.2(1) does not have an **override** option like Cisco IOS Software that forces the Static-RP to be elected for it?s specified multicast group list over dynamically learned RP?s. NX-OS 5.2(1) introduced the **override** option, which provides the same behavior as Cisco IOS Software; static RP?s are preferred over dynamic RP?s for the same multicast group list when the **override** option is configured.
- When comparing PIM Static-RP?s to dynamically learned RP?s (Auto-RP and BSR) during the election process: The RP with the most specific multicast group-list is elected. If the group-lists are identical, the router with the highest RP IP address is elected.
- When configuring a PIM domain border, the **ip pim border** interface CLI command prevents BSR and Auto-RP packets from being sent or received on an interface. The Cisco IOS Software command equivalent (**ip pim bsr-border**) only prevents BSR packets. Cisco IOS Software requires the **ip multicast boundary** interface command to prevent Auto-RP packets.
- PIM neighbor authentication (IPSec ah-md5) can be enabled to authenticate directly connected neighbors to increase security. Cisco IOS Software does not support this functionality.
- PIM neighbor logging can be enabled with the global **ip pim log-neighbor-changes** CLI command. (Cisco IOS Software enables PIM neighbor logging by default)
- The data in the MSDP Source-Active (SA) messages are cached by default, whereas Cisco IOS Software requires the global **ip msdp cache-sa-state** and **ip msdp cache-rejected-sa** CLI commands.
- PIM is configured with the Source Specific Multicast (SSM) group range 232.0.0.0/8 by default (**ip pim ssm range 232.0.0.0/8**).
- Beginning with NX-OS 5.0(2a), PIM supports Bidirectional Forwarding Detection (BFD) for rapid failure detection.

Things You Should Know

The following list provides some additional facts about Cisco NX-OS that should be helpful when designing, configuring, and maintaining multicast enabled networks.

- If you remove the **feature pim** command, all relevant PIM configuration information is also removed.
- If you remove the **feature msdp** command, all relevant MSDP configuration information is also removed.
- IGMP Snooping is enabled globally by default. It can be disabled globally, or per layer-2 VLAN with the **no igmp snooping** command.
- IGMP version 2 is enabled by default when PIM Sparse Mode is configured on an interface.
- PIM configuration is supported under IP Tunnel (GRE) interfaces in Cisco NX-OS 5.2(1) and onward (PIM was previously not supported in IP Tunnels).
- PIM supports three modes of operation: Any Source Multicast (ASM), Single Source Multicast (SSM), Bidirectional Shared Tree (Bidr). The default mode is ASM. Bidr can be configured with the **bidr** option when configuring a RP.
- The Cisco NX-OS supports four types of PIM Rendezvous Points: Static, Bootstrap router (BSR), Auto-RP and Anycast-RP. (Do not configure Auto-RP and BSR in the same network)

- When configuring a PIM Static-RP, the group-list defaults to 224.0.0.0/4 if one is not specified.
- The Cisco NX-OS has two different CLI syntax options when configuring BSR and Auto RP's (New Cisco NX-OS syntax, and backwards compatible Cisco IOS Software syntax).
- The Cisco NX-OS supports multicast routing per layer-3 Virtual Routing and Forwarding (VRF) instance.
- PIM SSM and Bidr are not supported on Virtual Port-Channels (vPCs).

Configuration Comparison

The following sample code shows configuration similarities and differences between the Cisco NX-OS and Cisco IOS Software CLIs. There are few significant differences: Cisco NX-OS does not require the global **ip multicast-routing** command, but does require PIM and MSDP to be enabled individually with the global **feature** CLI commands. The Cisco NX-OS has backwards compatible syntax with Cisco IOS Software when configuring PIM BSR and Auto-RP, but Cisco NX-OS requires RP forwarding and/or listening to be configured prior to learning or forwarding dynamic RP information. Both Cisco NX-OS and Cisco IOS Software support multicast routing within a VRF instance, but Cisco NX-OS requires global commands to be configured under the VRF context as opposed to using the **vrf** option as with Cisco IOS Software.

Cisco IOS CLI	*Cisco NX-OS CLI*
Enabling Multicast Forwarding	
	The Cisco NX-OS does not have a single global command to enable multicast forwarding/routing.
Enabling the PIM Feature	
	feature pim
Configuring PIM Sparse Mode on an Interface	
	interface Ethernet1/1
	ip address 192.168.10.1/24
	ip pim sparse-mode
Configuring a PIM Auto-RP	
	interface loopback10
	ip address 172.16.1.1/32
	ip pim sparse-mode
	ip pim auto-rp rp-candidate loopback10 group-list 224.0.0.0/4
	ip pim auto-rp mapping-agent loopback10

ip pim auto-rp forward listen

or

ip pim send-rp-announce loopback10 group-list 224.0.0.0/4

ip pim send-rp-discovery loopback10

ip pim auto-rp forward listen

Configuring a PIM BSR RP

interface loopback10

ip address 172.16.1.1/32

ip pim sparse-mode

ip pim bsr bsr-candidate loopback10

ip pim bsr rp-candidate loopback10 group-list 224.0.0.0/4

ip pim bsr forward listen

or

ip pim bsr-candidate loopback10

ip pim rp-candidate loopback10 group-list 224.0.0.0/4

ip pim bsr forward listen

Configuring a PIM Static-RP

ip pim rp-address 172.16.1.1

Configuring a PIM Anycast-RP (BSR Example)

interface loopback0

ip address 192.168.10.1/32

ip pim sparse-mode

interface loopback10

description Anycast-RP-Address

ip address 172.16.1.1/32

ip pim sparse-mode

ip pim bsr bsr-candidate loopback0

ip pim bsr rp-candidate loopback10 group-list 224.0.0.0/4

ip pim anycast-rp 172.16.1.1 192.168.10.1

ip pim anycast-rp 172.16.1.1 192.168.10.2

ip pim bsr forward listen

Configuring PIM Neighbor Authentication

interface Ethernet1/1

ip address 192.168.10.1/24

ip pim sparse-mode

ip pim hello-authentication ah-md5 3 a667d47acc18ea6b

Configuring a PIM BSR Border on an Interface

interface Ethernet1/1

ip address 192.168.10.1/24

ip pim sparse-mode

ip pim border

Configuring PIM in a Non-Default VRF Instance

vrf context production

ip pim rp-address 172.16.1.1 group-list 224.0.0.0/4

interface loopback10

vrf member production

ip address 172.16.1.1/32

interface Ethernet1/1

vrf member production

ip address 192.168.10.1/24

ip pim sparse-mode

Configuring IGMP Version 3 for an Interface

interface Ethernet1/1

ip address 192.168.10.1/24

ip pim sparse-mode

ip igmp version 3

Configuring an IGMP Snooping Querier for a VLAN

vlan 10

ip igmp snooping querier 192.168.10.1

Configuring MSDP (Anycast-RP)

interface loopback0

description MSDP Peer Address

ip address 192.168.1.1/32

interface loopback10

description PIM RP Address

ip address 1.1.1.1/32

ip pim rp-address 1.1.1.1 group-list 224.0.0.0/4

ip msdp peer 192.168.2.1 connect-source loopback0

Verification Command Comparison

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Cisco_NX-OS/IOS_Multicast_Comparison

The following table compares some useful **show** commands for verifying and troubleshooting multicast network configurations.

Cisco NX-OS Multicast	Cisco IOS Software Multicast	Command Description
show ip igmp groups	show ip igmp groups	Displays all IGMP attached group membership information
show ip igmp interface	show ip igmp interface	Displays IGMP information for all interfaces
show ip igmp interface brief	-	Displays a one line summary status per interface
show ip igmp interface *int-type*	show ip igmp interface *int-type*	Displays IGMP information for a specific interface
show ip igmp interface vrf *name*	show ip igmp vrf *name*	Displays IGMP information for a specific VRF instance
show ip igmp local-groups *int-type*	-	Displays IGMP local groups associated to a specific interface
show ip igmp local-groups vrf *name*	-	Displays IGMP local groups associated to a specific VRF instance
show ip igmp route	-	Displays IGMP attached group membership information
show ip igmp route *x.x.x.x*	-	Displays IGMP attached group membership for a specific group
show ip igmp route *int-type*	-	Displays IGMP attached group membership for a specific interface
show ip igmp route vrf *name*	-	Displays IGMP attached group membership for a specific VRF instance
show ip igmp snooping	-	Displays global and per interface IGMP Snooping information
show ip igmp snooping explicit-tracking	show ip igmp snooping explicit-tracking	Displays explicit tracking information for IGMPv3
show ip igmp snooping groups	show mac-address-table multicast igmp-snooping	Displays IGMP Snooping groups information
show ip igmp snooping mrouter	show ip igmp snooping mrouter	Displays detected multicast routers
show ip igmp snooping otv	-	Displays IGMP Snooping OTV information
show ip igmp snooping querier	-	Displays IGMP Snooping querier information
show ip igmp snooping statistics	show ip igmp snooping statistics	Displays packet/error counter statistics
show ip igmp snooping vlan #	-	Displays IGMP Snooping information per specific VLAN
show ip msdp count	show ip msdp count	Displays MSDP SA cache counters
show ip msdp mesh-group	-	Displays MSDP Mesh-Group members

show ip msdp peer	show ip msdp peer	Displays all MSDP peers
show ip msdp peer *x.x.x.x*	show ip msdp peer *x.x.x.x*	Displays a specific MSDP peer
show ip msdp peer vrf *name*	show ip msdp vrf *name*	Displays MSDP peers related to a specific VRF instance
show ip msdp peer policy	-	Displays the MSDP peer policies
show ip msdp peer route	-	Displays the MSDP route-cache
show ip msdp sa-cache	show ip msdp sa-cache	Displays the MSDP SA route-cache
show ip msdp source	-	Displays the MSDP learned sources and associated statistics
show ip msdp summary	show ip msdp summary	Displays the MSDP peer summary
show ip pim df	show ip pim interface df	Displays Bidr designated forwarders
show ip pim df *x.x.x.x*	show ip pim interface df *x.x.x.x*	Displays Bidr designated forwarders for a specific RP or group
show ip pim df vrf *name*	-	Displays Bidr designated forwarders for a specific VRF instance
show ip pim group-range	-	Displays the PIM group-ranges
show ip pim group-range *x.x.x.x*	-	Displays a specific PIM group-range
show ip pim group-range vrf *name*	-	Displays the PIM group-ranges for a specific VRF instance
show ip pim interface	-	Displays all PIM enabled interfaces
show ip pim interface brief *x.x.x.x*	-	Displays a one line summary of all PIM enabled interfaces
show ip pim interface *int-type*	show ip pim interface *int-type*	Displays information for a specific PIM interface
show ip pim interface vrf *name*	-	Displays the PIM interfaces for a specific VRF instance
show ip pim neighbor	show ip pim neighbor	Displays all PIM neighbors
show ip pim neighbor *x.x.x.x*	show ip pim neighbor *x.x.x.x*	Displays a specific PIM neighbor for a specific IP address
show ip pim neighbor interface *int-type*	show ip pim neighbor *int-type*	Displays a specific PIM neighbor for a specific interface
show ip pim neighbor vrf *name*		Displays PIM neighbors for a specific VRF instance
show ip pim oif-list *x.x.x.x*	-	Displays PIM OIF-List for a specific multicast group address
show ip pim policy statistics	-	Displays PIM statistics
show ip pim route	-	Displays PIM routes
show ip pim route *x.x.x.x*	-	Displays a specific PIM route
show ip pim route vrf *name*	-	Displays PIM routes for a specific VRF instance
show ip pim rp	show ip pim rp mapping	Displays PIM RP information

show ip pim rp *x.x.x.x*	show ip pim rp *x.x.x.x*	Displays information for a specific PIM group address
show ip pim rp vrf *name*	-	Displays information for PIM RP's in a specific VRF instance
show ip pim rp-hash *x.x.x.x*	show ip pim rp-hash *x.x.x.x*	Displays PIM RP-Hash value for a specific group
show ip pim statistics	-	Displays PIM packet statistics
show ip pim statistics vrf *name*	-	Displays per packet statistics for a specific VRF instance
show ip pim vrf *name*	show ip pim vrf *name*	Displays detailed PIM information per specific VRF instance
show ip mroute	show ip mroute	Displays the multicast routing table
show forwarding multicast route group <group>	show ip mroute count	Displays mroute flags and forwarding/RPF counters
show ip mroute summary	show ip mroute summary	Displays the multicast routing table with packet counts and bit rates
show ip mroute *x.x.x.x*	show ip mroute *x.x.x.x*	Displays a specific multicast route
show ip mroute vrf *name*	show ip mroute vrf *name*	Displays the multicast routing table for a specific VRF instance
show ip route rpf	show ip rpf	Displays the Reverse Path Forwarding (RPF) table used for multicast source lookup