Multicast for Virtual Multipoint Interfaces

The Multicast for Virtual Multipoint Interfaces feature enables multicast support for RFC 5578-compliant Radio-Aware Routing (RAR). Multicast is defined as a network group membership spanning the entire network. The virtual multipoint interface (VMI) operates in aggregate mode, which means that all virtual access interfaces created by PPP over Ethernet (PPPoE) sessions are aggregated logically under the configured VMI. Packets sent to the VMI are forwarded to the correct virtual access interface. When a VMI operates in aggregate mode, the interfaces operate in nonbroadcast multiple access (NBMA) mode. Multicast traffic is forwarded only the he NBMA neighbors where a listener for that group is present.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Restrictions for Multicast for Virtual Multipoint Interfaces

Only IPv4 is supported for nonbroadcast multiple access (NBMA) multicasting.

Information About Multicast for Virtual Multipoint Interfaces

Multicast Support for VMIs

By default, virtual multipoint interfaces (VMIs) operate in aggregate mode, which means that all of the virtual access interfaces created by PPP over Ethernet (PPPoE) sessions are aggregated logically under the configured VMI. Applications above Layer 2, such as the Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First version 3 (OSPFv3), should be defined only on the VMI. Packets sent to the VMI are forwarded to the correct virtual access interface. When VMIs are in aggregate mode, they operate in nonbroadcast multiple access (NBMA) mode. Multicast traffic is forwarded only to the NBMA neighbors where a listener for that group is present.

If you are running multicast applications that require the virtual access interfaces to be exposed to applications above Layer 2 directly, you can configure the VMI to operate in bypass mode. Most multicast applications require that the virtual access interfaces be exposed directly to the routing protocols to ensure that the multicast Reverse Path Forwarding (RPF) can operate as expected. When you use the bypass mode, you must define a VMI to handle presentation of cross-layer signals such as, neighbor up, neighbor down, and metrics. Applications are aware of the actual underlying virtual access interfaces and send packets to them directly. Additional information is required on the virtual template configuration.

Multicast Routing in NBMA Mode

Multicast is defined as a network group membership spanning the entire network. Usually, multicast is unidirectional from a source to a group of receivers. In both IPv4 and IPv6 architectures, a portion of the address space is reserved for multicast groups, and group addresses are requested to and assigned by Internet Assigned Numbers Authority (IANA). See the table below for IPv4 examples.

Table 1: Assigned IPv4 Multicast Addresses

Addresses	Usage
224.0.0.1	All hosts
224.0.0.2	All multicast hosts
224.0.0.5	Open Shortest Path First (OSPF) devices
224.0.0.10	Interior Gateway Routing Protocol (IGRP) devices
224.0.0.13	All Protocol Independent Multicast (PIM) devices
224.0.0.19 to 224.0.0.255	Unassigned

Nonbroadcast multiple access (NBMA) mode is achieved on a virtual multipoint interface (VMI) in aggregate mode. When operating in multicast NBMA mode, only the virtual interfaces that are part of the multicast tree receive multicast traffic.

How to Configure Multicast for Virtual Multipoint Interfaces

Enabling Bypass Mode for Multicast Applications

Perform this optional task to enable bypass mode on a VMI and override the default aggregation that occurs on VMIs. Bypass mode is recommended for multicast applications.

Before you begin

Configure the virtual template and the appropriate PPP over Ethernet (PPPoE) sessions for the virtual multipoint interface (VMI) before performing this task.

Note Using bypass mode can cause databases in the applications to be larger because knowledge of more interfaces is required for normal operation.

After you enter the **mode bypass** command, Cisco recommends that you copy the running configuration to NVRAM because the default mode of operation for VMI is to logically aggregate the virtual access interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface vmi** *interface-number*
4. **physical-interface** *type number*
5. **mode bypass**
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface vmi** *interface-number* **Example:** `Device(config)# interface vmi 1`	Enters interface configuration mode and creates a VMI.

	Command or Action	Purpose
Step 4	**physical-interface** *type number* **Example:** `Device(config-if)# physical-interface fa 0/0`	Creates the physical subinterface to be associated with VMI on the device.
Step 5	**mode bypass** **Example:** `Device(config-if)# mode bypass`	Overrides the default aggregation on the VMI and sets the mode to bypass to support multicast traffic on the interface.
Step 6	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configuration Examples for Multicast for Virtual Multipoint Interfaces

Examples: IP Address Coordination for the VMI in Aggregate Mode

The default mode for operation of the virtual multipoint interface (VMI) is aggregate mode. In aggregate mode, all of the virtual access interfaces created by PPP over Ethernet (PPPoE) sessions are logically aggregated under the VMI. As such, applications above Layer 2, such as the Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First version 3 (OSPFv3), should be defined on the VMI only. Packets sent to the VMI will be correctly forwarded to the correct virtual access interface.

The next examples show the IP address coordination needed between the virtual-template configuration and the VMI configuration.

The following example shows the configuration of VMI in aggregate mode using IPv4 as the routing protocol:

```
!
interface Virtual-Template1
 ip unnumbered vmi1
 service-policy output FQ
!
interface vmi1
 ip address 2.2.2.1 255.255.255.0
 physical-interface FastEthernet 0/0
!
```

The following example shows the configuration of VMI in aggregate mode using IPv4 and IPv6 as the routing protocols:

```
interface Virtual-Template1
 ip unnumbered vmi1
 ipv6 enable
 service-policy output FQ
```

```
!
interface vmi1
 ip address 2.2.2.1 255.255.255.0
 ipv6 enable
 physical-interface FastEthernet 0/0
!
```

The following example shows the configuration of VMI in aggregate mode using IPv6 as the routing protocol:

```
interface Virtual-Template1
 ipv6 enable
 service-policy output FQ
!
interface vmi1
 ipv6 enable
 physical-interface FastEthernet 0/0
!
```

Examples: Enabling Multicast Support with Bypass or Aggregate Mode

Note The IPv4 address that you configure on the virtual multipoint interface (VMI) is not advertised or used; instead the IPv4 address on the virtual template is used.

Example: Bypass Mode on VMIs for Multicast Traffic

The following example shows how to enable multicast on virtual multipoint interfaces (VMIs). The example includes changing the VMI to bypass mode and enabling Protocol Independent Multicast (PIM) sparse mode on the virtual-template interface:

```
Device# enable
Device# configure terminal
!
Device(config)# interface Virtual-Template1
Device(config-if)# ip address 209.165.200.227 255.255.255.224
Device(config-if)# load-interval 30
Device(config-if)# no keepalive
Device(config-if)# ip pim sparse-dense-mode
Device(config-if)# service-policy output FQ
!
!
Device(config)# interface vmi1
Device(config-if)# ip address 10.3.9.1 255.255.255.0
Device(config-if)# load-interval 30
Device(config-if)# physical-interface FastEthernet 0/0
Device(config-if)# mode bypass
!
Device(config)# end
```

Example: EIGRP for IPv4 Using Bypass Mode

The following example shows how to configure the Enhanced Interior Gateway Routing Protocol (EIGRP) for IPv4 using bypass mode. In this example, the IP address of the virtual multipoint interface,VMI1, needs to be defined, but the interface is not routable because the VMI is configured as down/down:

```
hostname host1
!
no aaa new-model
clock timezone EST -5
ip cef
!
no ip domain lookup
subscriber authorization enable
!
subscriber profile host1
 pppoe service manet_radio
!
!
multilink bundle-name authenticated
no virtual-template subinterface
!
archive
 log config
!
policy-map FQ
 class class-default
  fair-queue
!
!
!bba-group pppoe VMI1
 virtual-template 1
 service profile host1
!
!
interface Loopback1
ip address 209.165.200.225 255.255.255.224
 load-interval 30
!
interface FastEthernet 0/0
 no ip address
 no ip mroute-cache
 load-interval 30
 speed 100
 full-duplex
 pppoe enable group VMI1
!
interface Serial 1/0
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/1
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/2
 no ip address
 no ip mroute-cache
shutdown
 clock rate 2000000
!
interface Serial 1/3
no ip address
 no ip mroute-cache
 shutdown
```

```
 clock rate 2000000
!
interface FastEthernet 2/0
 switchport access vlan 2
 duplex full
speed 100
!
interface FastEthernet 2/1
 switchport access vlan 503
 load-interval 30
 duplex full
 speed 100
!
interface FastEthernet 2/2
 shutdown
!
interface FastEthernet 2/3
 shutdown
!
interface Virtual-Template1
 ip address 209.165.200.225 255.255.255.224
 load-interval 30
 no keepalive
 service-policy output FQ
!
interface Vlan1
 no ip address
 no ip mroute-cache
 shutdown
!
interface Vlan2
 ip address 209.165.200.225 255.255.255.224
 no ip mroute-cache
 load-interval 30
!
interface Vlan503
 ip address 209.165.200.225 255.255.255.224
 load-interval 30
 ipv6 address 2001:0DB8::/32
ipv6 enable
!
interface vmi1
ip address 209.165.200.226 255.255.255.224
 load-interval 30
 physical-interface FastEthernet 0/0
 mode bypass
!
router eigrp 1
 redistribute connected
 network 209.165.200.225 255.255.255.224
 network 209.165.200.226 255.255.255.224
```

Example: EIGRP for IPv6 Using Bypass Mode

The following example shows how to configure the Enhanced Interior Gateway Routing Protocol (EIGRP) for IPv6 using bypass mode:

```
!
ip cef
!
!
!
no ip domain lookup
```

```
ipv6 unicast-routing
ipv6 cef
subscriber authorization enable
!
subscriber profile host1
 pppoe service manet_radio
!
multilink bundle-name authenticated
no virtual-template subinterface
!
!
!
archive
 log config
!
!
policy-map FQ
class class-default
 fair-queue
!
!
!
bba-group pppoe VMI1
 virtual-template 1
service profile host1
!
!
interface Loopback1
load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
!
interface FastEthernet 0/0
 no ip address
 no ip mroute-cache
 load-interval 30
 speed 100
 full-duplex
 pppoe enable group VMI1
!
interface Serial 1/0
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/1
 no ip address
 no ip mroute-cache
 shutdown
clock rate 2000000
!
interface Serial 1/2
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/3
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
```

```
!
interface FastEthernet 2/0
 switchport access vlan 2
 duplex full
 speed 100
!
interface FastEthernet 2/1
 switchport access vlan 503
 load-interval 30
 duplex full
 speed 100
!
interface FastEthernet 2/2
 shutdown
!
interface FastEthernet 2/3
 shutdown
!
interface Virtual-Template1
 no ip address
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
 no keepalive
 service-policy output FQ
!
interface Vlan1
 no ip address
 no ip mroute-cache
 shutdown
!
interface Vlan2
 no ip address
 no ip mroute-cache
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
!
interface Vlan503
 no ip address
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
!
interface vmi1
no ip address
 load-interval 30
 ipv6 enable
 physical-interface FastEthernet 0/0
 mode bypass
!
!
no ip http server
no ip http secure-server
!
ipv6 router eigrp 1
 no shutdown
 redistribute connected
!
!
!
```

Example: EIGRP with IPv4 and IPv6 Traffic Using Bypass Mode

The following example shows how to configure the Enhanced Interior Gateway Routing Protocol (EIGRP) with IPv4 and IPv6 using bypass mode:

```
!
hostname host1
!
enable
configure terminal
ip cef
no ip domain lookup
ipv6 unicast-routing
ipv6 cef
subscriber authorization enable
!
subscriber profile host1
 pppoe service manet_radio
!
multilink bundle-name authenticated
no virtual-template subinterface
!
archive
 log config
!
!
policy-map FQ
 class class-default
  fair-queue
!
bba-group pppoe VMI1
 virtual-template 1
 service profile host1
!
!
interface Loopback1
 ip address 209.165.200.225 255.255.255.224
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
!
interface FastEthernet 0/0
 no ip address
 no ip mroute-cache
 load-interval 30
 speed 100
 full-duplex
 pppoe enable group VMI1
!
interface Serial 1/0
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/1
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/2
```

```
no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/3
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface FastEthernet 2/0
 switchport access vlan 2
 duplex full
 speed 100
!
interface FastEthernet 2/1
 switchport access vlan 503
 load-interval 30
 duplex full
 speed 100
!
interface FastEthernet 2/2
 shutdown
!
interface FastEthernet 2/3
 shutdown
!
interface Virtual-Template1
 ip address 209.165.200.225 255.255.255.224
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
 no keepalive
 service-policy output FQ
!
interface Vlan1
 no ip address
 no ip mroute-cache
 shutdown
!
interface Vlan2
 ip address 209.165.200.226 255.255.255.224
 no ip mroute-cache
 load-interval 30
!
interface Vlan503
 ip address 209.165.200.226 255.255.255.224
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 eigrp 1
!
interface vmi1
 ip address 209.165.200.226 255.255.255.224
 load-interval 30
 ipv6 enable
 physical-interface FastEthernet 0/0
 mode bypass
!
router eigrp 1
 redistribute connected
 network 209.165.200.226 255.255.255.224
```

```
 network 209.165.200.227 255.255.255.224
 auto-summary
!
!
no ip http server
no ip http secure-server
!
ipv6 router eigrp 1
 eigrp router-id 10.9.1.1
 no shutdown
 redistribute connected
!
!
!
end
```

Example: OSPFv3 for Multicast Traffic Using Aggregate Mode

In this example, multicast is configured as a nonbroadcast multiple access (NBMA) network. To configure multicast, the **ip multicast-routing** global configuration command is required. To configure the virtual multipoint interface (VMI) in aggregate mode for multicast, you must configure the VMI with the **ip PIM nbma-mode** command. The following example shows the VMI on an Open Shortest Path First version 3 (OSPFv3) network:

```
!
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname mcrtr4
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
logging buffered 51200 warnings
!
no aaa new-model
!
ip source-route
!
!
ip cef
!
!
ip domain name yourdomain.com
ip multicast-routing
ip multicast cache-headers
no ipv6 cef
subscriber authorization enable
!
subscriber profile chan
 pppoe service manet_radio
!
!
multilink bundle-name authenticated
!username lab privilege 15 secret 5 $1$v1bl$B5KD7o3jVKYqfoKoS0FUJ1
!
!
!
archive
 log config
```

```
  hidekeys
!
!
!
!
!
bba-group pppoe chan
 virtual-template 1
 service profile chan
!
!
interface Loopback0
 ip address 15.15.15.15 255.255.255.255
 ip broadcast-address 0.0.0.0
!
interface FastEthernet 0/0
 description $ETH-LAN$$ETH-SW-LAUNCH$$INTF-INFO-FE 0/0$
 ip address 1.1.1.2 255.255.255.0
 ip broadcast-address 0.0.0.0
 ip pim sparse-mode
 ip igmp version 3
 duplex auto
 speed auto
!
interface FastEthernet 0/1
 no ip address
 ip broadcast-address 0.0.0.0
 duplex auto
 speed auto
 pppoe enable group chan
!
interface FastEthernet 0/0/0
!
interface FastEthernet 0/0/1
!
interface FastEthernet 0/0/2
!
interface FastEthernet 0/0/3
interface FastEthernet 0/1/0
 no ip address
 ip broadcast-address 0.0.0.0
 duplex auto
 speed auto
!
interface Virtual-Template1
 ip unnumbered vmi1
 no peer default ip address
 fair-queue
!
interface Vlan1
 ip address 10.15.60.53 255.255.255.0
!
interface vmi1
 ip address 2.2.2.2 255.255.255.0
 ip pim nbma-mode
 ip pim sparse-mode
 ip ospf network point-to-multipoint
 load-interval 30
 physical-interface FastEthernet0/1
!
router ospfv3 1
 log-adjacency-changes
 redistribute connected subnets
 redistribute static
```

```
 network 1.1.1.0 0.0.0.255 area 0
 network 2.2.2.0 0.0.0.255 area 0
!
ip forward-protocol nd
ip http server
ip http access-class 23
ip http authentication local
ip http secure-server
ip http timeout-policy idle 60 life 86400 requests 10000
!
!
ip pim rp-address 16.16.16.16
ip pim register-source vmi1
!
access-list 23 permit 10.10.10.0 0.0.0.7
access-list 110 permit ip any any
!
!
!
!
control-plane
!
!
!
!
mgcp fax t38 ecm
!
!
line con 0
 exec-timeout 0 0
 login local
line aux 0
line vty 0 4
 access-class 23 inprivilege level 15
 login local
 transport input telnet ssh
line vty 5 15
 access-class 23 in
 privilege level 15
 login local
 transport input telnet ssh
!
exception data-corruption buffer truncate
scheduler allocate 20000 1000
end
```

Example: OSPFv3 for IPv6 Multicast Traffic Using Bypass Mode

```
hostname host1
!
enable
configure terminal
!
no aaa new-model
clock timezone EST -5
!
!
!
ip cef
no ip domain lookup
ipv6 unicast-routing
ipv6 cef
subscriber authorization enable
```

```
!
subscriber profile host1
 pppoe service manet_radio
!
multilink bundle-name authenticated
no virtual-template subinterface
!
!
archive
 log config
!
policy-map FQ
 class class-default
  fair-queue
!
bba-group pppoe VMI1
 virtual-template 1
 service profile host1
!
interface Loopback1
 no ip address
 load-interval 30
 ipv6 address 2001:0DB1::1/64
 ipv6 enable
!
interface FastEthernet 0/0
 no ip address
 no ip mroute-cache
 load-interval 30
 speed 100
 full-duplex
 ipv6 enable
 pppoe enable group VMI1
!
interface Serial 1/0
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/1
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/2
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface Serial 1/3
 no ip address
 no ip mroute-cache
 shutdown
 clock rate 2000000
!
interface FastEthernet 2/0
 switchport access vlan 2
 duplex full
 speed 100
!
interface FastEthernet 2/1
```

```
 switchport access vlan 503
 load-interval 30
 duplex full
 speed 100
!
interface FastEthernet 2/2
 shutdown
!
interface FastEthernet 2/3
shutdown
!
interface Virtual-Template1
 no ip address
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
!
ipv6 ospf network point-to-multipoint
ipv6 ospf cost dynamic
 ipv6 ospf 1 area 0
 no keepalive
 service-policy output FQ
!
interface Vlan1
 no ip address
 no ip mroute-cache
 shutdown
!
interface Vlan2
 no ip address
 no ip mroute-cache
load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface Vlan503
 load-interval 30
 ipv6 address 2001:0DB8::/32
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface vmi1
 no ip address
 load-interval 30
 ipv6 enable
 physical-interface FastEthernet 0/0
 mode bypass
!
!
no ip http server
no ip http secure-server
!ipv6 router ospf 1
 log-adjacency-changes
 redistribute connected metric-type 1
!
!
!
control-plane
!
!
line con 0
 exec-timeout 0 0
 stopbits 1
```

```
line aux 0
line vty 0 4
 login
!
end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multicast commands	Cisco IOS Multicast Command Reference
Enhanced Interior Gateway Routing Protocol (EIGRP) configuration tasks and commands	*IP Routing: EIGRP Configuration Guide* Cisco IOS IP Routing: EIGRP Command Reference
Open Shortest Path First (OSPF) configuration tasks and commands	*IP Routing: OSPF Configuration Guide* Cisco IOS IP Routing: OSPF Command Reference
IPv6 configuration tasks and commands	*IPv6 Configuration Library* Cisco IOS IPv6 Command Reference

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Multicast for Virtual Multipoint Interfaces

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 2: Feature Information for Multicast for Virtual Multipoint Interfaces

Feature Name	Releases	Feature Information
Multicast for Virtual Multipoint Interfaces	15.1(3)T	The Multicast for Virtual Multipoint Interfaces feature enables multicast support for RFC 5578-compliant Radio-Aware Routing. No new or modified commands were introduced with this feature.