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 to the 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

<table>
<thead>
<tr>
<th>Addresses</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>224.0.0.1</td>
<td>All hosts</td>
</tr>
<tr>
<td>224.0.0.2</td>
<td>All multicast hosts</td>
</tr>
<tr>
<td>224.0.0.5</td>
<td>Open Shortest Path First (OSPF) devices</td>
</tr>
<tr>
<td>224.0.0.10</td>
<td>Interior Gateway Routing Protocol (IGRP) devices</td>
</tr>
<tr>
<td>224.0.0.13</td>
<td>All Protocol Independent Multicast (PIM) devices</td>
</tr>
<tr>
<td>224.0.0.19 to 224.0.0.255</td>
<td>Unassigned</td>
</tr>
</tbody>
</table>

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.

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 \texttt{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. \texttt{enable}
2. \texttt{configure terminal}
3. \texttt{interface vmi interface-number}
4. \texttt{physical-interface type number}
5. \texttt{mode bypass}
6. \texttt{end}

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>\texttt{enable}</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>\texttt{configure terminal}</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>\texttt{interface vmi interface-number}</td>
<td>Enters interface configuration mode and creates a VMI.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface vmi 1</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Step 4 physical-interface type number Example: Device(config-if)# physical-interface fa 0/0</td>
<td>Creates the physical subinterface to be associated with VMI on the device.</td>
</tr>
<tr>
<td>Step 5 mode bypass Example: Device(config-if)# mode bypass</td>
<td>Overrides the default aggregation on the VMI and sets the mode to bypass to support multicast traffic on the interface.</td>
</tr>
<tr>
<td>Step 6 end Example: Device(config-if)# end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

### 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:

```plaintext
! interface Virtual-Template1
   ip unnumbered vml1
   service-policy output FQ
! interface vml1
   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:

```plaintext
interface Virtual-Template1
   ip unnumbered vml1
   ipv6 enable
   service-policy output FQ
```
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:

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
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:

```
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
```

Multicast for Virtual Multipoint Interfaces
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 vml1
  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
!
!
Multicast for Virtual Multipoint Interfaces
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
tenet 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:

```plaintext
!
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
!
!
!
mqcp fax t38 ecm
!
!
line con 0
  exec-timeout 0 0
login local
line aux 0
line vty 0 4
  access-class 23 in privilege 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


Multicast for Virtual Multipoint Interfaces

Example: OSPFv3 for IPv6 Multicast Traffic Using Bypass Mode
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

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Multicast commands</td>
<td>Cisco IOS Multicast Command Reference</td>
</tr>
</tbody>
</table>
| 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

<table>
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<th>Description</th>
<th>Link</th>
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<tr>
<td>The Cisco Support and Documentation website provides online resources to</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
<tr>
<td>download documentation, software, and tools. Use these resources to install</td>
<td></td>
</tr>
<tr>
<td>and configure the software and to troubleshoot and resolve technical</td>
<td></td>
</tr>
<tr>
<td>issues with Cisco products and technologies. Access to most tools on the</td>
<td></td>
</tr>
<tr>
<td>Cisco Support and Documentation website requires a Cisco.com user ID and</td>
<td></td>
</tr>
<tr>
<td>password.</td>
<td></td>
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</table>
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>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
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<tbody>
<tr>
<td>Multicast for Virtual Multipoint Interfaces</td>
<td>15.1(3)T</td>
<td>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.</td>
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</table>