Cisco Remote PHY Device Downstream Virtual Splitting

This document provides information on how to configure downstream virtual splitting on Remote PHY systems.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see 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 at the end of this document.

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

Hardware Compatibility Matrix for Cisco Remote PHY Device

Note   Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Device Software Release are supported in all subsequent releases.

Table 1: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases
	Cisco Remote PHY Device 2x2
	PID—RPD-2X2=

Information about RPD Downstream Virtual Splitting

The primary use case for multicast delivery between CCAP-core and the RPD is for the delivery of broadcast video services from a single CCAP-core element to a number of RPDs. This allows the system to scale by allowing a single CCAP-core element to generate and serve streams to all the RPDs that are configured to receive the same broadcast lineup. Since broadcast serving groups are quite large (~100,000 or more subscribers), using multicast to deliver the same copy to hundreds of remote PHY devices provides significant cost savings for operators. This mechanism can be used for broadcast video delivered via MPEG QAM channels or for that delivered via IP over DOCSIS. It is meant for the replication of an entire QAM channel to multiple RPDs.

Configure RPD Downstream Virtual Splitting

This section describes how to configure RPD Downstream Virtual Splitting on Cisco cBR-8.

Note   To know more about the commands referenced in this module, see the Cisco IOS Master Command List.

Configure Multicast DEPI Pool

To configure the multicast DEPI pool, complete the following procedure:

```
configure terminal
cable depi multicast pool id
{ip|ipv6} address ip mask
```

To verify the multicast DEPI pool configuration, use the **show cable depi multicast pool** command as shown in the example below:

```
Router# show cable depi multicast pool
Load for five secs: 4%/0%; one minute: 5%; five minutes: 5%
No time source, *09:23:41.545 CST Mon Apr 23 2018
POOL ID    Net IP          Net Mask        Redundant DESCRIPTION
1          227.0.0.0       255.255.255.0   FALSE
2          228.0.0.0       255.255.254.0   FALSE
127        227.226.225.0   255.255.255.0   FALSE     to TE9/1/1+TE9/1/7

POOL ID    IPv6                                      Redundant DESCRIPTION
6          FF3A::9000:0/126                          FALSE
```

Configure Redundant Multicast DEPI Pool

When a secondary line card is configured, multicast IP addresses are assigned to its downstream controllers from the redundant multicast DEPI pool.

To configure the redundant multicast DEPI pool, complete the following procedure:

```
configure terminal
cable depi multicast pool id
redundant
```

To verify the multicast DEPI pool configuration, use the **show cable depi multicast pool** command as shown in this example:

```
Router# show cable depi multicast pool
Load for five secs: 4%/0%; one minute: 4%; five minutes: 4%
No time source, *14:14:13.780 CST Tue Aug 7 2018
POOL ID     Net IP           Net Mask        Redundant DESCRIPTION
1           227.0.0.0        255.255.0.0     FALSE
127         227.226.225.0    255.255.255.0   FALSE     to TE9/1/1+TE9/1/7

POOL ID     IPv6                                       Redundant DESCRIPTION
2           FF39::8000:0/120                           FALSE
4           FF39::9000:0/112                           TRUE
```

To view the IPv6 addresses assigned to the secondary linecard downstream controllers, use the **show cable depi multicast ipv6 all** command as shown in this example:

```
Router# show cable depi multicast ipv6 all
Load for five secs: 5%/0%; one minute: 5%; five minutes: 4%
No time source, *14:15:08.476 CST Tue Aug 7 2018
IPv6                                       POOL ID     CONTROLLER
FF39::9000:0                               4           0/0/0(1-Te0/1/0)
FF39::9000:8                               4           0/0/1(2-Te0/1/0)
FF39::9000:10                              4           0/0/2(3-Te0/1/0)
FF39::9000:18                              4           0/0/3(4-Te0/1/0)
FF39::9000:20                              4           0/0/4(5-Te0/1/0
```

Note

- To view the IPv4 addresses, use the **show cable depi multicast ip all** command.

- One redundant DEPI pool is available for either IPv4 or IPv6 addresses.

- If you do not configure redundant pool, secondary linecard downstream controllers use the same IP as the downstream controllers in the primary linecard.

- You cannot use the redundant multicast pool in the downstream controller profile configuration.

- DEPI multicast pool can be configured as redundant pool if DEPI multicast pool contains less than 266 IP addresses, and if line card high avaiability is configured on the Cisco cBR-8.

Enable Multicast Sharing under Downstream Controller Profile

To enable the multicast sharing under downstream controller profile, complete the following procedure:

```
configure terminal
cable downstream controller-profile id
multicast-pool id
```

Then configure the other parameters of the controller profile and related RF channels.

You can change the multicast pool for the downstream sharing controllers without configuring the RPD. See the following example for detailed configuration:

```
Router#config terminal
Router(config)#cable downstream controller-profile 111
Warning: changes to this profile will affect the following controllers:
Downstream controller-profile 111 is being used by controller Downstream-Cable:
        6/0/0,  6/0/1,

Confirm to continue? [no]: yes
Router(config-controller-profile)#multicast-pool 50
This profile is being used by the following RPDs:
Controller RPD DS Port List:
  RPD ID           I/F       Name
  ---------------- --------- ----------------
  0004.9f03.0214   Te6/1/0   rpd_b
  000c.2923.9991   Te6/1/0   rpd_a               ...

Confirm to continue? [no]: yes
```

To verify the multicast sharing is enabled under the downstream controller profile, use the **show cable downstream controller-profile** command as shown in the example below:

```
Router# show cable downstream controller-profile 1
Load for five secs: 8%/1%; one minute: 10%; five minutes: 10%
No time source, *07:14:32.551 CST Tue Nov 15 2016
Downstream controller-profile 1
Description:
Downstream controller-profile 1 is being used by controller Downstream-Cable:
  3/0/0,
  Admin:  UP
  MaxOfdmSpectrum: 0
  MaxCarrier: 128
  BasePower: 33.0 dBmV
  Mode: normal
  Frequency profile: unconfigured
  DS Splitting: Yes
  Multicast Pool ID: 1
```

Configure the RPD with the Same Downstream Controller and Profile

To configure the RPDs with the same downstream controller and profile, complete the following procedure:

```
configure terminal
cable rpd name
identifier id
core-interface TenGigabitEthernet slot/subslot/port
principal
rpd-ds 0 downstream-cable slot/subslot/port profile id
rpd-us 0 upstream-cable slot/subslot/port profile id
r-dti id
rpd-event profile id
rpd-55d1-us-event profile id
```

Note Configure at least 2 RPDs with the same downstream controller and profile to implement the multicast DEPI.

Configure the RPDs to different fiber-nodes

To configure the RPDs to different fiber-nodes, complete the following procedure:

```
configure terminal
cable fiber-node id
downstream Downstream-Cable slot/subslot/port
upstream Upstream-Cable slot/subslot/port
```

Note Configure at least 2 fiber-nodes with the same downstream controller to implement the multicast DEPI.

Configure the RPDs to MAC Domain

To configure the RPDs to the MAC domain, complete the following procedure:

```
configure terminal
interface cable slot/subslot/port
downstream Downstream-Cable slot/subslot/port rf-channel id
upstream index Upstream-Cable slot/subslot/port us-channel index
cable upstream index jumbo-grants
cable upstream balance-scheduling
cable upstream bonding-group id
upstream id
attributes 800000F0
cable bundle id
cable map-advance static value
cable sid-cluster-group num-of-cluster value
cable sid-cluster-switching max-request value
```

Note Different RPDs can be configured to share the same downstream controller under one MAC domain or different MAC domains.

Enable Multicast on Cisco cBR-8 Router

To enable the multicast on cBR-8, complete the following procedure:

```
configure terminal
ip multicast-routing distributed
```

Enable Multicast on Layer 2 Switch

To enable multicast on Layer 2 switch, complete the following procedure:

```
configure terminal
ip igmp snooping
vlan configuration vlan
ip igmp snooping querier ip
```

Only need to create IGMP Snooping Group on one switch between DPIC and RPD.

Create IGMP Snooping Group under vlan which is used for connection between DPIC and RPD.

IP address used for IGMP snooping querier can be any address that is not conflict with the existing IP address in the system.

Enable Multicast on Layer 3 Router

To enable multicast on Layer 3 router, complete the following procedure:

```
configure terminal
ip pim ssm default
interface gigabitEthernet 0/0/0
ip pim sparse-dense-mode
ip igmp version 3
```

SSM must be enabled on all routers between DPIC and RPD.

All PIM neighbor must be enabled on all routers.

PIM neighbor can use sparse-dense-mode or sparse-mode.

Verify RPD Downstream Virtual Splitting Configuration on cBR-8 Side

To verify the RPD Downstream Virtual Splitting configuration on cBR-8 side, complete the procedure as shown in the example below, and check if these criteria are met:

- The remote session ID begins with 0x8 in the output of the **show cable rpd depi | in Ds** command.

```
Router# show cable rpd depi | in Ds
0x40003F21 0x80003D22 1377638051 Ds3/0/0:0    est   04:20:36 1      P
0x40003F31 0x80003D32 1377638051 Ds3/0/0:16   est   04:20:35 3      P
0x40003F41 0x80003D42 1377638051 Ds3/0/0:32   est   04:20:35 5      P
0x40003F39 0x80003D3A 1377638051 Ds3/0/0:24   est   04:20:35 4      P
0x40003F29 0x80003D2A 1377638051 Ds3/0/0:8    est   04:20:34 2      P
0x40103F21 0x80003D22 1404837649 Ds3/0/0:0    est   00:07:21 14     P
0x40103F39 0x80003D3A 1404837649 Ds3/0/0:24   est   00:07:21 17     P
0x40103F41 0x80003D42 1404837649 Ds3/0/0:32   est   00:07:21 18     P
0x40103F29 0x80003D2A 1404837649 Ds3/0/0:8    est   00:07:21 15     P
0x40103F31 0x80003D32 1404837649 Ds3/0/0:16   est   00:07:21 16     P
```

- There is assigned IP and pool ID in the output of the **show cable depi multicast ip all** command.

```
Router# show cable depi multicast ip all
Load for five secs: 7%/2%; one minute: 8%; five minutes: 8%
No time source, *23:00:55.344 CST Sun Nov 13 2016
ASSIGNED IP      POOL ID    CONTROLLER
225.225.225.0    1          3/0/0
```

- The cable modem is online in the output of the **show cable modem rpd** command.

```
Router# show cable modem
Load for five secs: 8%/3%; one minute: 9%; five minutes: 9%
No time source, *16:06:52.191 CST Thu Mar 2 2017

 D
MAC Address     IP Address     I/F          MAC          Prim  RxPwr  Timing Num
 I
                                            State        Sid   (dBmv) Offset CPE
 P
5039.558a.6c1c 40.242.0.17    C7/0/0/U1    online       5     0.50   816    0
 N
5039.558a.754a 40.242.9.201   C7/0/0/U0    online       6     0.00   814    0
 N
5039.558a.754e 40.242.9.207   C7/0/0/U0    online       7     0.00   814    0
 N
5039.558a.6b98 40.242.0.16    C7/0/0/U0    online       8     0.00   817    0
 N
0025.2e34.4380 40.242.62.172  C7/0/1/U1    online       2     0.00   783    0
 N


Router# show cable rpd
Load for five secs: 8%/3%; one minute: 9%; five minutes: 9%
No time source, *16:06:55.706 CST Thu Mar 2 2017

MAC Address     IP Address     I/F       State     Role HA  Name
0004.9f03.0214  120.105.4.7    Te7/1/0   online    Pri  Act rpd_b
000c.2923.9991  120.105.4.6    Te7/1/0   online    Pri  Act rpd_a
000c.2923.9991  120.105.4.6    Te6/1/0   online    Aux  Act rpd_a


Router# show cable modem rpd 0004.9f03.0214
Load for five secs: 8%/3%; one minute: 9%; five minutes: 9%
No time source, *16:07:07.790 CST Thu Mar 2 2017

 D
MAC Address     IP Address     I/F          MAC          Prim  RxPwr  Timing Num
 I
                                            State        Sid   (dBmv) Offset CPE
 P
5039.558a.6c1c 40.242.0.17    C7/0/0/U1    online       5     0.50   816    0
 N
5039.558a.754a 40.242.9.201   C7/0/0/U0    online       6     0.00   814    0
 N
5039.558a.754e 40.242.9.207   C7/0/0/U0    online       7     0.00   814    0
 N
```

Verify RPD Virtual Downstream Splitting Configuration on Node Side

To verify the RPD Downstream Virtual Splitting configuration on node side, complete the procedure on RPD as shown in the example below, and check if these criteria are met:

- All L2TP session ID must be start with 800.

```
RPD# show l2tp session
L2TP Tunnel Information Total tunnels 1 sessions 13
LocSessID RemSessID LocTunID  RemTunID  State Type     Last Chg
80003d22  40103f21  9fef9255  53bc1f11  est   MCM      07:10:54 2016-11-13
80003d2a  40103f29  9fef9255  53bc1f11  est   MCM      07:10:57 2016-11-13
80003d42  40103f41  9fef9255  53bc1f11  est   MCM      07:10:56 2016-11-13
```

```
80003d32   40103f31   9fef9255   53bc1f11   est   MCM        07:10:59 2016-11-13
80003d3a   40103f39   9fef9255   53bc1f11   est   MCM        07:10:56 2016-11-13
```

• All downstream DEPI SrcIP must be multicast IP that is the same as cBR-8 side.

```
RPD# show downstream depi configuration
Channel PwSubtype     SessionId  SrcIp
0       MCM           2147499298 225.225.225.0
8       MCM           2147499306 225.225.225.0
16      MCM           2147499314 225.225.225.0
24      MCM           2147499322 225.225.225.0
32      MCM           2147499330 225.225.225.0
```

Example: RPD Downstream Virtual Splitting Configuration

The following example shows how to configure RPD Downstream Virtual Splitting:

```
Router# configure terminal
Router(config)# cable depi multicast pool 1
Router(config-multicast-pool)# ip address 225.225.225.0 255.255.255.0
Router(config-multicast-pool)# exit
Router(config)# cable downstream controller-profile 0
Router(config-controller-profile)# multicast-pool 1
Router(config-controller-profile)# max-carrier 128
Router(config-controller-profile)# base-channel-power 34
Router(config-controller-profile)# rf-chan 0 95
Router (config-prof-rf-chan)# type DOCSIS
Router (config-prof-rf-chan)# frequency 285000000
Router (config-prof-rf-chan)# rf-output NORMAL
Router (config-prof-rf-chan)# qam-profile 1
Router (config-prof-rf-chan)# power-adjust 0
Router (config-prof-rf-chan)# docsis-channel-id 1
Router (config-prof-rf-chan)# end
Router# configure terminal
Router(config)# cable rpd node_1
Router(config-rpd)# identifier 0004.9f03.0214
Router(config-rpd)# core-interface Te9/1/0
Router(config-rpd-core)# principal
Router(config-rpd-core)# rpd-ds 0 downstream-cable 9/0/0 profile 0
Router(config-rpd-core)# rpd-us 0 upstream-cable 9/0/0 profile 221
Router(config-rpd-core)# exit
Router(config-rpd)# r-dti 20
Router(config-rpd)# rpd-event profile 0
Router(config-rpd)# rpd-55d1-us-event profile 0
Router(config-rpd)# exit
Router(config)# cable rpd node_2
Router(config-rpd)# identifier 000c.2923.9991
Router(config-rpd)# core-interface Te9/1/0
Router(config-rpd-core)# principal
Router(config-rpd-core)# rpd-ds 0 downstream-cable 9/0/0 profile 0
Router(config-rpd-core)# rpd-us 0 upstream-cable 9/0/1 profile 221
Router(config-rpd-core)# exit
Router(config-rpd)# r-dti 20
Router(config-rpd)# rpd-event profile 0
Router(config-rpd)# rpd-55d1-us-event profile 0
Router(config-rpd)# exit
Router(config)# cable fiber-node 100
Router(config-fiber-node)# downstream Downstream-Cable 9/0/0
Router(config-fiber-node)# upstream Upstream-Cable 9/0/0
Router(config-fiber-node)# exit
Router(config)# cable fiber-node 101
```

```
Router(config-fiber-node)# downstream Downstream-Cable 9/0/0
Router(config-fiber-node)# upstream Upstream-Cable 9/0/1
Router(config-fiber-node)# exit
Router(config)# interface Cable 9/0/0
Router(config-if)# downstream Downstream-Cable 9/0/0 rf-channel 0
Router(config-if)# downstream Downstream-Cable 9/0/0 rf-channel 8
Router(config-if)# upstream 0 Upstream-Cable 9/0/0 us-channel 0
Router(config-if)# upstream 1 Upstream-Cable 9/0/0 us-channel 1
Router(config-if)# upstream 2 Upstream-Cable 9/0/0 us-channel 2
Router(config-if)# upstream 3 Upstream-Cable 9/0/0 us-channel 3
Router(config-if)# upstream 4 Upstream-Cable 9/0/1 us-channel 0
Router(config-if)# upstream 5 Upstream-Cable 9/0/1 us-channel 1
Router(config-if)# upstream 6 Upstream-Cable 9/0/1 us-channel 2
Router(config-if)# upstream 7 Upstream-Cable 9/0/1 us-channel 3
Router(config-if)# cable upstream 0 jumbo-grants
Router(config-if)# cable upstream balance-scheduling
Router(config-if)# cable upstream bonding-group 1
Router(config-upstream-bonding)# upstream 0
Router(config-upstream-bonding)# upstream 1
Router(config-upstream-bonding)# upstream 2
Router(config-upstream-bonding)# upstream 3
Router(config-upstream-bonding)# attributes 800000F0
Router(config-upstream-bonding)# exit
Router(config-if)# cable upstream bonding-group 2
Router(config-upstream-bonding)# upstream 4
Router(config-upstream-bonding)# upstream 5
Router(config-upstream-bonding)# upstream 6
Router(config-upstream-bonding)# upstream 7
Router(config-upstream-bonding)# attributes 8000000F
Router(config-upstream-bonding)# exit
Router(config-if)# cable bundle 1
Router(config-if)# cable map-advance static 1000
Router(config-if)# cable sid-cluster-group num-of-cluster 2
Router(config-if)# cable sid-cluster-switching max-request 2
Router(config-if)# exit
Router(config)# ip multicast-routing distributed
Router(config)# interface TenGigabitEthernet 9/1/0
Router(config-if)# ip address 192.168.3.1 255.255.255.0
Router(config-if)# end
```

Feature Information for RPD Downstream Virtual Splitting

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 RPD Downstream Virtual Splitting

Feature Name	Releases	Feature Information
DS virtual splitting	Cisco 2x2 RPD Software 2.x	This feature was introduced on the Cisco 2x2 Remote PHY Device.