M-CMTS DEPI

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The Downstream External PHY Interface (DEPI) is a communication protocol between the Modular Cable Modem Termination System (M-CMTS) core and the Edge Quadrature Amplitude Modulation (EQAM). It is an IP tunnel between the MAC (M-CMTS core) and PHY (EQAM) in an M-CMTS system, which contains both a data path for Data-Over-Cable Service Interface Specifications (DOCSIS) frames and a control path for setting up, maintaining, and tearing down data sessions.

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 for M-CMTS DEPI" section on page 182.

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

Contents

Prerequisites

Note The hardware components introduced in a given Cisco IOS Release are supported in all subsequent releases unless otherwise specified.

Table 1 Cable Hardware Compatibility Matrix for M-CMTS DEPI

Platform	Processor Engine	Cable Interface Cards
Cisco RF Gateway 10	Cisco IOS Release 12.2(50)SQ • Supervisor V-10GE engine card	• Cisco RFGW-10 DS-48 • Cisco RFGW-10 DS-48-1G
Cisco RF Gateway 10	Cisco IOS-XE Release 3.2.0SQ • Supervisor engine SUP 7-E-card	• Cisco RFGW-10 DS-48 • Cisco RFGW-10 DS-48-1G • Cisco RFGW-10 DS-384

Restrictions

- DOCSIS MPEG-TS (DMPT) mode is supported on the M-CMTS.

Information About M-CMTS DEPI

To configure the M-CMTS DEPI feature, you should understand the following concepts:

DEPI

DEPI is based on Layer Two Tunneling Protocol-Version 3 (L2TPv3) protocol. The formatted DOCSIS frames or MPEG packets from the M-CMTS are transported through Layer 2 or Layer 3 and delivered to the EQAM for transmission. The line card receives DEPI data packets from the Cisco CMTS, and converts the DOCSIS data in the DEPI payload to RF QAM signals in a Hybrid Fiber Coax (HFC) network.

DEPI uses two types of messages to communicate between the M-CMTS and the EQAM—DEPI control message and the DEPI data message (data packet).

The DEPI Control message is used to establish control connections and data sessions between the M-CMTS core and the PHY EQAM. The control messages are terminated on the Supervisor card, and are handled by the Supervisor IOS software. The DEPI data message is used to carry the DOCSIS data from the M-CMTS core to the PHY EQAM. The DEPI data messages are terminated and handled by the line card. The Supervisor engine handles the control connections and session setup for DEPI traffic and sends messages to the line card.

The DEPI control plane is based on L2TPv3 signalling. The DEPI process is initiated by the M-CMTS core. The control channel allows for signaling messages to be sent between the M-CMTS core and EQAM. Typical control messages are set up using a *control connection* between the M-CMTS core and EQAM. An L2TP session is established before L2TP begins to forward session frames for data. Multiple sessions may be bound to a single control connection.

DEPI data packet processing (manual DEPI configuration) uses the L2TPv3 protocol over IP. The EQAM initiates the DEPI process by forwarding the DEPI data message packets from the EQAM to the M-CMTS core. The destination IP address of the EQAM and the session ID of the L2TPv3 header of each packet is used to identify the destination of the packet to the QAM channel. The session ID is negotiated between the M-CMTS core and the EQAM through the DEPI control plane protocol or configured manually on the M-CMTS and the EQAM.

Two basic encapsulation techniques exist for DOCSIS—the DOCSIS MPT (DMPT) mode and the Packet Streaming Protocol (PSP) mode.

DMPT places integer number of MPEG transport packets (TP) into the L2TP payload. This mode is defined for interoperability with legacy video QAM devices. Only one DMPT flow can be present in a QAM channel. The EQAM extracts the MPEG transport packets within the DEPI payload and forwards them to the output QAM.

Bonded DOCSIS through downstream channel bonding is a technique of grouping multiple QAM channels into a bonding group to provide a logical downstream channel with larger aggregated bandwidth. Bonded traffic can be encapsulated in DMPT. In DMPT mode, the DOCSIS frame is first encapsulated in 188-byte MPEG-TS packets and then placed into the L2TPv3. You can place up to 7 MPEG-TS packets in a single IP packet.

DMPT traffic from the M-CMTS Core contains SYNC messages (DOCSIS time stamps). The EQAM finds all the SYNC messages in the DMPT payload and corrects the SYNC values.

The DMPT mode is considered *best-effort* mode. This means that all attempts are made to process the DMPT data with the lowest delay through both the network and the EQAM, but no guarantee of quality of service (QoS) is offered.

Note The DEPI configuration with the DMPT mode for session setup is used on the Cisco RFGW-10. PSP mode is *not* supported in this release.

DEPI Latency Measurement

The DEPI Latency Measurement (DLM) packet is a special type of data packet used for measuring the network latency between the M-CMTS core and the EQAM. There are two types of DLM packets—ingress DLM packet and egress DLM packet. The ingress DLM measures the latency between the M-CMTS core and the ingress point in the EQAM. The egress DLM measures the latency between the M-CMTS core and the egress point of the EQAM. The DEPI control plane is supported with a direct connection between the shared port adapter (SPA) and the EQAM, or between the Cisco uBR-MC3GX60V line card and the EQAM.

Manual DEPI Configuration

The following section describe manual DEPI sessions on the Cisco RFGW-10:

- Manual DEPI Data Sessions, page 120
- QAM-Port Load Balancing Group, page 121
- Benefits, page 121

Manual DEPI Data Sessions

The session ID in the L2TPv3 header identifies data packets as DMPT or PSP. The session IDs are manually configured on the EQAM and the M-CMTS core.

In the earlier Cisco IOS Releases, DEPI session IDs could be configured manually at the QAM subinterface. Starting with Cisco IOS-XE Release 3.2.0SQ, the 32-bit session IDs are generated internally for the DEPI sessions. These session IDs are configured manually on the M-CMTS node, thus improving the performance of the system with higher session load for new line cards.

In Cisco IOS-XE Release 3.2.0SQ, all QAM channels on the RF port can be used for DEPI, when the QAM subinterface is configured for DEPI. QAM-port load balancing groups are assigned to QAM channels while configuring local DEPI sessions.

Cisco IOS-XE Release 3.2.0SQ supports global templates or profiles on the Cisco RFGW-10 DS-384 line card. Each port on the Cisco RFGW10 DS-384 line card provides a frequency range from 45 MHz to 1003 MHz. The Supervisor card uses two frequency schemes—static frequency scheme and the user-defined frequency scheme—to configure the frequency profile at the port level. RF profiles can be created globally at the chassis level and applied to any QAM channel on the Cisco RFGW-10 DS-384 line card. The RF profiles are used for grouping QAM channels with the same modulation, annex mode, symbol rate, and interleaver depth. For more information, see Configuring the Cisco RFGW-10 DS-384 Line Card.

QAM-Port Load Balancing Group

A QAM-port load balancing group is a QAM block or midplane 10 Gigabit Ethernet interface. It is used for load balancing the data sessions across two midplane 10 Gigabit Ethernet interfaces.

Note QAM-port load balancing groups are required for configuring manual DEPI sessions. For remote DEPI sessions, these groups are dynamically assigned.

Two QAM-port load balancing groups exist per line card. The QAM channels are equally divided between the two QAM-port load balancing groups on any line card. Each QAM-port load balancing group supports 192 carriers for the Cisco RFGW-10 DS-384 line card, and 24 carriers for the Cisco RFGW-10 DS-48 line card. The **show cable linecard load-balancing-group** command lists the current carriers on the line card

Benefits

- The DEPI manual configuration uses the L2TPv3 protocol.

DEPI Control Plane Configuration

This section describes the DEPI control plane on the Cisco RFGW-10:

DEPI Control Plane Sessions

For both primary and non-primary downstream channels, the DEPI data session is established when the DEPI control connection is active. The Transport Stream Identifier (TSID) must be configured on both the EQAM and the M-CMTS router because it is used to bind a physical QAM of the EQAM to the logical wideband channel. Only the M-CMTS router initiates the DEPI data session creation, not the EQAM.

Benefits

- The DEPI control plane provides the capability to detect failures in a multi-hop network between the M-CMTS router and EQAM.
- The Cisco RFGW-10 (EQAM) learns the configuration from the M-CMTS router via the DEPI control plane.
- The DEPI control plane facilitates an automatic and accurate method to determine delay via the DLM.
- The DEPI control plane allows interoperability.

Difference Manual DEPI and DEPI Control Plane Configuration

The manual DEPI configuration also supports N+1 DEPI redundancy and port-level redundancy on the Cisco uBR-MC3GX60V line card.

The following are the differences between the manual DEPI and control plane DEPI configuration:

- In manual DEPI configuration, you do not have to configure the protect tunnel. The working card configuration is automatically applied to the protect card through IPC messages. In DEPI control plane redundancy, you must configure the protect tunnel on both the EQAM and the M-CMTS router.
- For manual DEPI configuration, the Gig Ethernet ports on the Cisco uBR-MC3GX60V line card must be in active-passive mode.
- The DEPI connection between the EQAM and the M-CMTS router is static in manual DEPI configuration. Whereas, the data sessions are established dynamically in the DEPI control plane configuration.

DEPI Control Connections

Configuring a DEPI tunnel on a SPA or Cisco uBR-MC3GX60 line card downstream channel will establishes a DEPI control connection (if it does not exist). The M-CMTS router (not the EQAM) initiates the control session connection. At least one DEPI control connection must exist for each SPA or Cisco uBR-MC3GX60 line card, which has RF channels configured, to establish a DEPI session with an EQAM. There can be multiple control connections from one SPA or Cisco uBR-MC3GX60 line card to one or more EQAMs. When a DEPI control connection is disconnected, all the associated DEPI data sessions are disconnected.

When the primary link on the SPA or Cisco uBR-MC3GX60 line card toggles more than five times within 30 seconds, and the secondary link is up, the secondary link is selected for traffic. The link switches back to the primary link during the next primary link transition after 30 seconds or when the secondary link fails. To get the primary port link toggle information, use the **show controller modular-cable** command. To get the primary (port0) or secondary link (port1) status, use the **show controller gigabitEthernet** command.

DEPI Reconciliation Timeout

DEPI reconciliation timeout is the specified duration of the control plane reconciliation, after which the data plane becomes idle. The DEPI reconciliation timeout by default is set to 60 seconds.

Effective with Cisco IOS-XE Release 3.3.1SQ, the DEPI reconciliation timeout configuration can be changed using the command **cable downstream depi-session timeout**.

It is recommended to have DEPI reconciliation timeout configuration during the line card or route processor switchover in CMTS and Cisco RFGW-10.

DEPI SSO

The Cisco RFGW-10 Supervisor card redundancy and the route processor (RP) redundancy on the Cisco uBR10012 router in stateful switchover (SSO) mode support both DEPI manual mode and DEPI protocol mode (control plane DEPI). Minimal disruption might occur in the manual DEPI in the case of RP redundancy on the Cisco uBR10012 router. The control plane and data sessions are re-established after the RP switchover in control plane DEPI while the data plane non-stop forwarding continues to send DEPI data traffic to the EQAM.

With Supervisor card redundancy, the Supervisor card switchover does not affect the statically configured DEPI connections in DEPI manual mode. Hence, the switchover interruption to DEPI data traffic is in subseconds. In DEPI protocol mode, the DEPI control plane is SSO-unaware as the underlying IOS L2TPv3 protocol is SSO-unaware. Neither the L2TPv3 protocol state nor the DEPI state is check pointed from the active Supervisor card to the standby Supervisor card. During Supervisor card switchover, the DEPI control plane and data plane are recovered as follows with minimal service outage time:

- DEPI control plane and data plane re-establishment: During the Supervisor card switchover, the newly active Supervisor card re-establishes the DEPI control connections and data sessions with its M-CMTS peer. The IDs of the re-established sessions fall into the same DEPI session ID range as before.
- DEPI data plane non-stop forwarding: While the newly active Supervisor card is re-establishing the DEPI connections and data sessions, the Cisco RFGW-10 receives and processes DEPI data traffic that the M-CMTS router continues to forward through the existing data sessions. This non-stop forwarding function minimizes the service outage time for a couple of seconds. The existing data sessions are removed after the new sessions are established.

For more information on the Supervisor card Redundancy, see *1:1 Supervisor Card Redundancy* feature guide.

DEPI Path Redundancy and N+1 DEPI Redundancy

Cisco IOS Release 12.2(50)SQ2 introduces support for DEPI Path Redundancy (DPR), which is used in conjunction with N+1 DEPI control plane redundancy for the Cisco uBR-MC3GX60V line card. This feature allows you to configure a backup DEPI session on the protect card using the **protect-tunnel** command in DEPI tunnel configuration mode. In this mode, the protect line card has a fully operational secondary DEPI control connection and sessions for the QAM channels on the working line card. The primary DEPI control connection and session is established on the Gig Ethernet ports on the working line card. These primary and secondary DEPI sessions are paired using the common TSID, which uniquely identifies the target QAM channel.

Note The output of the **show hccp linecard detail** command displays "APP Switch" for "last_switch_reason" if a line card switchover is triggered by DEPI.

Note The N+1 DEPI redundancy feature is supported only on the Cisco uBR-MC3GX60 line card. This feature is not supported on the Cisco Wideband SPA.

The N+1 DEPI redundancy feature requires an EQAM that supports data path redundancy based on CableLabs Downstream External PHY Interface Specification (CM-SP-DEPI-I08-100611).

The Cisco uBR-MC3GX60V line card supports up to six DEPI tunnels per Gigabit Ethernet port and a separate DEPI session per downstream channel. Each DEPI session is associated with only one DEPI tunnel and multiple DEPI sessions can be associated with a single DEPI tunnel.

In an N+1 DEPI redundancy, the protect line card initiates DEPI control sessions on each QAM channel at bootup. When the M-CMTS router detects a line card failure, the protect line card enables all the sessions that were backing up the sessions of the failed line card.

The network connectivity must be set up to ensure that the Cisco RFGW-10 is reachable through the protect Cisco uBR-MC3GX60V line card.

Gigabit Ethernet Port-level Redundancy

The port-level redundancy is configured by default on the Cisco Wideband SPA and Cisco uBR-MC3GX60V line card. You do not have to manually configure the Gigabit Ethernet port-level redundancy on the M-CMTS router.

DEPI CIN and VRF

The Converged Interconnect Network (CIN) is the standard term used for the network between the M-CMTS and the RFGW-10. This network can be a direct connection or a Layer 2 or Layer 3 network. Because the CIN is a private network, a virtual routing and forwarding (VRF) instance ensures that only valid traffic is routed to it by removing the IP Address of the interface from the global routing table (and from the interface).

Note Layer 3 CIN support is limited to when the primary Gigabit Ethernet link of the M-CMTS DEPI port is connected directly to the EQAM and the secondary link is connected through a Layer 3 router. The Layer 3 router between the M-CMTS and the EQAM must support modification of the MAC addresses on its Layer 3 interface.

VRF for DEPI session is used only on the M-CMTS router. It is recommended that VRF should be configured for the Gigabit Ethernet interfaces to ensure that the CIN routes are isolated from the default routing table of the M-CMTS router. When connecting two SPAs to a Layer 2 CIN, the Gigabit Ethernet interfaces for these SPAs must be configured with different VRFs.

PortFast mode-enabled switches must be used when Gigabit Ethernet link redundancy is configured for the Gigabit Ethernet interfaces. For information on the switches that support the PortFast mode, see http://www.cisco.com/en/US/tech/tk389/tk621/technologies_tech_note09186a008009482f.shtml.

DEPI EQAM Statistics

The DEPI EQAM Statistics feature enables EQAM to send QAM channel statistics to the M-CMTS router for all data sessions in every DEPI tunnel. Support for this feature is introduced in Cisco IOS Release 12.2(50)SQ2. The DEPI EQAM Statistics feature is configured by default on the M-CMTS router. To disable this configuration use the **no** form of the **depi eqam-stats** command in global configuration mode.

Note Cisco RFGW-10 sends EQAM statistics to the M-CMTS router. No other EQAM supports the EQAM Statistics feature.

To verify EQAM statistics, use the **show depi session** command with the **verbose** keyword in privileged EXEC mode.

How to Configure Manual DEPI

This section describes how to configure DEPI manually on the M-CMTS router and Cisco RFGW-10:

- Configuring Manual DEPI on the M-CMTS Router, page 125
- Configuring Manual DEPI on the Cisco RFGW-10, page 129

Prerequisites

- To configure manual DEPI sessions, the bandwidth should be specified for the midplane. Use the **cable mode depi local lbg** *lbg-interface* command to configure the QAM channel with the QAM-port load balancing group to forward traffic to the line card.
- Session IDs (**depi-remote-id**) cannot be configured. The 32-bit session IDs generated by the Cisco RFGW-10 are used by the RF channels on the Cisco CMTS. Use the **cable depi-sessions manual summary** command to view the session ID of a data session.

Note If the channel IDs and the QAM-port load balancing groups are not changed on the Cisco RFGW-10, the 32-bit session IDs are preserved across the Cisco RFGW-10 until the line card reloads.

- The RF power specified on the Cisco CMTS needs to be within the allowed power range on the QAM channel. The allowed power range varies with the density specified at the port.
- The SPA controller configuration on the Cisco uBR10012 router should match both the EQAM Gigabit Ethernet and 10 Gigabit Ethernet configuration, and the RF configuration.
- The *dest_ip_address* must be of the front panel Gigabit Ethernet port on the Cisco RFGW-10 UEQAM that is connected to the SPA on the Cisco uBR10012 router.

Configuring Manual DEPI on the M-CMTS Router

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*}
4. **modular-host subslot** *slot*/*subslot*
5. **rf-channel** *rf-channel* **cable downstream channel-id** *channel-id*
6. **rf-channel** *rf-channel* **frequency** *freq* [**annex** {**A** | **B**} **modulation** {**64** | **256**} [**interleave-depth** {**8** | **12** | **16** | **32** | **64** | **128**}]]
7. **rf-channel** *rf-channel* **ip-address** *dest_ip_address* **mac-address** *dest_mac_address* **depi-remote-id** session_*id*
8. **rf-channel** *rf-channel* **rf-power** *power-level*
9. **no rf-channel** *rf-channel* **rf-shutdown**
10. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*} **Example:** `Router(config)# controller modular-cable 1/0/0`	Specifies the modular cable controller interface for the SPA or the line card. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *bay*—Bay in a SIP where a SPA is located. The valid values are 0 (upper bay) and 1 (lower bay). • *port*—Interface number on the SPA. • *subslot*—Cable interface line card subslot. The valid values are 0 and 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.
Step 4	**modular-host subslot** *slot*/*subslot* **Example:** `Router(config-controller)# modular-host subslot 6/0`	Specifies the modular host line card that is used for DOCSIS 3.0 downstream or downstream channel bonding operations.
Step 5	**rf-channel** *rf-channel* **cable downstream channel-id** *channel-id* **Example:** `Router(config-controller)# rf-channel 0 cable downstream channel-id 24`	Assigns a downstream channel ID to an RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. The valid values for the RF port depend on the configuration of the annex modulation. • *channel-id*—Unique channel ID. The valid range is from 1 to 255.

	Command or Action	Purpose
Step 6	**rf-channel** *rf-channel* **frequency** *freq* [**annex** {**A** | **B**} **modulation** {**64** | **256**} [**interleave-depth** {**8** | **12** | **16** | **32** | **64** | **128**}]] **Example:** `Router(config-controller)# rf-channel 0 freq 555000000 annex B mod 64qam inter 32`	Configures the frequency of an RF channel in modular cable controller configuration mode. • *rf-port*—RF channel physical port on the SPA or the line card. The valid values for the RF port depend on the configuration of the annex modulation. • *freq*—Center frequency of the RF channel. The valid range for each RF channel is different based on the annex type. • **none**—Removes the specified frequency if the RF channel is shut down. This can be configured on the modular cable controller of the N+1 protect line card as no frequency is required to be configured on that controller. • **annex** {**A** | **B**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. • **modulation** {**64** | **256**}—Indicates the modulation rate (64 or 256 QAM) for each RF channel. • **interleave-depth**—Indicates the downstream interleave depth. For annex A, the interleave value is 12. For annex B, valid values are 8, 16, 32, 64, and 128.
Step 7	**rf-channel** *rf-channel* **ip address** *dest_ip_address* **mac-address** *dest_mac_address* **remote-depi-id** session_*id* **Example:** `Router(config-controller)# rf-channel 0 ip-address 192.168.20.10 mac-address 001d.e5ea.c53c depi-remote-id 196608`	Binds the DEPI tunnel, which inherits the configuration of the specified L2TP class and DEPI class, to an RF channel under a modular controller. • *rf-channel*—RF channel physical port on the SPA or the line card. • *dest_ip_address*—IP address of the Gigabit Ethernet port. • dest_mac_address—MAC address of the Gigabit Ethernet port. • *session_id*—Specifies the automatically generated session-id on the QAM subinterface.

	Command or Action	Purpose
Step 8	**rf-channel** *rf-channel* **rf-power** *power-level* **Example:** `Router(config-controller)# rf-channel 0 rf-power 46`	Configures the RF power of an RF channel on the SPA or the line card. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *power-level*—Desired RF output power level in dBmV. The valid range is dependent on the cable interface. The format is XY.Z. By default, .Z is added as .0.
Step 9	**no rf-channel** *rf-channel* **rf-shutdown** **Example:** `Router(config-controller)# no rf-channel 0 rf-shutdown`	Enables the RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation.
Step 10	**exit** **Example:** `Router(config-controller)# exit`	Exits the controller configuration mode.

Examples

The following is an example of the manual DEPI configuration on the M-CMTS router:

```
Router> enable
Router# configure terminal
Router(config)# controller Modular-Cable 1/1/0
Router(config-controller)# modular-host subslot 7/1
Router(config-controller)# rf-channel 0 cable downstream channel-id 1
Router(config-controller)# rf-channel 0 frequency 555000000 annex B modulation 256qam
interleave 32
Router(config-controller)# rf-channel 0 ip-address 192.168.20.10 mac-address
001d.e5ea.c53c depi-remote-id 196608
Router(config-controller)# rf-channel 0 rf-power 30.0
Router(config-controller)# no rf-channel 0 rf-shutdown
Router(config-controller)# exit
```

Configuring Manual DEPI on the Cisco RFGW-10

- Configuring Manual DEPI Sessions on the Cisco RFGW-10 DS-48 Line Card, page 130
- Configuring Manual DEPI Sessions on the Cisco RFGW-10 DS-384 Line Card, page 134

Configuring Manual DEPI Sessions on the Cisco RFGW-10 DS-48 Line Card

This section describes how to configure manual DEPI sessions on Cisco RFGW-10.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** {**qam** | **qam-red**} *slot*/*port* [**.***channel*]
4. **cable downstream lqam-group** *group_ID*
5. **cable downstream stacking** *stacking*
6. **no cable downstream rf-shutdown**
7. **cable downstream Annex** {**A** | **B** | **C**}
8. **cable downstream frequency** *frequency*
9. **cable downstream interleave-level** {**1** | **2**}
10. **cable downstream interleave-depth** *depth-value*
11. **cable downstream modulation** {**64** | **256**}
12. **cable downstream rf-power** *power*
13. **cable mode depi** {**local lbg** *lbg-interface* | **remote** [**learn**]}
14. **cable depi dest-ip** *IP address*
15. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** {**qam** | **qam-red**} *slot*/*port* [.*channel*] **Example:** `Router(config)# interface qam 7/4.1`	Specifies a QAM interface or redundancy-configured (QAM-red) interface. • *slot*—QAM or QAM-red slot for the line card on Cisco RFGW-10. If line card redundancy is configured on the QAM, the interface is QAM-red. The valid range is from 3 to 12. • *port*—Interface number on the line card. The valid values range from 1 to 12. • .*channel*—(Optional) Specifies the channel on the port. The valid values range from 1 to 4.
Step 4	**cable downstream lqam-group** *group_ID* *Example:* `Router(config-subif)# cable downstream lqam 1`	Configures an LQAM group. • *group_ID*—LQAM group ID on QAM interface on the line card. The valid values range from 1 to 48.
Step 5	**cable downstream stacking** *stacking* **Example:** `Router(config-subif)# cable downstream stacking 4`	Configures the stacking level. Stacking level can be 1, 2, or, 4. • QAM channel 1 is enabled on the specified RF port for stacking level 1. • QAM channels 1 and 2 are enabled on the specified RF port for stacking level 2. • QAM channels 1, 2, 3, and 4 are enabled on the specified RF port for stacking level 4.
Step 6	**no cable downstream rf-shutdown** **Example:** `Router(config-subif)# no cable downstream rf-shutdown`	Enables the integrated upconverter.

	Command or Action	Purpose
Step 7	**cable downstream Annex** {**A** | **B**} **Example:** `Router(config-subif)# cable downstream Annex A`	Configures the MPEG framing format for a downstream port. • **annex** {**A** | **B**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. The default is Annex B for all Cisco cable interface line cards.
Step 8	**cable downstream frequency** *frequency* **Example:** `Router(config-subif)# cable downstream frequency 520000000`	Configures the downstream center frequency for the cable interface line card. *Frequency* is QAM channel frequency in Hz. On cable interfaces with an integrated upconverter, to reset the downstream frequency and disable the RF output from the integrated upconverter, use the **no** form of this command.
Step 9	**cable downstream interleave-level** {**1** | **2**} **Example:** `Router(config-subif)# cable downstream interleave-level 1`	Configures the interleave-level. The default interleave level is 2. **Note** This command is for Annex B only.
Step 10	**cable downstream interleave-depth** *depth-value* **Example:** `Router(config-subif)# cable downstream interleave-depth I12-J17`	Configures the interleave-depth. **Note** This command is for Annex B only. As you can configure various combinations of the I/J values for Annex B, the input for this command is the fee-code that is derived from the I/J values. The default I/J values are 32/4.
Step 11	**cable downstream modulation** {**64** | **256**} **Example:** `Router(config-subif)# cable downstream modulation 256`	Configures the modulation format for a downstream port on a cable interface line card. • 64—Modulation rate is 6 bits per downstream symbol. • 256—Modulation rate is 8 bits per downstream symbol. If you change the modulation format, the interface is shut down and all the cable modems are disconnected. The default modulation is set to 64 QAM on all the cable interface cards.
Step 12	**cable downstream rf-power** *power* **Example:** `Router(config-subif)# cable downstream rf-power 50`	Configures the RF power output level on an integrated upconverter. • *power*—RF power value in tenth of a dBmV. To reset the RF output power level to its default value, use the **no** form of this command.

	Command or Action	Purpose
Step 13	**cable mode depi local lbg** *lbg-interface* **|remote** [**learn**] **Example:** `Router(config-subif)# cable mode depi local lbg 1`	Sets the mode of the QAM channel. • **depi**—Specifies the DEPI mode of the QAM channel. • **local**—Specifies that the QAM channel is manually configured. • **lbg—**Specifies the QAM-port load balancing group. This implies the carrier is assigned a bandwidth on the specificity QAM-port load balancing group—the midplane10 Gigabit Ethernet port. • *lbg-interface*—QAM-port load balancing group interface. The valid values are 1 and 2. • **remote**—Specifies that the QAM channel is remotely configured. • **learn**—(Optional) Specifies that the QAM channel is in *learn* mode and the Cisco RFGW-10 can learn the channel configuration from the M-CMTS router. All QAM channels on a single port must be in *learn* mode for this configuration to work.
Step 14	**cable depi dest-ip** *IP address* **Example:** `Router(config-subif)# cable depi dest-ip 10.1.1.1`	Configures the DEPI sessions manually on the QAM line cards. • **dest-ip**—Specifies the IP address of the destination network.
Step 15	**end** **Example:** `Router(config-subif)# end`	Returns to privileged EXEC mode.

Examples

The following example shows DEPI sessions created manually created on a QAM line card 7 on the Cisco RFGW-10:

```
Router> enable
Router# configure terminal
Router(config)# interface qam 7/4.1
Router(config)# cable downstream lqam 1
Router(config-subif)# cable downstream stacking 4
Router(config-subif)# no cable downstream rf-shutdown
Router(config-subif)# cable downstream Annex A
Router(config-subif)# cable downstream frequency 520000000
Router(config-subif)# cable downstream interleave-level 1
Router(config-subif)# cable downstream interleave-depth I12-J17
Router(config-subif)# cable downstream modulation 256
Router(config-subif)# cable downstream rf-power 50
Router(config-subif)# cable mode depi local lbg 1
Router(config-subif)# cable depi dest-ip 10.1.1.1
Router(config-subif)# end
```

Configuring Manual DEPI Sessions on the Cisco RFGW-10 DS-384 Line Card

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cable downstream rf-profile** *rf-profile-id*
4. **cable downstream annex** {**A** | **B** | **C**}
5. **cable downstream modulation** {**64** | **256**}
6. **cable downstream interleaver-depth option1** *depth-value* **option2** *depth-value*
7. **cable downstream symbol rate** *symbols*
8. **exit**
9. **cable downstream freq-profile** *freq-profile-id*
10. **lane** *lane_id* **start-freq** *frequency*
11. **block** *block-id* **start-freq** *frequency*
12. **exit**
13. **exit**
14. **interface** {**qam** | **qam-red**} *slot/port*
15. **cable downstream freq-profile** *freq-profile-id*
16. **exit**
17. **interface** {**qam** | **qam-red**} *slot*/*port* [**.***channel*]
18. **cable downstream lqam-group** *group_ID*
19. **cable downstream rf-power** *power*
20. **cable downstream frequency** *qam-center-frequency* **lane** *lane-id* **block** *block-id*
21. **cable mode depi** {**local lbg** *lbg-interface* | **remote** [**learn**]}
22. **no cable downstream rf-shutdown**
23. **cable depi dest-ip** *IP address*
24. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable downstream rf-profile** *rf-profile-id* **Example:** `Router(config)# cable downstream rf-profile 64qam-B`	Enters the RF profile configuration mode and creates the RF profile at the global chassis level on the Cisco RFGW-10 DS-384 line card. The RF profiles are used for grouping QAM channels with same modulation, annex mode, symbol rate, and interleaver depth.
Step 4	**cable downstream annex** {**A** | **B** | **C**} **Example:** `Router(config-rf-prof)# cable downstream annex B`	Sets the annex mode in the RF profile. • **annex** {**A** | **B** | **C**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. – **C**—Annex C. Indicates that the downstream is designed to operate in Japanese cable systems. The default is Annex B for all Cisco cable interface line cards.
Step 5	**cable downstream modulation** {**64**|**256**} **Example:** `Router(config-rf-prof)# cable downstream modulation 64`	Sets the modulation format in the RF profile. Configures the modulation format for a downstream port on a cable interface line card. • 64—Modulation rate is 6 bits per downstream symbol. • 256—Modulation rate is 8 bits per downstream symbol. If you change the modulation format, the interface is shut down and all the cable modems are disconnected. The default modulation is set to 64 QAM on all the cable interface cards.

	Command or Action	Purpose
Step 6	**cable downstream interleaver depth option1** *depth-value* **option2** *depth-value* **Example:** `Router(config-rf-prof)# cable downstream interleaver-depth option1 I128-J1 option2 I32-J4`	Sets the interleaver-depth in the RF profile. • **option1**—Indicates the interleaver-depth FEC I/J values at the RF profile. • *depth-value*—Downstream interleaver depth values. The default is FEC I=32, J=4. • **option2**—Indicates the interleaver-depth FEC I/J values that are available when the profile in assigned to the QAM subinterface.
Step 7	**cable downstream symbol rate** *symbols* **Example:** `Router(config-rf-prof)# cable downstream symbol-rate 3500000`	Sets the symbol rate in the RF profile. • *symbols*—Symbol rate of the line card in seconds. The valid range is from 3500000 to 7000000 symbols per second.
Step 8	**exit** **Example:** `Router(config-rf-prof)# exit`	Exits RF profile configuration mode.
Step 9	**cable downstream freq-profile** *freq-profile-id* **Example:** `Router(config)# cable downstream freq-profile freq-profile1`	Enters the frequency profile configuration mode in a user-defined frequency scheme. Creates the frequency profile globally at the chassis level on the Cisco RFGW-10 DS-384 line card. • *freq-profile-id*—Profile ID applied to the RF port. The default is 1.
Step 10	**lane** *lane-id* **start-freq** *frequency* **Example:** `Router(config-freq-prof)# lane 1 start-freq 48000000`	Enters lane frequency mode and configures the lane frequency in the frequency profile. *lane-id*—Lane ID in the frequency profile. The range is from 1 to 4. **start-freq**—Specifies the starting frequency of the lane. *frequency*—Downstream start frequency of a lane. The valid range is from 48000000 to 999000000 Hz.
Step 11	**block** *block-id* **start-freq** *frequency* **Example:** `Router(config-freq-prof-lane)# block 1 start-freq 48000000`	Configures the block frequency in the lane for a frequency profile. *block-id*—Block ID in the lane frequency profile. The valid range is from 1 to 4. **start-freq**—Specifies the starting frequency of the block. *frequency*—Downstream start frequency of a block in a lane. The valid range is from 48000000 to 999000000 Hz. **Note** The valid range of the block depends on the starting frequency of the parent lane.
Step 12	**exit** **Example:** `Router(config-freq-prof-lane)# exit`	Exits the lane frequency configuration mode.

	Command or Action	Purpose
Step 13	**exit** **Example:** `Router(config-freq-prof)# exit`	Exits the frequency profile configuration mode.
Step 14	**interface** {**qam** | **qam-red**} *slot/port* **Example:** `Router(config-if)# interface qam 7/4`	Specifies a QAM interface or redundancy-configured (QAM-red) interface.
Step 15	**cable downstream freq-profile** *freq-profile-id* **Example:** `cable downstream freq-profile freq-profile1`	Applies the frequecy profile on the QAM port. • *freq-profile-id*—Profile ID applied to the RF port.
Step 16	**exit**	Exits QAM interface mode.
Step 17	**interface** {**qam** | **qam-red**} *slot***/***port*[**.***channel*] **Example:** `Router(config-subif)# interface qam 7/4.1`	Specifies a QAM interface or redundancy-configured (QAM-red) interface. • *slot*—QAM or QAM-red slot for the line card on Cisco RFGW-10. If line card redundancy is configured on the QAM, the interface is QAM-red. The valid range is from 3 to 12. • *port*—Interface number on the line card. The valid range is from 1 to 8. • .*channel*—(Optional) Specifies the channel on the port. The valid range is from 1 to 128.
Step 18	**cable downstream lqam-group** *group_ID* *Example:* `Router(config-subif)# cable downstream lqam 1`	Configures an LQAM group. • *group_ID*—LQAM group ID on QAM interface on the line card. The valid values range from 1 to 48.
Step 19	**cable downstream rf-power** *power* **Example:** `Router(config-subif)# cable downstream rf-power 50`	Configures the RF power output level on an integrated upconverter. • *power*—RF power value in tenth of a dBmV. To reset the RF output power level to its default value, use the **no** form of this command.

	Command or Action	Purpose
Step 20	**cable downstream frequency** *qam-center-frequency* **lane** *lane-id* **block** *block-id* **Example:** `Router(config-subif)# cable downstream frequency 714000000 lane 2 block 4`	Configures the center frequency for QAM channel. • *frequency*—Sets the center frequency on the QAM subinterface on the Cisco RFGW10-DS-384 line card. Valid ranges in MHz per Annex type are: – Annex A: 1003-744; default is 259 – Annex B, Annex C: 1002-768; default is 234. **Note** The center frequency assigned to Cisco RFGW-10 DS-384 QAM channel should be within the frequency range as specified by the frequency profile at the QAM interface (port level). The Cisco RFGW-10 DS0-384 supports a maximum of 8 QAM channels per block. Thus, while configuring the center frequencies on the QAM channels, ensure that only a maximum of 8 carriers belong to a particular block (as defined by the freq-profile applied at the QAM interface).
Step 21	**cable mode depi local lbg** *lbg-interface* |**remote** [**learn**] **Example:** `Router(config-subif)# cable mode depi local lbg 1`	Sets the mode of the QAM channel. • **depi**—Specifies the DEPI mode of the QAM channel. • **local**—Specifies that the QAM channel is manually configured. • **lbg—**Specifies the QAM-port load balancing group. This implies the carrier is assigned a bandwidth on the specified QAM-port load balancing group—the midplane10 GigabitEthernet • *lbg-interface*—QAM-port Load balancing group. The valid values are 1 and 2. • **remote**—Specifies that the QAM channel is remotely configured. • **learn**—(Optional) Specifies that the QAM channel is in “learn” mode and the Cisco RFGW-10 can learn the channel configuration from the M-CMTS router. All QAM channels on a single port must be in “learn” mode for this configuration to work.
Step 22	**no cable downstream rf-shutdown** **Example:** `Router(config-subif)# no cable downstream rf-shutdown`	Enables the integrated upconverter.

	Command or Action	Purpose
Step 23	**cable depi dest-ip** *IP address* **Example:** `Router(config-subif)# cable depi dest-ip 10.1.1.1`	Configures the DEPI sessions manually on the QAM line cards. • dest-ip—Specifies the IP address of the destination network from Cisco RFGW-10 to M-CMTS.
Step 24	**end** **Example:** `Router(config-subif)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure manual DEPI sessions on the Cisco RFGW-10 DS-384 line card:

```
Router> enable
Router# configure terminal
Router(config)# cable downstream rf-profile 64qam-B
Router(config-rf-prof)# cable downstream annex B
Router(config-rf-prof)# cable downstream modulation 64
Router(config-rf-prof)# cable downstream interleaver-depth option1 I128-J1 option2 I32-J4
Router(config-rf-prof)# cable downstream symbol-rate 3500000
Router(config-rf-prof)# exit
Router(config)# cable downstream freq-profile freq-profile1
Router(config-freq-prof)# lane 1 start-freq 48000000
Router(config-freq-prof-lane)# block 1 start-freq 48000000
Router(config-freq-prof-lane)# exit
Router(config-freq-prof)# exit
Router(config)# interface qam 7/4
Router(config-if)# cable downstream freq-profile freq-profile1
Router(config-if)# exit
Router(config)# interface qam 7/4.1
Router(config-subif)# cable downstream lqam 1
Router(config-subif)# cable downstream rf-power 50
Router(config-subif)# cable downstream frequency 714000000 lane 2 block 4
Router(config-subif)# cable mode depi local lbg 1
Router(config-subif)# no cable downstream rf-shutdown
Router(config-subif)# cable depi dest-ip 10.1.1.1
Router(config-subif)# end
```

How to Configure DEPI Control Plane

This section describes how to configure DEPI control plane on the M-CMTS router and Cisco RFGW-10

- Configuring DEPI Control Plane on the M-CMTS Router, page 140
- Configuring DEPI Control Plane on Cisco RFGW-10, page 146
- Disabling a DEPI Data Session on the M-CMTS Router, page 170

For a quick tour on how to configure DEPI on the Cisco M-CMTS router and the EQAM device, view the following videos available on Cisco.com:

- Configuring the Downstream External PHY Interface Feature on the Cisco M-CMTS and EQAM Device [Part 1 of 2]
- Configuring the Downstream External PHY Interface Feature on the Cisco M-CMTS and EQAM Device [Part 2 of 2]

Prerequisites

- Support of bidirectional communication should be provided using the Gigabit Ethernet ports on the Cisco Wideband SPA or Cisco uBR-MC3GX60V line card.
- Support for DLM (ingress) should be provided.
- Support of EQAM configuration from the M-CMTS router (with EQAM in *learn* mode) should be provided. The *learn* mode is currently supported only on Cisco RFGW-10.
- Support for connectivity verification and link failure detection should be provided.
- Support should be provided for the Management Information Base (MIB).

Configuring DEPI Control Plane on the M-CMTS Router

Note The DEPI control plane configuration steps for the Cisco Wideband SPA and Cisco -MC3GX60 line card are the same.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2tp-class** *l2tp-class-name*
4. **hello** *seconds*
5. **retransmit retries** *max-retransmissions*
6. **retransmit timeout** [**max** | **min**] *retransmit-timeout*
7. **exit**
8. **depi-class** *depi-class-name*
9. **exit**
10. **depi-tunnel** *working-depi-tunnel-name*

11. **l2tp-class** *l2tp-class-name*
12. **depi-class** *depi-class-name*
13. **dest-ip** *dest-ip-address*
14. (Optional) **tos** *value*
15. **exit**
16. **controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*}
17. (Cisco Wideband SPA only) **modular-host subslot** *slot*/*subslot*
18. **rf-channel** *rf-channel* **cable downstream channel-id** *channel-id*
19. **rf-channel** *rf-channel* **frequency** *freq* [**annex** {**A** | **B**} **modulation** {**64** | **256**} [**interleave-depth** {**8** | **12** | **16** | **32** | **64** | **128**}]]
20. **rf-channel** *rf-channel* **depi-tunnel** *depi-tunnel-name* **tsid** *id*
21. **rf-channel** *rf-channel* **rf-power** *power-level*
22. **no rf-channel** *rf-channel* **rf-shutdown**
23. **exit**
24. **interface gigabitethernet** *slot*/*subslot*/*port*
25. **ip-address** *ip-address mask-ip-address*
26. **negotiation** {**forced** | **auto**}
27. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**l2tp-class** *l2tp-class-name* **Example:** `Router(config)# l2tp-class class1`	Creates an l2tp-class template. The template must be configured but the optional settings are not mandatory. **Note** If all the control channels have the same parameters then a separate template must be created for the M-CMTS.

	Command or Action	Purpose
Step 4	**hello** *seconds* **Example:** `Router(config-l2tp-class)# hello 5`	(Optional) Configures the interval used to exchange the "hello" keepalive packets in a Layer 2 control channel. • *seconds*—Number of seconds that a router at one end of a Layer 2 control channel waits between sending the "hello" keepalive packets to its peer router. The valid range is from 0 to 1000. The default value is 60. **Note** If you want the DEPI tunnel to be less sensitive to network disturbances, increase the interval for the "hello" keepalive packets. We recommend that you specify 5 seconds on the M-CMTS router.
Step 5	**retransmit retries** *max-retransmissions* **Example:** `Router(config-l2tp-class)# retransmit retries 5`	(Optional) Configures the retransmission retry settings of the control packets. • *max-retransmissions*—Number of retransmission cycles that occur before determining that the peer provider edge (PE) router does not respond. The valid range is from 5 to 1000. The default value is 15. Specify a smaller value for faster failure detection. **Note** We recommend that you specify 5 on the M-CMTS router.
Step 6	**retransmit timeout** [**max** | **min**] *retransmit-timeout* **Example:** `Router(config-l2tp-class)# retransmit timeout max 1`	Specifies maximum and minimum retransmission intervals (in seconds) for resending the control packets. • {**max** | **min**} *retransmit-timeout*—The valid range is from 1 to 8. The default maximum interval is 8; the default minimum interval is 1. **Note** We recommend that you specify 1 second on the M-CMTS router.
Step 7	**exit** **Example:** `Router(config-l2tp-class)# exit`	Exits the L2TP class configuration mode.
Step 8	**depi-class** *depi-class-name* **Example:** `Router(config)# depi-class SPA0`	Creates a DEPI class template.
Step 9	**exit** **Example:** `Router(config-depi-class)# exit`	Exits the DEPI class configuration mode.
Step 10	**depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config)# depi-tunnel SPA0`	Creates a DEPI tunnel template.

	Command or Action	Purpose
Step 11	**l2tp-class** *l2tp-class-name* **Example:** `Router(config-depi-tunnel)# l2tp-class class1`	Specifies the L2TP control channel parameters to be inherited.
Step 12	**depi-class** *depi-class-name* **Example:** `Router(config-depi-tunnel)# depi-class SPA0`	Specifies the DEPI control channel parameters to be inherited.
Step 13	**dest-ip** *dest-ip-address* **Example:** `Router(config-depi-tunnel)# dest-ip 192.0.2.103`	Specifies the destination IP address of the termination point for the DEPI tunnel. When configuring on the M-CMTS router, destination IP address is the IP address of the EQAM. When configuring on the EQAM, this is the IP address of the M-CMTS router.
Step 14	**tos** *value* **Example:** `Router(config-depi-tunnel)# tos 100`	(Optional) Sets the value of the ToS byte for IP packets in the L2TPv3 data session. The valid values range from 0 to 255. The default value is 0.
Step 15	**exit** **Example:** `Router(config-depi-tunnel)# exit`	Exits the data session configuration mode.
Step 16	**controller modular-cable** {*slot/bay/port* | *slot/subslot/controller*} **Example:** `Router(config)# controller modular-cable 1/0/0`	Specifies the modular cable controller interface for the SPA or the line card. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *bay*—The bay in a SIP where a SPA is located. Valid values are 0 (upper bay) and 1 (lower bay). • *port*—Specifies the interface number on the SPA. • *subslot*—Cable interface line card subslot. Valid values are 0 and 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.
Step 17	**modular-host subslot** *slot/subslot* **Example:** `Router(config-controller)# modular-host subslot 6/0`	(Cisco Wideband SPA only) Specifies the modular host line card that is used for DOCSIS 3.0 downstream or downstream channel bonding operations.
Step 18	**rf-channel** *rf-channel* **cable downstream channel-id** *channel-id* **Example:** `Router(config-controller)# rf-channel 0 cable downstream channel-id 24`	Assigns a downstream channel ID to an RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *channel-id*—Unique channel ID. The valid range is from 1 to 255.

	Command or Action	Purpose
Step 19	**rf-channel** *rf-channel* **frequency** *freq* [**annex** {**A** | **B**} **modulation** {**64** | **256**} [**interleave-depth** {**8** | **12** | **16** | **32** | **64** | **128**}]] **Example:** `Router(config-controller)# rf-channel 0 freq 555000000 annex B mod 64qam inter 32`	Configures the frequency of an RF channel in modular cable controller configuration mode. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *freq*—Center frequency of the RF channel. The valid range for each RF channel is different based on the Annex type. • **none**—Removes the specified frequency if the RF channel is shut down. This can be configured on the modular cable controller of the N+1 protect line card as no frequency is required to be configured on that controller. • **annex** {**A** | **B**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. • **modulation** {**64** | **256**}—Indicates the modulation rate (64 or 256 QAM) for each RF channel. • **interleave-depth**—Indicates the downstream interleave depth. For annex A, the interleave value is 12. For annex B, valid values are 8, 16, 32, 64, and 128.
Step 20	**rf-channel** *rf-channel* **depi-tunnel** *depi-tunnel-name* **tsid** *id* **Example:** `Router(config-controller)# rf-channel 0 depi-tunnel SPA0 tsid 100`	Binds the DEPI tunnel, which inherits the configuration of the specified L2TP class and DEPI class, to an RF channel under a modular controller. • *rf-channel*—RF channel physical port on the SPA or the line card. • *depi-tunnel-name*—Name of the DEPI tunnel. • **tsid** *id*—Specifies the Transport Stream Identifier (TSID) value on the QAM subinterface. The TSID is used to associate the logical RF channel of the SPA or the line card to a physical QAM on RF Gateway 10.
Step 21	**rf-channel** *rf-channel* **rf-power** *power-level* **Example:** `Router(config-controller)# rf-channel 0 rf-power 46`	Configures the RF power of an RF channel on the SPA or the line card. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *power-level*—Desired RF output power level in dBmV. The valid range is dependent on the cable interface. The format is XY.Z. By default, .Z is added as .0.

	Command or Action	Purpose
Step 22	**no rf-channel** *rf-channel* **rf-shutdown** **Example:** `Router(config-controller)# no rf-channel 0 rf-shutdown`	Enables the RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation.
Step 23	**exit** **Example:** `Router(config-controller)# exit`	Exits the controller configuration mode.
Step 24	**interface gigabitethernet** *slot*/*subslot*/*port* **Example:** `Router(config)# interface gigabitethernet 1/0/0`	Specifies the location of the Gigabit Ethernet interface on the M-CMTS router. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *subslot*—Specifies the secondary slot of the SIP where the SPA is installed or the cable interface line card subslot. Valid values are 0 and 1. • *port*—Specifies the interface number.
Step 25	**ip-address** *ip-address mask-ip-address* **Example:** `Router(config-if)# ip-address 192.0.2.155 255.255.255.0`	Sets the IP address for the SPA or the line card field-programmable gate array (FPGA). This address is used as the source IP address for packets that the router transmits to the EQAM device.
Step 26	**negotiation** {**forced** | **auto**} **Example:** `Router(config-if)# negotiation auto`	Enables negotiation on the SPA or the line card interface.
Step 27	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Examples

The following is an example of the DEPI control plane configuration on the M-CMTS router:

```
Router> enable
Router# configure terminal
Router(config)# l2tp-class class1
Router(config-l2tp-class)# hello 5
Router(config-l2tp-class)# retransmit retries 5
Router(config-l2tp-class)# retransmit timeout max 1
Router(config-l2tp-class)# exit
Router(config)# depi-class SPA0
Router(config-depi-class)# exit
Router(config)# depi-tunnel SPA0
Router(config-depi-tunnel)# l2tp-class class1
Router(config-depi-tunnel)# depi-class SPA0
Router(config-depi-tunnel)# dest-ip 192.0.2.103
```

```
Router(config-depi-tunnel)# tos 100
Router(config-depi-tunnel)# exit
Router(config)# controller modular-cable 1/0/0
Router(config-controller)# modular-host subslot 6/0
Router(config-controller)# rf-channel 0 cable downstream channel-id 24
Router(config-controller)# rf-channel 0 freq 555000000 annex B mod 64qam inter 32
Router(config-controller)# rf-channel 0 depi-tunnel SPA0 tsid 100
Router(config-controller)# rf-channel 0 rf-power 46.8
Router(config-controller)# no rf-channel 0 rf-shutdown
Router(config-controller)# exit
Router(config)# interface gigabitethernet 1/0/0
Router(config-if)# ip-address 192.0.2.155 255.255.255.0
Router(config-if)# negotiation auto
Router(config-if)# end
```

Configuring DEPI Control Plane on Cisco RFGW-10

This section describes how to configure DEPI control plane on the Cisco RFGW-10 line cards. The DEPI control plane can be configured for learn and non-learn modes.

In learn mode, the Cisco RFGW-10 learns the configuration from the M-CMTS.

- Configuring DEPI Control Plane on Cisco RFGW-10 for Learn Mode, page 146

In non-learn mode, the Cisco RFGW-10 does not learn the configuration from the M-CMTS. The sections describe how to configure learn mode on the two line cards.

- Configuring DEPI Control Plane (Non-Learn) on Cisco RFGW-10 DS-48 Line Card, page 151
- Configuring M-CMTS DEPI Control Plane (Non-Learn) on Cisco RFGW-10 DS-384 Line Card, page 156

Configuring DEPI Control Plane on Cisco RFGW-10 for Learn Mode

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **l2tp-class** *l2tp-class-name*
4. **hello** *seconds*
5. **retransmit retries** *max-retransmissions*
6. **retransmit timeout** [**max** | **min**] *retransmit-timeout*
7. **exit**
8. **depi-class** *depi-class-name*
9. **exit**
10. **depi-tunnel** *working-depi-tunnel-name*
11. **l2tp-class** *l2tp-class-name*
12. **depi-class** *depi-class-name*
13. **dest-ip** *dest-ip-address*
14. **exit**

15. **interface** {**qam** | **qam-red**} *slot*/*port*[**.***channel*]
16. **cable downstream lqam-group** *group_ID*
17. **cable mode** {**depi local lbg** *lbg-interface* | **remote** [**learn**]]
18. **cable downstream tsid** *id*
19. **depi depi-tunnel** *working-depi-tunnel-name*
20. **exit**
21. **interface gigabitethernet** *slot*/*port*
22. **no switchport**
23. **ip-address** *ip-address mask-ip-address*
24. **end**

Note To configure the IP address on the Cisco RFGW-10, perform Step 21 to Step 24 when the M-CMTS router has a direct Gigabit Ethernet connection with the Cisco RFGW-10.
You can configure the IP address on a VLAN as long as the configured IP address is accessible from the M-CMTS router because the Cisco RFGW-10 supports Layer 3 switching.

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`l2tp-class` *l2tp-class-name* **Example:** `Router(config)# l2tp-class class1`	Creates an L2TP class template. The template must be configured but the optional settings are not mandatory. **Note** If all the control channels have the same parameters then one template must be created for the Cisco RFGW-10.

	Command or Action	Purpose
Step 4	**hello** *seconds* **Example:** `Router(config-l2tp-class)# hello 15`	(Optional) Configures the interval used to exchange the "hello" keepalive packets in a Layer 2 control channel. • *seconds*—Number of seconds that a router at one end of a Layer 2 control channel waits between sending the "hello" keepalive packets to its peer router. The valid range is from 0 to 1000 seconds. The default value is 60 seconds. **Note** The "hello" value on the Cisco RFGW-10 can be different from what is configured on the M-CMTS router. We recommend that you specify 15 seconds on the Cisco RFGW-10. A value of less than 10 seconds might subject the system to session flaps and may trigger line card switchover, if the M-CMTS router experiences loss of network connectivity.
Step 5	**retransmit retries** *max-retransmissions* **Example:** `Router(config-l2tp-class)# retransmit retries 5`	(Optional) Configures the retransmission retry settings of the control packets. • *max-retransmissions*—Number of retransmission cycles that occur before determining that the peer provider edge (PE) router does not respond. The valid range is from 5 to 1000. The default value is 15. Specify a smaller value for faster failure detection. **Note** We recommend that you specify 5 on the Cisco RFGW-10.
Step 6	**retransmit timeout** [**max** | **min**] *retransmit-timeout* **Example:** `Router(config-l2tp-class)# retransmit timeout max 1`	Specifies maximum and minimum retransmission intervals (in seconds) for resending the control packets. • {**max** | **min**} *retransmit-timeout*—The valid range is from 1 to 8. The default maximum interval is 8; the default minimum interval is 1. **Note** We recommend that you specify 1 second on the Cisco RFGW-10.
Step 7	**exit** **Example:** `Router(config-l2tp-class)# exit`	Exits the L2TP class configuration mode.
Step 8	**depi-class** *depi-class-name* **Example:** `Router(config)# depi-class SPA0`	Creates a DEPI class template.
Step 9	**exit** **Example:** `Router(config-depi-class)# exit`	Exits the DEPI class configuration mode.

	Command or Action	Purpose
Step 10	**depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config)# depi-tunnel SPA0`	Creates a DEPI tunnel template.
Step 11	**l2tp-class** *l2tp-class-name* **Example:** `Router(config-depi-tunnel)# l2tp-class class1`	Specifies the L2TP control channel parameters to be inherited.
Step 12	**depi-class** *depi-class-name* **Example:** `Router(config-depi-tunnel)# depi-class SPA0`	Specifies the DEPI control channel parameters to be inherited.
Step 13	**dest-ip** *dest-ip-address* **Example:** `Router(config-depi-tunnel)# dest-ip 192.0.2.155`	Specifies the destination IP address of the M-CMTS Gigabit Ethernet port.
Step 14	**exit** **Example:** `Router(config-depi-tunnel)# exit`	Exits the DEPI configuration mode.
Step 15	**interface** {**qam** | **qam-red**} *slot*/*port* [.*channel*] **Example:** `Router(config)# interface qam 6/4.1`	Specifies a QAM interface or redundancy-configured (QAM-red) interface. • *slot*—QAM or QAM-red slot for the line card on Cisco RF Gateway 10. If line card redundancy is configured on the QAM, the interface is QAM-red. The valid range is from 3 to 12. • *port*—Interface number on the line card. The valid range is from 1 to 12. • .*channel*—(Optional) Specifies the channel on the port. The valid range is from 1 to 4.
Step 16	**cable downstream lqam-group** *group_ID* *Example:* `Router(config-subif)# cable downstream lqam 1`	Configures an LQAM group. • *group_ID*—LQAM group ID on QAM interface on the line card. The valid values range from 1 to 48.

	Command or Action	Purpose
Step 17	**cable mode depi local lbg** *lbg-interface* | **remote** [**learn**] **Example:** `Router(config-subif)# cable mode depi remote learn`	Sets the mode of the QAM channel. • **depi**—Specifies the DEPI mode of the QAM channel. • **local**—Specifies that the QAM channel is manually configured. • **lbg**—Specifies the QAM-port load balancing group.This implies the carrier is assigned a bandwidth on the specificity QAM-port load balancing group—the midplane 10 Gigabit Ethernet. • *lbg-interface*—QAM-port Load balancing group. The valid values are 1 and 2. • **remote**—Specifies that the QAM channel is remotely configured. • **learn**—(Optional) Specifies that the QAM channel is in *learn* mode and the Cisco RFGW-10 can learn the channel configuration from the M-CMTS router. All QAM channels on a single port must be in *learn* mode for this configuration to work.
Step 18	**cable downstream tsid** *id* **Example:** `Router(config-subif)# cable downstream tsid 100`	Configures the Transport Stream Identifier (TSID) value on the QAM subinterface. The valid range is from 0 to 65535.
Step 19	**depi depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config-subif)# depi depi-tunnel SPA0`	Binds the DEPI tunnel to the QAM.
Step 20	**exit** **Example:** `Router(config-subif)# exit`	Exits the subinterface configuration mode. The Cisco RFGW-10 is now ready to accept incoming control connection requests from the M-CMTS but cannot initiate a control connection with the M-CMTS.
Step 21	**interface gigabitethernet** *slot/port* **Example:** `Router(config)# interface gigabitethernet 6/13`	Specifies the Gigabit Ethernet interface.
Step 22	**no switchport** **Example:** `Router(config-if)# no switchport`	Disables switching mode.

	Command or Action	Purpose
Step 23	**ip-address** *ip-address mask-ip-address* **Example:** `Router(config-if)# ip-address 192.0.2.103 255.255.255.0`	Sets the IP address for the SPA or the line card field-programmable gate array (FPGA). This address is used as the source IP address of Cisco RFGW-10.
Step 24	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure remote DEPI sessions on the Cisco RFGW-10, which is in **learn** mode.

```
Router> enable
Router# configure terminal
Router(config)# l2tp-class class1
Router(config-l2tp-class)# hello 15
Router(config-l2tp-class)# retransmit retries 5
Router(config-l2tp-class)# retransmit timeout max 1
Router(config-l2tp-class)# exit
Router(config)# depi-class 0
Router(config-depi-class)# exit
Router(config)# depi-tunnel 0
Router(config-depi-tunnel)# l2tp-class class1
Router(config-depi-tunnel)# depi-class SPA0
Router(config-depi-tunnel)# dest-ip 192.0.2.155
Router(config-depi-tunnel)# exit
Router(config)# interface qam 6/4.1
Router(config-subif) # cable downstream lqam 1
Router(config-subif)# cable mode depi remote learn
Router(config-subif)# cable downstream tsid 100
Router(config-subif)# depi depi-tunnel SPA0
Router(config-subif)# exit
Router(config)# interface gigabitethernet 6/13
Router(config-if)# no switchport
Router(config-if)# ip-address 192.0.2.103 255.255.255.0
Router(config-subif)# end
```

Configuring DEPI Control Plane (Non-Learn) on Cisco RFGW-10 DS-48 Line Card

Prerequisites

Note Configure Step 1 to Step 13 as in Configuring DEPI Control Plane on Cisco RFGW-10 for Learn Mode, page 146 to configure the DEPI control plane on RFGW-10. Follow the below steps to configure non-learn mode on the line card.

SUMMARY STEPS

1. **interface** {**qam** | **qam-red**} *slot/port* [**.***channel*]
2. **cable downstream lqam-group** *group_ID*

3. **cable mode** {**depi local lbg** *lbg-interface* | **remote**}
4. **cable downstream stacking** *stacking*
5. **no cable downstream rf-shutdown**
6. **cable downstream Annex** {**A** | **B** | **C**}
7. **cable downstream frequency** *frequency*
8. **cable downstream interleave-level** {**1** | **2**}
9. **cable downstream interleave-depth** *depth-value*
10. **cable downstream modulation** {**64** | **256**}
11. **cable downstream rf-power** *power*
12. **cable downstream tsid** *id*
13. **depi depi-tunnel** *working-depi-tunnel-name*
14. **exit**
15. **interface gigabitethernet** *slot/port*
16. **no switchport**
17. **ip-address** *ip-address mask-ip-address*
18. **end**

Note To configure the IP address on the Cisco RFGW-10, perform Step 15to Step 18 when the M-CMTS router has a direct Gigabit Ethernet connection with the Cisco RFGW-10.
You can configure the IP address on a VLAN as long as the configured IP address is accessible from the M-CMTS router because the Cisco RFGW-10 supports Layer 3 switching.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface** {**qam** | **qam-red**} *slot*/*port* [.*channel*] **Example:** `Router(config)# interface qam 6/4.1`	Specifies a QAM interface or redundancy-configured (QAM-red) interface. • *slot*—QAM or QAM-red slot for the line card on Cisco RF Gateway 10. If line card redundancy is configured on the QAM, the interface is QAM-red. The valid range is from 3 to 12. • *port*—Interface number on the line card. The valid range is from 1 to 12. • .*channel*—(Optional) Specifies the channel on the port. The valid range is from 1 to 4.
Step 2	**cable downstream lqam-group** *group_ID* *Example:* `Router(config-subif)# cable downstream lqam 1`	Configures an LQAM group. • *group_ID*—LQAM group ID on QAM interface on the line card. The valid values range from 1 to 48.
Step 3	**cable mode depi local lbg** *lbg-interface* | **remote** [learn] **Example:** `Router(config-subif)# cable mode depi remote`	Sets the mode of the QAM channel. • **depi**—Specifies the DEPI mode of the QAM channel. • **local**—Specifies that the QAM channel is manually configured. • **lbg**—Specifies the QAM-port load balancing group. This implies the carrier is assigned a bandwidth on the specified QAM-port load balancing group—the midplane10 Gigabit Ethernet. • **lbg-interface**—QAM-port load balancing group. The valid values are 1 and 2. • **remote**—Specifies that the QAM channel is remotely configured. • **learn**—(Optional) Specifies that the QAM channel is in *learn* mode and the Cisco RFGW-10 can learn the channel configuration from the M-CMTS router. All QAM channels on a single port must be in *learn* mode for this configuration to work.
Step 4	**cable downstream stacking** *stacking* **Example:** `Router(config)# cable downstream stacking 4`	Configures the stacking level. Stacking level can be 1, 2, or 4. • QAM channel 1 is enabled on the specified RF port for stacking level 1. • QAM channels 1 and 2 are enabled on the specified RF port for stacking level 2. • QAM channels 1, 2, 3, and 4 are enabled on the specified RF port for stacking level 4.

	Command or Action	Purpose
Step 5	**no cable downstream rf-shutdown** **Example:** `Router(config-if)# no cable downstream rf-shutdown`	Enables the integrated upconverter.
Step 6	**cable downstream Annex** {**A** | **B** | **C**} **Example:** `Router(config-if)# cable downstream Annex A`	Configures the MPEG framing format for a downstream port. • **annex** {**A** | **B** | **C**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. – **C**—Annex C. Indicates that the downstream is designed to operate in Japanese cable systems The default is Annex B for all Cisco cable interface line cards.
Step 7	**cable downstream frequency** *frequency* **Example:** `Router(config-if)# cable downstream frequency 520000000`	Configures the downstream center frequency for the cable interface line card. The *frequency* is QAM channel frequency in Hz. On cable interfaces with an integrated upconverter, to reset the downstream frequency and disable the RF output from the integrated upconverter, use the **no** form of this command.
Step 8	**cable downstream interleave-level** {**1** | **2**} **Example:** `Router(config-subif)# cable downstream interleave-level 1`	Configures the interleave-level. The default interleave level is 2. **Note** This command is for Annex B only.
Step 9	**cable downstream interleave-depth** *depth-value* **Example:** `Router(config-subif)# cable downstream interleave-depth I12-J17`	Configures the interleave-depth. **Note** This command is for Annex B only. As you can configure various combinations of the I/J values for Annex B, the input for this command is the fee-code that is derived from the I/J values. The default I/J values are 32/4.
Step 10	**cable downstream modulation** {**64** | **256**} **Example:** `Router(config-subif)# cable downstream modulation 256`	Configures the modulation format for a downstream port on a cable interface line card. • 64—Modulation rate is 6 bits per downstream symbol. • 256—Modulation rate is 8 bits per downstream symbol. If you change the modulation format, the interface is shut down and all the cable modems are disconnected. The default modulation is set to 64 QAM on all the cable interface cards.

	Command or Action	Purpose
Step 11	**cable downstream rf-power** *power* **Example:** `Router(config-subif)# cable downstream rf-power 50`	Configures the RF power output level on an integrated upconverter. • *power*—RF power value in tenth of a dBmV. To reset the RF output power level to its default value, use the **no** form of this command.
Step 12	**cable downstream tsid** *id* **Example:** `Router(config-subif)# cable downstream tsid 100`	Configures the Transport Stream Identifier (TSID) value on the QAM subinterface. The valid range is from 0 to 65535.
Step 13	**depi depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config-subif)# depi depi-tunnel SPA0`	Binds the DEPI tunnel to the QAM.
Step 14	**exit** **Example:** `Router(config-subif)# exit`	Exits the subinterface configuration mode. The Cisco RFGW-10 is now ready to accept incoming control connection requests from the M-CMTS but cannot initiate a control connection with the M-CMTS.
Step 15	**interface gigabitethernet** *slot/port* **Example:** `Router(config)# interface gigabitethernet 6/13`	Specifies the Gigabit Ethernet interface.
Step 16	**no switchport** **Example:** `Router(config-if)# no switchport`	Disables switching mode.
Step 17	**ip-address** *ip-address mask-ip-address* **Example:** `Router(config-if)# ip-address 192.0.2.103 255.255.255.0`	Sets the IP address for the SPA or the line card field-programmable gate array (FPGA). This address is used as the source IP address of Cisco RFGW-10.
Step 18	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure remote DEPI sessions on Cisco RFGW-10 DS-48, in non-learn mode.

```
Router> enable
Router# configure terminal
Router(config)# l2tp-class class1
Router(config-l2tp-class)# exit
Router(config)# depi-class SPA0
Router(config-depi-class)# exit
Router(config)# depi-tunnel SPA0
Router(config-depi-tunnel)# l2tp-class class1
```

```
Router(config-depi-tunnel)# depi-class SPA0
Router(config-depi-tunnel)# dest-ip 192.0.2.155
Router(config-depi-tunnel)# exit
Router(config)# interface qam 6/4.1
Router(config)# cable downstream lqam 1
Router(config-subif)# cable mode depi remote
Router(config-subif)# cable downstream stacking 4
Router(config-subif)# no cable downstream rf-shutdown
Router(config-subif)# cable downstream Annex B
Router(config-subif)# cable downstream frequency 520000000
Router(config-subif)# cable downstream tsid 100
Router(config-subif)# cable downstream interleave-level 2
Router(config-subif)# cable downstream interleave-depth 5
Router(config-subif)# cable downstream modulation 256qam
Router(config-subif)# cable downstream rf-power 50
Router(config-subif)# depi depi-tunnel 0
Router(config-subif)# end
```

Configuring M-CMTS DEPI Control Plane (Non-Learn) on Cisco RFGW-10 DS-384 Line Card

SUMMARY STEPS

Note Configure Step 1 to Step 13 as in Configuring DEPI Control Plane on Cisco RFGW-10 for Learn Mode, page 146 to configure the DEPI control plane on RFGW-10. Follow the below steps to configure non-learn mode on the line card.

1. **cable downstream rf-profile** *rf-profile-id*
2. **cable downstream annex** {**A** | **B** | **C**}
3. **cable downstream modulation** {**64** | **256**}
4. **cable downstream interleaver-depth option1** *depth-value* **option2** *depth-value*
5. **cable downstream symbol rate** *symbols*
6. **exit**
7. **cable downstream freq-profile** *freq-profile-id*
8. **lane** *lane_id* **start-freq** *frequency*
9. **block** *block-id* **start-freq** *frequency*
10. **exit**
11. **exit**
12. **interface** {**qam** | **qam-red**} *slot/port*
13. **cable downstream freq-profile** *freq-profile-id*
14. **exit**
15. **interface** {**qam** | **qam-red**} *slot*/*port*[**.***channel*]
16. **cable downstream lqam-group** *group_ID*
17. **cable downstream frequency** *qam-center-frequency* **lane** *lane-id* **block** *block-id*
18. **cable downstream rf-power** *power*
19. **cable mode depi** {**local lbg** *lbg-interface* | **remote** [**learn**]}

20. **no cable downstream rf-shutdown**
21. **cable downstream tsid** *id*
22. **depi depi-tunnel** *working-depi-tunnel-name*
23. **exit**
24. **interface gigabitethernet** *slot/port*
25. **no switchport**
26. **ip-address** *ip-address mask-ip-address*
27. **end**

Note To configure the IP address on the Cisco RFGW-10, perform Step 23to Step 26 when the M-CMTS router has a direct Gigabit Ethernet connection with the Cisco RFGW-10.
You can configure the IP address on a VLAN as long as the configured IP address is accessible from the M-CMTS router because the Cisco RFGW-10 supports Layer 3 switching.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**cable downstream rf-profile** *rf-profile-id* **Example:** `Router(config)# cable downstream rf-profile 64qam-B`	Enters the RF profile configuration mode and creates the RF profile at the global chassis level on the Cisco RFGW-10 DS-384 line card. The RF profiles are used for grouping QAM channels with same modulation, annex mode, symbol rate, and interleaver depth.
Step 2	**cable downstream annex** {**A** | **B** | **C**} **Example:** `Router(config-rf-prof)# cable downstream annex B`	Sets the annex mode in the RF profile. • **annex** {**A** | **B** | **C**}—Indicates the MPEG framing format for each RF channel. – **A**—Annex A. Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. – **B**—Annex B. Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. – **C**—Annex C. Indicates that the downstream is designed to operate in Japanese cable systems. The default is Annex B for all Cisco cable interface line cards.
Step 3	**cable downstream modulation (64 | 256)** **Example:** `Router(config-rf-prof)# cable downstream modulation 64`	Sets the modulation format in the RF profile. Configures the modulation format for a downstream port on a cable interface line card. • 64—Modulation rate is 6 bits per downstream symbol. • 256—Modulation rate is 8 bits per downstream symbol. If you change the modulation format, the interface is shut down and all the cable modems are disconnected. The default modulation is set to 64 QAM on all the cable interface cards.
Step 4	**cable downstream interleaver depth option1** *depth-value* **option2** *depth-value* **Example:** `Router(config-rf-prof)# cable downstream interleaver-depth option1 I128-J1 option2 I32-J4`	Sets the interleaver-depth in the RF profile. • **option1**—Indicates the interleaver-depth FEC I/J values at the RF profile. • *depth-value*—Downstream interleaver depth values. The default is FEC I=32, J=4. • **option2**—Indicates the interleaver-depth FEC I/J values that are available when the profile in assigned to the QAM subinterface.
Step 5	**cable downstream symbol rate** *symbols* **Example:** `Router(config-rf-prof)# cable downstream symbol-rate 3500000`	Sets the symbol rate in the RF profile. • *symbols*—Symbol rate of the line card in seconds. Valid range is from 3500000 to 7000000 symbols per second.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-rf-prof)# exit`	Exits RF profile configuration mode.
Step 7	**cable downstream freq-profile** *freq-profile-id* **Example:** `Router(config)# cable downstream freq-profile freq-profile1`	Enters the frequency profile configuration mode in a user-defined frequency scheme. Creates the frequency profile globally at the chassis level on the Cisco RFGW-10 DS-384 line card. • *freq-profile-id*—Profile ID applied to the RF port. The default is 1.
Step 8	**lane** *lane-id* **start-freq** *frequency* **Example:** `Router(config-freq-prof)# lane 1 start-freq 48000000`	Enters lane frequency mode and configures the lane frequency in the frequency profile. • *lane-id*—Lane ID in the frequency profile. The range is from 1 to 4. • **start-freq**—Specifies the starting frequency of the lane. • *frequency*—Downstream start frequency of a lane. The valid range is from 48000000 to 999000000 Hz.
Step 9	**block** *block-id* **start-freq** *frequency* **Example:** `Router(config-freq-prof-lane)# block 1 start-freq 48000000`	Configures the block frequency in the lane for a frequency profile. • *block-id*—Block ID in the lane frequency profile. The valid range is from 1 to 4. • **start-freq**—Specifies the starting frequency of the block. • *frequency*—Downstream start frequency of a block in a lane. The valid range is from 48000000 to 999000000 Hz. **Note** The valid range of the block depends on the starting frequency of the parent lane.
Step 10	**exit** **Example:** `Router(config-freq-prof-lane)# exit`	Exits the lane frequency configuration mode.
Step 11	**exit** **Example:** `Router(config-freq-prof)# exit`	Exits the frequency profile configuration mode.
Step 12	**interface** {**qam** | **qam-red**} *slot/port* **Example:** `Router(config-if)# interface qam 7/4`	Specifies a QAM interface or redundancy-configured (QAM-red) interface.

	Command or Action	Purpose
Step 13	**cable downstream freq-profile** *freq-profile-id* **Example:** `cable downstream freq-profile freq-profile1`	Applies the frequency profile on the QAM port. *freq-profile-id*—Profile ID applied to the RF port.
Step 14	**exit**	Exits QAM interface mode.
Step 15	**interface** {**qam** | **qam-red**} *slot*/*port* [**.***channel*] **Example:** `Router(config-subif)# interface qam 7/4.1`	Specifies a QAM interface or redundancy-configured (QAM-red) interface. • *slot*—QAM or QAM-red slot for the line card on Cisco RF Gateway 10. If line card redundancy is configured on the QAM, the interface is QAM-red. The valid range is from 3 to 12. • *port*—Interface number on the line card. The valid range is from 1 to 8. • *.channel*—(Optional) Specifies the channel on the port. The valid range is from 1 to 128.
Step 16	**cable downstream lqam-group** *group_ID* *Example:* `Router(config-subif)# cable downstream lqam 1`	Configures an LQAM group. • *group_ID*—LQAM group ID on QAM interface on the line card. The valid values range from 1 to 48.
Step 17	**cable downstream rf-power** *power* **Example:** `Router(config-subif)# cable downstream rf-power 50`	Configures the RF power output level on an integrated upconverter. • *power*—RF power value in tenth of a dBmV. To reset the RF output power level to its default value, use the **no** form of this command.
Step 18	**cable downstream frequency** *qam-center-frequency* **lane** *lane-id* **block** *block-id* **Example:** `Router(config-subif)# cable downstream frequency 714000000 lane 2 block 4`	Configures the center frequency for QAM channel. • *frequency*—Sets the center frequency on the QAM subinterface on the Cisco RFGW10-DS-384 line card. Valid ranges in MHz per Annex type are: – Annex A: 1003-744; default is 259 – Annex B, Annex C: 1002-768; default is 234. **Note** The center frequency assigned to Cisco RFGW-10 DS-384 QAM channel should be within the frequency range as specified by the frequency profile at the QAM interface (port level). The Cisco RFGW-10 DS0-384 supports a maximum of 8 QAM channels per block. Thus, while configuring the center frequencies on the QAM channels, ensure that only a maximum of 8 carriers belong to a particular block (as defined by the freq-profile applied at the QAM interface).

	Command or Action	Purpose
Step 19	**cable mode depi local lbg** *lbg-interface* |**remote** [**learn**] **Example:** `Router(config-subif)# cable mode depi remote`	Sets the mode of the QAM channel. • **depi**—Specifies the DEPI mode of the QAM channel. • **local**—Specifies that the QAM channel is manually configured. • **lbg**—Specifies the QAM-port load balancing group. This implies the carrier is assigned a bandwidth on the specified QAM-port load balancing group—the midplane10 Gigabit Ethernet • *lbg-interface*—QAM-port load balancing group. The valid values are 1 and 2. • **remote**—Specifies that the QAM channel is remotely configured. • **learn**—(Optional) Specifies that the QAM channel is in *learn* mode and the Cisco RFGW-10 can learn the channel configuration from the M-CMTS router. All QAM channels on a single port must be in *learn* mode for this configuration to work.
Step 20	**no cable downstream rf-shutdown** **Example:** `Router(config-subif)# no cable downstream rf-shutdown`	Enables the integrated upconverter.
Step 21	**cable downstream tsid** *id* **Example:** `Router(config-subif)# cable downstream tsid 100`	Configures the Transport Stream Identifier (TSID) value on the QAM subinterface. The valid range is from 0 to 65535.
Step 22	**depi depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config-subif)# depi depi-tunnel SPA0`	Binds the DEPI tunnel to the QAM.
Step 23	**exit** **Example:** `Router(config-subif)# exit`	Exits the subinterface configuration mode. The Cisco RFGW-10 is now ready to accept incoming control connection requests from the M-CMTS but cannot initiate a control connection with the M-CMTS.
Step 24	**interface gigabitethernet** *slot/port* **Example:** `Router(config)# interface gigabitethernet 6/13`	Specifies the Gigabit Ethernet interface.
Step 25	**no switchport** **Example:** `Router(config-if)# no switchport`	Disables switching mode.

	Command or Action	Purpose
Step 26	**ip-address** *ip-address mask-ip-address* **Example:** `Router(config-if)# ip-address 192.0.2.103 255.255.255.0`	Sets the IP address for the SPA or the line card field-programmable gate array (FPGA). This address is used as the source IP address of Cisco RFGW-10.
Step 27	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure remote DEPI sessions on the Cisco RFGW-10 DS-384 line card, in non-learn mode:

```
Router> enable
Router# configure terminal
Router(config)# l2tp-class class1
Router(config-l2tp-class)# exit
Router(config)# depi-class SPA0
Router(config-depi-class)# exit
Router(config)# depi-tunnel SPA0
Router(config-depi-tunnel)# l2tp-class class1
Router(config-depi-tunnel)# depi-class SPA0
Router(config-depi-tunnel)# dest-ip 192.0.2.155
Router(config-depi-tunnel)# exit
Router(config)# cable downstream rf-profile 64qam-B
Router(config-rf-prof)# cable downstream annex B
Router(config-rf-prof)# cable downstream modulation 64
Router(config-rf-prof)# cable downstream interleaver-depth option1 I128-J1 option2 I32-J4
Router(config-rf-prof)# cable downstream symbol-rate 3500000
Router(config-rf-prof)# exit
Router(config)# cable downstream freq-profile freq-profile1
Router(config-freq-prof)# lane 1 start-freq 48000000
Router(config-freq-prof-lane)# block 1 start-freq 48000000
Router(config-freq-prof-lane)# exit
Router(config-freq-prof)# exit
Router(config)# interface qam 7/4
Router(config-if)# cable downstream freq-profile freq-profile1
Router(config-if)# exit
Router(config)# interface qam 7/4.1
Router(config-subif)# cable downstream lqam 1
Router(config-subif)# cable downstream rf-power 50
Router(config-subif)# cable downstream frequency 714000000 lane 2 block 4
Router(config-subif)# cable mode depi local remote
Router(config-subif)# no cable downstream rf-shutdown
Router(config-subif)# cable downstream tsid 100
Router(config-subif)# depi depi-tunnel SPA0
Router(config-subif)# end
```

Configuring DEPI Reconciliation Timeout

The DEPI reconciliation timeout by default is to set to 60 seconds. Effective with Cisco IOS-XE Release 3.3.1SQ, the DEPI reconciliation timeout can be changed using the command **cable downstream depi-session timeout**.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cable downstream depi-session timeout** *sec*
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable downstream depi-session timeout** *sec* **Example:** `Router(config)# cable downstream depi-session timeout 90`	Specifies the DEPI reconciliation timeout in seconds. • *sec*— The range is from 60 to 300. The default is 60.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Examples

The following example shows how to configure DEPI reconciliation timeout on the Cisco RFGW-10.

```
Router> enable
Router# configure terminal
Router(config)# cable downstream depi-session timeout 90
Router(config)# exit
```

N+1 DEPI Redundancy on the M-CMTS Router and Cisco RFGW-10

Configuring N+1 Redundancy on the M-CMTS Router and Cisco RFGW-10

Note The N+1 DEPI redundancy feature is supported only on the Cisco uBR-MC3GX60V line card. This feature is not supported on the Cisco Wideband SPA.

The procedure is the same for configuring N+1 DEPI redundancy on the M-CMTS router and Cisco RFGW-10. You must configure N+1 DEPI redundancy on the M-CMTS router before configuring it on the Cisco RFGW-10.

The working tunnel and the protect tunnel are configured using the same **depi-tunnel** command. The protect tunnel inherits L2TP class and DEPI class parameters from the working tunnel. When you configure the protect tunnel and specify the destination IP address for the protect tunnel, the QAM channel parameters specified for the working tunnel are automatically accepted by the protect tunnel.

Prerequisites

- You must configure N+1 line card redundancy for the Cisco uBR-MC3GX60V line card before configuring N+1 DEPI redundancy.
- You must configure N+1 DEPI redundancy on the M-CMTS router before configuring it on the Cisco RFGW-10.
- The tunnel names for the working and protect tunnels must be distinct and the protect tunnel must be associated with the corresponding working tunnel.
- The working tunnel must be configured on the Cisco RFGW-10 before configuring the protect tunnel.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **depi-tunnel** *protect-depi-tunnel-name*
4. **dest-ip** *dest-ip-address*
5. **exit**
6. **depi-tunnel** *working-depi-tunnel-name*
7. **protect-tunnel** *protect-depi-tunnel-name*
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**depi-tunnel** *protect-depi-tunnel-name* **Example:** `Router(config)# depi-tunnel protect1`	Specifies a protect tunnel name and enters DEPI tunnel configuration mode.
Step 4	**dest-ip** *dest-ip-address* **Example:** `Router(config-depi-tunnel)# dest-ip 192.0.2.103`	Specifies the destination IP address of the termination point for the protect tunnel. **Note** When configuring on the M-CMTS router, destination IP address is the IP address of the EQAM. When configuring on the EQAM, this is the IP address of the M-CMTS router.
Step 5	**exit** **Example:** `Router(config-depi-tunnel)# exit`	Exits the DEPI tunnel configuration mode.
Step 6	**depi-tunnel** *working-depi-tunnel-name* **Example:** `Router(config)# depi-tunnel working1`	Specifies a working tunnel name that is already configured with QAM channel parameters, and enters DEPI tunnel configuration mode.
Step 7	**protect-tunnel** *protect-depi-tunnel-name* **Example:** `Router(config-depi-tunnel)# protect-tunnel protect1`	Associates the protect tunnel to the corresponding working tunnel. **Note** Use the same protect tunnel that you created using the **depi-tunnel** command to associate the protect tunnel to the corresponding working tunnel.
Step 8	**end** **Example:** `Router(config-depi-tunnel)# end`	Exits DEPI tunnel configuration mode and returns to privileged EXEC mode.

Examples

The following example shows how to configure a DEPI tunnel for the protect cable interface line card on the Cisco RFGW-10.

Destination IP address of the M-CMTS router must be specified as the endpoint for the protect tunnel:

```
Router> enable
Router# configure terminal
```

```
Router(config)# depi-tunnel protect1
Router(config-depi-tunnel)# dest-ip 192.0.2.103
Router(config-depi-tunnel)# exit
```

The protect tunnel is then configured on an existing working DEPI tunnel:

```
Router(config)# depi-tunnel working1
Router(config-depi-tunnel)# protect-tunnel protect1
Router(config-depi-tunnel)# end
```

Configuring DLM on the M-CMTS Router

Prerequisities

- Starting Cisco IOS Release 12.2(50)SQ4 and later, **cluster run** must be enabled on the Cisco RFGW-10.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*}
4. **rf-channel** *rf-channel* **network-delay** *delay* [**sampling-rate** *rate*]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**controller modular-cable** {*slot/bay/port* | *slot/subslot/controller*} **Example:** `Router(config)# controller modular-cable 1/0/0`	Specifies the modular cable controller interface for the SPA or the line card. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *bay*—The bay in a SIP where a SPA is located. Valid values are 0 (upper bay) and 1 (lower bay). • *port*—Specifies the interface number on the SPA. • *subslot*—Cable interface line card subslot. Valid values are 0 and 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.
Step 4	**rf-channel** *rf-channel* **network-delay** *delay* [**sampling-rate** *rate*] **Example:** `Router(config-controller)# rf-channel rf6 network-delay auto sampling-rate 1`	Configures the network delay for an RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *delay*—The Converged Interconnect Network (CIN) delay. The default value is 550 usec. The permitted range is from 0 to 3000 usec. • **auto**—Determines the delay through DLM packets automatically. • **sampling-rate** *rate*—(Optional) Specifies how often the DLM is sent. This option is available only when the network delay value is set as **auto**. The permitted range is from 1 to 500 sec. The default value is 10 sec.
Step 5	**end** **Example:** `Router(config-controller)# end`	Returns to privileged EXEC mode.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*} **Example:** `Router(config)# controller modular-cable 1/0/0`	Specifies the modular cable controller interface for the SPA or the line card. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *bay*—The bay in a SIP where a SPA is located. Valid values are 0 (upper bay) and 1 (lower bay). • *port*—Specifies the interface number on the SPA. • *subslot*—Cable interface line card subslot. Valid values are 0 and 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.
Step 4	**rf-channel** *rf-channel* **network-delay** *delay* [**sampling-rate** *rate*] **Example:** `Router(config-controller)# rf-channel rf6 network-delay auto sampling-rate 1`	Configures the network delay for an RF channel. • *rf-port*—RF channel physical port on the SPA or the line card. Valid values for the RF port depend on the configuration of the annex modulation. • *delay*—The Converged Interconnect Network (CIN) delay. The default value is 550 usec. The permitted range is from 0 to 3000 usec. • **auto**—Determines the delay through DLM packets automatically. • **sampling-rate** *rate*—(Optional) Specifies how often the DLM is sent. This option is available only when the network delay value is set as **auto**. The permitted range is from 1 to 500 sec. The default value is 10 sec.
Step 5	**end** **Example:** `Router(config-controller)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure the DLM on the M-CMTS with the **auto** keyword:

```
Router> enable
Router# configure terminal
Router(config)# controller modular-cable 1/0/0
Router(config-controller)# rf-channel rf6 network-delay auto sampling-rate 1
```

Configuring Clustering on the Cisco RFGW-10

Prerequisities

- Starting Cisco IOS Release 12.2(50)SQ4 and later, **cluster run** must be enabled on the Cisco RFGW-10 to handle DLM ingress traffic and midplane ping functionality.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **cluster run**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cluster run** **Example:** `Router(config)# cluster run`	Enables clustering on the Cisco RFGW-10.
Step 4	**end** **Example:** `Router(config)# end`	Returns to privileged EXEC mode.

Examples

The following example shows how to configure the clustering on the Cisco RFGW-10 :

```
Router> enable
Router# configure terminal
Router(config)# cluster run
Router(config)# end
```

Disabling a DEPI Data Session on the M-CMTS Router

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*}
4. **no rf-channel** *rf-channel* **depi-tunnel** *depi-tunnel-name* [**tsid** *id*]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller modular-cable** {*slot*/*bay*/*port* | *slot*/*subslot*/*controller*} **Example:** `Router(config)# controller modular-cable 1/0/0`	Specifies the modular cable controller interface for the SPA or the line card. • *slot*—SPA interface processor (SIP) or the line card slot. Slots 1 and 3 are used for SIPs. The valid range is from 5 to 8 for the line card slot. • *bay*—The bay in a SIP where a SPA is located. Valid values are 0 (upper bay) and 1 (lower bay). • *port*—Specifies the interface number on the SPA. • *subslot*—Cable interface line card subslot. Valid values are 0 and 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.

	Command or Action	Purpose
Step 4	**no rf-channel** *rf-channel* **depi-tunnel** *depi-tunnel-name* [**tsid** *id*] **Example:** `Router(config-controller)# no rf-channel 0 depi-tunnel SPA0`	Removes the specified DEPI data session under the modular controller. • *rf-channel*—RF channel physical port on the SPA or the line card. • *depi-tunnel-name*—Name of the DEPI tunnel. • **tsid** *id*—(Optional) Specifies the TSID value on the QAM subinterface. The TSID is used to associate the logical RF channel of the SPA or the line card to a physical QAM on Cisco RFGW-10.
Step 5	**end** **Example:** `Router(config-controller)# end`	Returns to Privileged EXEC mode.

Examples

The following is an example for disabling a DEPI data session on the M-CMTS router:

```
Router> enable
Router# configure terminal
Router(config)# controller modular-cable 1/0/0
Router(config-controller)# no rf-channel 0 depi-tunnel SPA0 tsid 100
Router(config-controller)# end
```

Configuration Examples for M-CMTS DEPI

This section provides the following configuration examples:

Example: Manual DEPI Configuration on the M-CMTS Router

The following example shows how to configure manual DEPI on the M-CMTS router:

```
Router# show running config
.
.
.
```

```
rf-channel 12 cable downstream channel-id 13
controller modular-cable 5/1/0
rf-channel 12 frequency 573000000 annex B modulation 256qam interleave 32
rf-channel 12 ip-address 192.168.11.1 mac-address 0022.9084.b53f depi-remote-id 196640
no rf-channel 12 rf-shutdown
!
```

Example: Manual DEPI Configuration on the Cisco RFGW-10

The following example shows how to configure manual DEPI sessions on the Cisco RFGW-10 DS-384 line card:

```
Router# show interface interface Qam3/1.3

cable carrier-id 3
cable downstream lqam-group 1
cable mode depi local lbg 1
cable downstream rf-profile name
cable downstream rf-power 49.0
cable downstream frequency 573000000
no cable downstream rf-shutdown
cable depi dest-ip 192.168.11.1
end
```

The following example shows how to create an RF profile for the Cisco RFGW-10 DS-384 used for manual DEPI:

```
Router # show running config

cable downstream rf-profile name
 cable downstream annex B
 cable downstream modulation 256
 cable downstream interleaver-depth option1 I32-J4 option2 I32-J4
 cable downstream symbol-rate 6952000
```

Example: DEPI Control Plane Configuration on the M-CMTS Router

The following example shows how to configure DEPI control plane on the M-CMTS router:

```
Router# show running-config
.
.
.
l2tp-class rf6
!
depi-class rf6
mode mpt
!
depi-tunnel rf6
tos 128
dest-ip 192.0.2.103
l2tp-class rf6
depi-class rf6
!
controller Modular-Cable 1/1/0
 modular-host subslot 7/1
 rf-channel 0 cable downstream channel-id 1
 rf-channel 0 frequency 555000000 annex B modulation 256qam interleave 32
 rf-channel 0 depi-tunnel GE_1-1-0 tsid 3011
```

```
 rf-channel 0 rf-power 30.0
 no rf-channel 0 rf-shutdown.
.
```

Example: DEPI Control Plane Configuration on Cisco RFGW-10

The following example shows how to configure DEPI control plane on the Cisco RFGW-10 DS-48 line card:

```
Router# show running-config
.
.
.
l2tp-class GE_8-1-0
 hello 1
 retransmit retries 5
 timeout setup 60

depi-tunnel GE_8-1-0
 dest-ip 192.168.4.1
 l2tp-class GE_8-1-0
 depi-class dmpt

interface Qam5/1.1
 cable carrier-id 1
 cable downstream lqam-group 1
 cable mode depi remote learn
 cable downstream tsid 5011
 depi depi-tunnel GE_8-1-0
!
```

The following example shows how to display the DEPI sessions configured on the Cisco RFGW-10 DS-48 line card:

```
Router# show cable depi-sessions l2tp summary

List of the Configured Depi Sessions

  SessionID   Type                State      Qam-info        PWtype
  x-----------x-------------------x----------x---------------x-------
  1074003983  DEPI_OVER_IP        ACTIVE       Qam     5/1.1   DMPT
```

The following example shows how to display DEPI control plane on the Cisco RFGW-10 DS-384 line card:

```
Router# show running-config

interface Qam3/1.1
 cable carrier-id 1
 cable downstream lqam-group 1
 cable mode depi remote learn
 cable downstream tsid 3011
 depi depi-tunnel GE_1-1-0
```

The following example show how to display the DEPI sessions configured on the Cisco RFGW-10 DS-384 line card:

```
Router# show cable depi-sessions l2tp summary

List of the Configured Depi Sessions

  SessionID   Type                State      Qam-info         PWtype
  x-----------x-------------------x----------x---------------x-------
  1073741834  DEPI_OVER_IP        ACTIVE     Qam     3/1.1    DMPT
```

Example: N+1 DEPI Redundancy Configuration on the M-CMTS Router

The following example shows how to configure N+1 DEPI redundancy on the Cisco CMTS router:

```
Router# show running-config
.
.
.
l2tp-class rf6
!
depi-class rf6
mode mpt
!
depi-tunnel rf6
tos 128
dest-ip 192.0.2.103
l2tp-class rf6
depi-class rf6
protect-tunnel test1_protect
!
depi-tunnel test1_protect
 dest-ip 24.30.14.103

controller Modular-Cable 8/0/0
ip-address 192.0.2.155
modular-host subslot 6/0
rf-channel 6 cable downstream channel-id 7
rf-channel 6 frequency 717000000 annex B modulation 64qam interleave 64
rf-channel 6 depi-tunnel rf6 tsid 6
rf-channel 6 rf-power 46
rf-channel 6 network-delay auto sampling-rate 1
no rf-channel 6 rf-shutdown
.
.
.
```

Example: Gigabit Ethernet Interface Configuration on the M-CMTS Router

The following example shows how to display the Gigabit Ethernet configuration on the M-CMTS:

```
Router# show running-config interface gigabitEthernet 1/0/0
.
.
.
interface GigabitEthernet1/0/0
ip address 192.0.2.155 255.255.255.0
negotiation auto
.
```

Example: Gigabit Ethernet Interface Configuration on Cisco RFGW-10

The following example show how to display the Gigabit Ethernet configuration on Cisco RFGW-10:

```
Router# show running-config interface gigabitEthernet 6/13
.
.
.
interface GigabitEthernet6/13
no switchport
ip address 192.0.2.103 255.255.255.0
.
.
.
```

Example: DEPI Reconciliation Timeout Configuration on Cisco RFGW-10

The following example show how to display the DEPI reconcilaition timeout configuration on Cisco RFGW-10:

```
Router# show running-config | begin depi-sess

cable downstream depi-session timeout 90
cable downstream rf-profile default-rf-profile
cable downstream annex B
cable downstream modulation 64
cable downstream interleaver-depth option1 I32-J4 option2 I32-J4
cable downstream symbol-rate 5056941
```

Enabling Traps for DEPI Tunnel or Session State Change

You can enable trap notifications when there is a change in DEPI tunnel or session state.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `RFGW-10> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `RFGW-10# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server enable traps l2tun {pseudowire| session}** **Example:** `RFGW-10(config)# snmp-server enable traps l2tun {pseudowire| session}`	Enables traps for receiving notifications on an NMS (network management system) when there is change in DEPI tunnel or session state. • **pseudowire**—Enable SNMP l2tun pseudowire traps. • **session**—Enable SNMP l2tun session traps.

Verifying M-CMTS DEPI on the Cisco RFGW-10

Verifying Manual DEPI

To verify a DEPI session, use the **show cable depi-sessions** command in privileged EXEC mode. The following example displays the manual DEPI sessions configured on the Cisco RFGW-10 DS-384 line card:

```
Router# show cable depi-sessions manual summary

List of the Configured Depi Sessions

 SessionID   Type                State      Qam-info        PWtype  Carrier-ID
 x-----------x-------------------x----------x---------------x-------x-------

 196640      MANUAL_DEPI_OVER_IP ACTIVE     Qam     3/1.3   DMPT    3
```

Verifying M-CMTS DEPI Control Plane

Verifying DEPI Tunnel Information

To verify a DEPI tunnel information, use the **show depi tunnel** command in privileged EXEC mode.

Note This command works on both the Cisco RFGW-10 and the M-CMTS router.

The following is a sample output of the **show depi tunnel** command for all the active control connections:

```
Router# show depi tunnel

LocTunID   RemTunID   Remote Name   State  Remote Address  Sessn L2TP Class/
                                                          Count VPDN Group
1834727012 3849925733 RFGW-10       est    192.0.2.155       1     rf6
```

The following is a sample output of the **show depi tunnel** command for a specific active control connection identified using the *depi-tunnel-name*:

```
Router# show depi tunnel 1834727012 verbose

Tunnel id 1834727012 is up, remote id is 3849925733, 1 active sessions
  Locally initiated tunnel
  Tunnel state is established, time since change 04:10:38
  Remote tunnel name is RFGW-10
    Internet Address 192.0.2.155, port 0
  Local tunnel name is myankows_ubr10k
    Internet Address 192.0.2.103, port 0
  L2TP class for tunnel is rf6
  Counters, taking last clear into account:
    0 packets sent, 0 received
    0 bytes sent, 0 received
    Last clearing of counters never
  Counters, ignoring last clear:
    0 packets sent, 0 received
    0 bytes sent, 0 received
  Control Ns 255, Nr 254
  Local RWS 1024 (default), Remote RWS 8192
  Control channel Congestion Control is enabled
    Congestion Window size, Cwnd 256
    Slow Start threshold, Ssthresh 8192
    Mode of operation is Slow Start
  Retransmission time 1, max 1 seconds
  Unsent queuesize 0, max 0
  Resend queuesize 0, max 2
  Total resends 0, ZLB ACKs sent 252
  Total peer authentication failures 0
  Current no session pak queue check 0 of 5
  Retransmit time distribution: 0 0 0 0 0 0 0 0 0 0
  Control message authentication is disabled
```

Note The counters in **show depi tunnel verbose** command output are not supported.

Verifying DEPI Session Information

To verify a DEPI session, use the **show depi session** command in privileged EXEC mode.

Note This command works on both the Cisco RFGW-10 and the M-CMTS router.

The following is a sample output of the **show depi session** command for all the established DEPI data sessions:

```
Router# show depi session

LocID      RemID      TunID      Username, Intf/      State  Last Chg Uniq ID
                                 Vcid, Circuit
```

```
1252018468 1252055513 1834727012 6,                   est    04:06:10 1
```

The following is a sample output of the **show depi session** command for a specific established DEPI data session identified using the *session-id*:

```
Router# show depi session 1252018468 verbose

Session id 1252018468 is up, tunnel id 1834727012
  Remote session id is 1252055513, remote tunnel id 3849925733
  Locally initiated session
Qam Channel Parameters
  Group Tsid is 0
  Frequency is 717000000
  Modulation is 64qam
  Annex is B
  Interleaver Depth I=32 J=4
  Power is 0
  Qam channel status is 0
  Unique ID is 1
Call serial number is 326100007
Remote tunnel name is RFGW-10
  Internet address is 192.0.2.155
Local tunnel name is myankows_ubr10k
  Internet address is 192.0.2.103
IP protocol 115
  Session is L2TP signaled
  Session state is established, time since change 04:06:24
    0 Packets sent, 0 received
    0 Bytes sent, 0 received
  Last clearing of counters never
  Counters, ignoring last clear:
    0 Packets sent, 0 received
    0 Bytes sent, 0 received
    Receive packets dropped:
      out-of-order:             0
      total:                    0
    Send packets dropped:
      exceeded session MTU:     0
      total:                    0
  DF bit on, ToS reflect enabled, ToS value 0, TTL value 255
  UDP checksums are disabled
  Session PMTU enabled, path MTU is 1492 bytes
  No session cookie information available
  FS cached header information:
    encap size = 28 bytes
    45000014 00004000 FF73706F 01030467
    0103049B 4AA0D9D9 00000000
  Sequencing is on
    Ns 0, Nr 0, 0 out of order packets received
    Packets switched/dropped by secondary path: Tx 0, Rx 0
  Peer Session Details
  Peer Session ID : 1073808091
  Peer Qam ID : Qam3/12.2
  Peer Qam State : ACTIVE
  Peer Qam Type : Secondary
  Peer Qam Statistics
  Total Pkts : 35177
  Total Octets : 6613276
  Total Discards : 0
  Total Errors : 0
  Total In Pkt Rate : 0
  Bad Sequence Num : 0
  Total In DLM Pkts : 0
  Conditional debugging is disabled
```

The following is a sample output of the **show depi session** command for all the configured DEPI data sessions:

```
Router# show depi session configured

Session Name           State    Reason                      Time
Modular-Cable1/0/0:0   IDLE     Power mismatch              Jun 10 09:59:07
```

Note The counters in **show depi session verbose** command output are not supported.

The following is a sample output of the **show cable depi-ctrl-sessions teardown detail** command which gives details on the reason for depi session tear down and tear down time:

```
Router# show cable depi-ctrl-sessions teardown detail

Session Name                   Teardown-Reason             Time
Qam3/1.1:0                     recv CDN                    Jun 23 08:59:43
Qam3/1.2:0                     recv CDN                    Jun 23 08:59:43
Qam3/1.3:0                     recv CDN                    Jun 23 08:59:50
Qam3/1.4:0                     recv CDN                    Jun 23 08:59:43
Qam3/2.1:0                     recv CDN                    Jun 23 09:08:09
Qam3/2.2:0                     recv CDN                    Jun 23 09:14:09
Qam3/2.3:0                     QAM not ready               Jun 23 08:59:34
Qam3/2.4:0                     QAM not ready               Jun 23 08:59:34
```

Verifying DLM Configuration Information

To verify the DLM configuration information, use the **show interface modular-cable dlm** command in privileged EXEC mode.

The following example shows sample output of the **show interface modular-cable** *slot*/*bay*/*port*:*interface_number* **dlm** command:

```
Router# show interface Modular-Cable 1/0/0:6 dlm

DEPI Latency Measurements for Modular-Cable1/0/0:6
Current CIN Delay: 146 usecs
Current DLM: 4566
Average DLM (last 10): 1514
Max DLM: 5115
Min DLM: 913
Ingress DLM
#           SysUpTime           Delay (Ticks)
x-----------x-------------------x------------
0           831149              949
1           831159              1168
2           831170              4566
3           831076              1005
4           831087              983
5           831097              1185
6           831108              1139
7           831118              1144
8           831128              2013
9           831139              996
```

Note The M-CMTS sends either ingress or egress DLM requests based on the EQAM capabilities that EQAM reports during DEPI data session establishment.

Additional References

The following sections provide references related to the M-CMTS DEPI Control Plane feature.

Related Documents

Related Topic	Document Title
See Table 2 for the list of commands applicable for this feature.	Cisco RF Gateway 10 Command Reference http://www.cisco.com/en/US/docs/cable/rf_gateway/command/reference/RFGW-10_Book.html
Software Features in Cisco IOS Release 12.2SQ	Cisco RF Gateway 10 Software Feature and Configuration Guide http://www.cisco.com/en/US/docs/cable/rf_gateway/feature/guide/rfgw_scg.html

Standards

Standard	Title
CM-SP-DEPI-I08-100611	Data-Over-Cable Service Interface Specification, Modular CMTS, Downstream External PHY Interface Specification

MIBs

MIB	MIBs Link
• DOCS-IF-M-CMTS-MIB • DOCS-DRF-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 3931	Layer Two Tunneling Protocol - Version 3 (L2TPv3)

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 M-CMTS DEPI

Table 2 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 2 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 2 Feature Information for M-CMTS DEPI

Feature Name	Releases	Feature Information
M-CMTS DEPI Control Plane	12.2(50)SQ	This feature was introduced. The following commands were introduced or modified: **New Commands**: • [**no**] **depi-class** *depi-class-name* • [**no**] **depi-tunnel** *depi-tunnel-name* • [**no**] **dest-ip** *dest-ip-address* • **show depi** {**tunnel** [*depi-tunnel-name*] | **session** [*session-id* | **configured**]} [**verbose**]
Ingress DLM	12.2(50)SQ	This feature was introduced.

Table 2 Feature Information for M-CMTS DEPI (continued)

Feature Name	Releases	Feature Information
DEPI Path Redundancy	Cisco IOS Release 12.2(50)SQ2	This feature was introduced. The following commands were introduced or modified: • **protect-tunnel** • **show depi session** • **show depi tunnel**
DEPI EQAM Statistics	Cisco IOS Release 12.2(50)SQ2	The DEPI EQAM statistics feature enables the EQAM to send RF channel statistics to the M-CMTS router. The following command was introduced: • **depi eqam-stats**
Manual DEPI	Cisco IOS-XE Release 3.2.0SQ	Manual DEPI session configuration was modified. The following commands were modified: • **cable mode depi** {**local lbg** *lbg-interface* | **remote** [**learn**]} • **cable depi dest-ip** *IP address*
DEPI Reconciliation Timeout	Cisco IOS-XE Release 3.31SQ	This feature was introduced. The following command was introduced: • **cable downstream depi-session timeout**

Glossary

CM—Cable Modem. A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.

CIN—Converged Interconnect Network. Is the standard term used for the network between the M-CMTS and RFGW. This network can be a direct connection, a Layer 2 network or a Layer 3 network.

DEPI—Downstream External PHY Interface. Is the interface between the M-CMTS Core and the EQAM.

DLM—DEPI Latency Measurement. Is a special type of data packet used for measuring the network latency between the M-CMTS core and the EQAM.

DOCSIS—Data-Over-Cable Service Interface Specifications

DMPT—DOCSIS MPT Mode

EQAM—Edge Quadrature Amplitude Modulation. A head end or hub device that receives packets of digital video or data.

FPGA—Field-Programmable Gate Array

L2TPv3—Layer 2 Transport Protocol – version 3

M-CMTS—Modular Cable Modem Termination System

MPEG—Moving Picture Experts Group

MPT—MPEG-TS mode of DEPI

PHY—Physical Layer

RF—Radio Frequency. In cable television systems, this refers to electromagnetic signals in the range 5 to 1000 MHz.

SPA—Shared Port Adapter

TS—Transport Stream

VRF—Virtual Routing and Forwarding. Ensures that only valid traffic is routed to it by removing the IP Address of the interface from the global routing table (and from the interface).