Cisco Service Control for Managing Remote Cable MSO Links Solution Guide

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Cisco Systems, Inc.
www.cisco.com

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About this Guide

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Introduction

This *Cisco Service Control for Managing Remote Cable MSO Links Solution Guide* describes the use of a Cisco Service Control solution in a cable environment to optimize traffic on remote links. It describes the setup of a solution that uses the Virtual Link Manager (VLM) to enable traffic optimization of remote links, and the monitoring of that solution after deployment.

This guide assumes a basic familiarity with the concept of the Cisco Service Control solution, the Cisco Service Control Engine (Cisco SCE) platforms, and related components.

Document Revision History

The following Document Revision History table records the changes made to this document.

Table 1   *Document Revision History*

Cisco Service Control Release and Date	Change Summary
Release 5.0.x July 30, 2104	First version of this document (new for the Release 5.0.x train).

Organization

This guide contains the following sections.

Table 2   Document Organization

Section	Title	Description
Chapter 1	Remote Cable MSO Links Solution Overview	Provides an overview of the Remote Cable MSO Solution.
Chapter 2	DOCSIS 3.0 Support for Remote Cable MSO Links Solution	Describes the Cisco Service Control for Managing Remote Cable MSO Links Solution is enhanced with new features that are consistent with DOCSIS 3.0 specifications.
Chapter 3	Learning Interface Topology and Association	Describes learning of interface topology and association of the remote cable MSO links solution.
Chapter 4	Configuring the Remote Cable MSO Links Solution	Describes: • Basic topology for managing remote cable MSO links and the high-level steps to configure the solution • Prerequisites for configuring a solution that uses traffic optimization on remote links with the VLM • Configuring the VLM by using the configuration files contained in the Subscriber Manager installation
Chapter 5	Managing the Remote Cable MSO Links Solution	Describes the three monitoring mechanisms that you can use to monitor the traffic optimization on remote links solution.
Chapter 6	Troubleshooting the Remote Cable MSO Links Solution	Describes several problem scenarios that you may encounter when using the solution.

Conventions

This document uses the following conventions.

Table 3   Conventions

Convention	Indication
bold font	Commands and keywords and user-entered text appear in **bold** font.
italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
[ ]	Elements in square brackets are optional.
{x	y	z }	Required alternative keywords are grouped in braces and separated by vertical bars.
[x	y	z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	Nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
courier font	Terminal sessions and information the system displays appear in courier font.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Note Means *reader take note*.

Tip Means *the following information will help you solve a problem*.

Caution Means *reader be careful*. In this situation, you might perform an action that could result in equipment damage or loss of data.

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Warning **Means *reader be warned*. In this situation, you might perform an action that could result in bodily injury.**

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C O N T E N T S

Remote Cable MSO Links Solution Overview

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Overview

In cable multiple service operator (MSO) networks, the Cisco SCE is inserted in a location upstream of the cable modem termination system (CMTS), which is the first IP hop in the MSO network. In this location, the Cisco SCE is often used to implement fair use policies (FUP) and perform congestion mitigation. MSOs work to ensure that the existing network infrastructure is used optimally by using the Cisco SCE to enforce fairness between the different subscribers when the network is in a state of congestion.

The bandwidth of the radio frequency interfaces of the CMTS ranges from several megabits per second (Mb/s) to tens of Mb/s. The CMTS aggregates these interfaces into higher bandwidth upstream links, typically 1 gigabit per second (Gb/s), where the Cisco SCE is connected.

Cable modems which are connected to the hybrid fiber-coaxial (HFC) cable downstream connection of the CMTS are associated with CMTS interfaces. The CMTS interfaces can be termed upstream or downstream upon bootup or dynamically (depending on the direction of traffic flow) when you use some load balancing algorithms.

Figure 1-1 shows a typical deployment topology of an Cisco SCE in an MSO network.

Figure 1-1   Cisco SCE Deployed in MSO Network
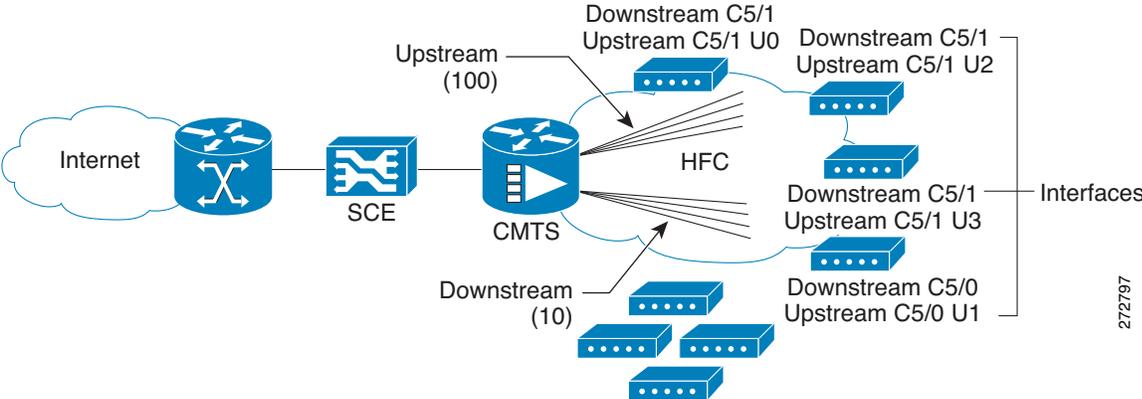
Solution Overview

As part of the Remote Cable MSO Links solution, the Virtual Link Manager (VLM) makes the Cisco SCE aware of the interface association of subscribers (cable modems) and accounts for and controls aggregate traffic in the context of a physical interface (CMTS upstream or downstream). This awareness allows the Cisco SCE to perform congestion mitigation at the level of the CMTS physical interface.

The solution is required to manage a large number of subscribers, each of which is connected to the CMTS and through it to the Cisco SCE. Within the CMTS, subscribers are connected to shared radio frequency interfaces, where they use the Data-Over-Cable Service Interface Specifications (DOCSIS) MAC layer to transport their traffic. The shared radio frequency interfaces are termed upstream and downstream.

CMTS upstream and downstream interfaces are aggregated through the CMTS interface toward the core of the network, and eventually end in one or several physical interfaces that are connected to the Cisco SCE, which monitors and controls traffic.

MSOs use the Cisco SCE to prioritize traffic within each of the CMTS radio frequency interfaces when traffic is congested. Cisco Service Control provides a virtual link concept that allows MSOs to monitor and control traffic for each interface.

Although it is possible to prioritize traffic by allocating packages to pairs of interfaces, this process is time consuming. The virtual links approach simplifies the model. Each virtual link is monitored and controlled separately within the Cisco Service Control solution, while virtual link provisioning is performed through the Cisco SCE CLI. The policy remains simple, and reflects only per-subscriber tiering.

Figure 1-2 shows traffic traveling through the Cisco SCE that is mapped into Cisco SCE virtual links, which reflect the CMTS physical interfaces. Monitoring and control are performed in the context of the virtual links.

Figure 1-2   Traffic Traversing Cisco SCE that Is Mapped to Cisco SCE Virtual Links
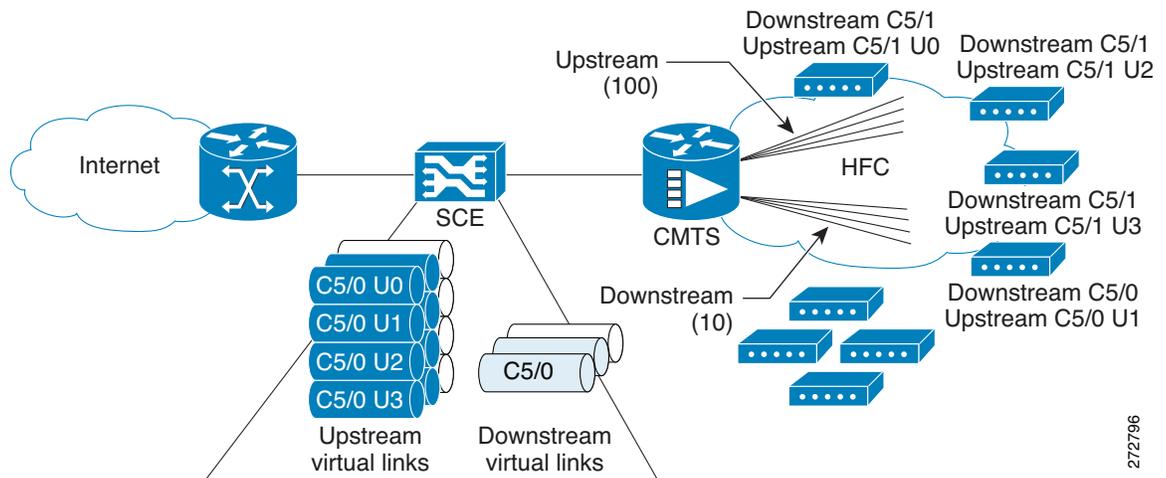
The Cisco Service Control solution provides the VLM to automate many of the configuration actions that the network administrator ordinarily performs, including:

- Provisioning virtual-link maps for each Cisco SCE based on the interface maps of the CMTSs that provide network access.

- Configuring bandwidth values for the virtual links based on the CMTS interface speed values. These values tend to change regularly as part of cable plant maintenance, or automatically as part of spectrum management. These changes must be traced and acted upon by the network administrator.

- Building the Subscriber Manager virtual-link mapping configuration.

  The virtual-link mapping configuration defines the mapping between the following:

  - DHCP options that define the subscribers interface associations that are extracted from the DHCP acknowledge message

  - From IPDR message the subscriber interface associations are retrieved by using CM-STATUS and SAMIS TYPE-1 templates.

  - Corresponding virtual links ID

DOCSIS 3.0 Support for Remote Cable MSO Links Solution

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Introduction

The Cisco Service Control for Managing Remote Cable MSO Links Solution is enhanced with new features that are consistent with DOCSIS 3.0 specifications.

The solution includes support for the following features:

- Downstream bonding of multiple channels—multiple channels are bonded to a single, virtual interface to provide higher bandwidth to the cable modems.

- Upstream bonding of multiple channels—multiple channels are bonded to a single, virtual interface to provide higher bandwidth for the cable modems in the upstream direction.

- Multiple Primary Channels—supports multiple primary channels defined under a vlink in downstream direction.

- Overlapped Bonding Groups—supports configurations where in a single channel can be part of more than one bonding group.

- Dynamic Channel Change of Cable Modems—enables effective control of channels and vlink utilization by identifying dynamic channel changes of cable modems.

- Support for non-Cisco CMTS—supports Arris CMTS.

IPDR LEG

IPDR LEG supports these features additionally:

- IPDR LEG enables Cisco SCE to support the multiple primary channels in bonding groups, dynamic channel changes of cable modems, and support for non-Cisco CMTSs (Only Arris CMTSs).

- IPDR enables CMTSs to send per-subscriber records to IPDR database. These records are used for reporting and billing purposes.

The IPDR record includes the required information for mapping cable modems and CPEs to virtual links.

The CMTS generates periodic and event based IPDR records for each cable modem. This record includes the IP address of the cable modem and CPEs.

If you configure CMTS to generate IPDR records periodically, by default, CMTS generates the records every 15 minutes.

Since the records are generated on event or periodically for all the cable modems, the IPDR reports support dynamic changes of cable modems between QAM channels. The IPDR LEG gets these IPDR reports and updates the dynamic channel changes.

Note   IPDR LEG does not support dynamic device learning.

For details on IPDR LEG, see the *Cisco Service Control Management Suite Subscriber Manager LEGs User Guide*.

Feature Overview

Downstream Bonding of Multiple Channels

The DOCSIS 3.0 downstream bonding enables high-speed broadband access and helps cable operators offer more bandwidth-intensive services by adding one or more additional downstream quadrature amplitude modulation (QAM) channels to the standard broadband DOCSIS system. This new set of downstream (DS) channels is grouped into one larger channel, known as a bonded channel.

With wideband data services, multiple DS channels are aggregated into a single logical wideband channel (bonding group) that delivers higher bandwidth to the wideband cable modem when compared to DOCSIS 2.0 technology. This aggregation of the DS channels is referred to as channel bonding. Data rates in this virtual channel range from hundreds of megabits to potentially gigabits per second, creating more available bandwidth in the network.

Figure 2-1 presents a simplified view of the Cisco DOCSIS 3.0 downstream solution.

Figure 2-1   DOCSIS 3.0 Downstream Solution
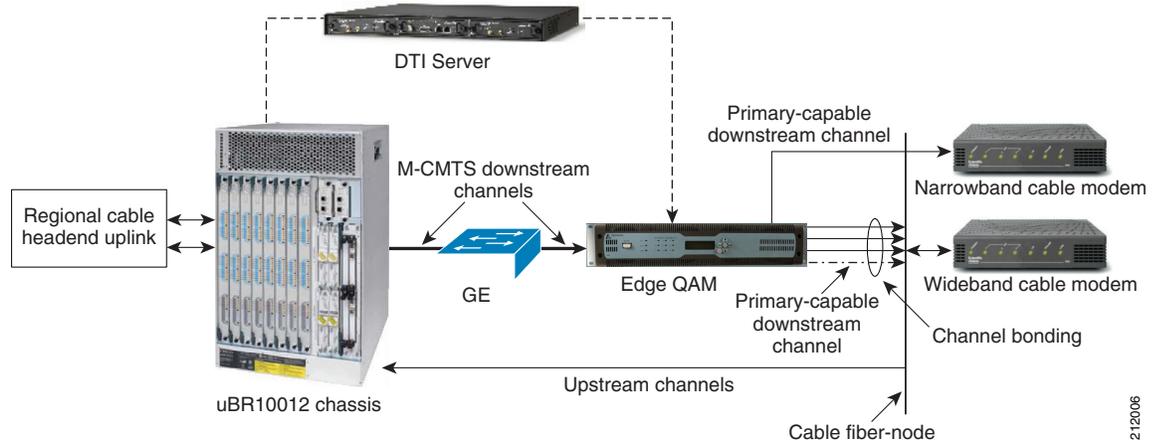
The DS channels are used either as primary channels (used for both broadband and narrowband channels) or secondary channels (used only for wideband channels), or both. The solution provides narrowband data services to support DOCSIS 1.x or 2.0 modems and wideband data services to support DOCSIS 3.0 modems over existing HFC networks and allows DOCSIS 1.x or 2.0 and DOCSIS 3.0 modems to share the same DS channel.

A maximum of eight channel bonding groups are supported.

The Cisco wideband CMTS uses one or more external edge QAM (EQAM) devices. The EQAM device is a network element in a separate chassis from the CMTS. The EQAM device has two or more Gigabit Ethernet input interfaces that connect to a wideband shared port adapters (SPA). For output, the EQAM device has multiple QAM modulators and RF converters that connect to an HFC network. The EQAM device accepts MPEG over IP on its Gigabit Ethernet interfaces and routes the services to its QAM RF outputs.

The enhanced Cisco Service Control solution leverages the Cisco SCE bandwidth control and reporting capabilities to monitor and control the CMTS resources at the QAM level. Multiple QAMs are aggregated into a virtual group (bundle group). The bandwidth allocation for different modems are done both on the CMTS and the EQAM. The EQAM minimizes the packets waiting in queue for each channel.

The EQAM manages the queues differently for legacy and 3.0 modems:

- All traffic to the legacy modems are routed through the primary narrowband channel queue.
- Traffic to 3.0 modems are routed through the shortest possible queue.

This feature is supported on Cisco uBR-MC3GX60V Broadband Processing Engine (BPE). The Cisco uBR-MC3GX60V Broadband Processing Engine (BPE) is a high-capacity, DOCSIS 3.0-capable line card for the Cisco uBR10012 Universal Broadband Router. Each line card supports 72 DOCSIS downstream and 60 upstream channels. For details about the line card, see the product datasheet on Cisco.com at the URL
http://www.cisco.com/en/US/prod/collateral/modules/ps4969/ps11291/data_sheet_c78-642540.html

Prioritizing Subscriber Association to Bonding Groups

In a normal scenario, cable modems are connected to one downstream bonding group and with one single primary channel. But, while using the SNMP, there are chances that the cable modem may associate itself to two service flows. The first service flow is usually mapped to a bonding group and the second service flow to a primary channel.

In a scenario where a cable modem associates itself to two separate service flows, the Cisco Service Control Subscriber Manager associates the subscriber based on the last retrieved service flow mapping. The Cisco Service Control Subscriber Manager uses this method because a subscriber cannot have more than one virtual link for each direction. As a result, the subscriber gets associated to a primary channel instead of a bonding group.

From Cisco Service Control Subscriber Manager Release 3.8.5, the service flow mapped to the bonding group gets priority over the service flow with a primary channel. As a result, if the Cisco Service Control Subscriber Manager detects more than one service flow, the Cisco Service Control Subscriber Manager associates the subscriber to a bonding group.

Bandwidth Control Enhancements

The enhancements to the Cisco SCE bandwidth control include:

- Support for wideband channels—A two-level virtual link hierarchy is created to support the wideband channels. The wideband channels are associated with the Aggregate Global Control (AGC) that provides a constant output signal despite variations in input signal strength. Wideband channels are associated with three AGCs in a two-level hierarchy.The top-level AGC is dynamic and the lower-level AGCs are equivalent to the existing AGCs. At the lower level, all the 3.0 modems for wideband are aggregated into one AGC. The other AGC contains both legacy and 3.0 modems.

  The committed information rate (CIR) and peak information rate (PIR) parameters are derived from the CMTS and QAM configurations.

  For the example, consider a wideband channel that includes three channels. One of the three channels is a primary channel (narrowband) and contains a mix of legacy and 3.0 cable modems. If 20 percentage bandwidth of the narrowband channel is allocated to 3.0 cable modems, the CIR and PIR values are calculated as:

  Each QAM rate - X = 30 Mb

  Percentage bandwidth allocated for 3.0 cable modems = 20 percentage

Note   For Arris CMTS, Cisco SCE does not support bandwidth percentage share for DOCSIS 3.0 cable modem.

Table 2-1 lists the CIR and PIR values of the 3.0 cable modems with 20 percentage bandwidth of narrowband channel allocation.

Table 2-1   CIR and PIR Values

AGC Name	CIR	PIR
Wideband-Cable1/0/0:0 (top level)	0	90 Mb (3X)
Wideband-Cable1/0/0:0_P	24 Mb (0.8X)	30 Mb (X)
Wideband-Cable1/0/0:0 _W	20	90 Mb (3X)

- Subscriber fairness within virtual links—To enforce subscriber fairness within the virtual links, the bandwidth is first allocated between the subscribers based on their RP level, followed by the services of each subscriber.

- Application limitation within virtual links—Cisco SCE limits specific applications within the virtual link without losing control over the traffic.

- Enabling global control with CMTS-awareness solution.

Upstream Bonding of Multiple Channels

CMTS supports upstream channel bonding to provide higher bandwidth for the cable modems in the upstream direction.

The Upstream channel bonding is similar to the downstream channel bonding explained earlier. However, the Upstream VLINK to channel mapping considers only the total bandwidth available from the configured channels for PIR and CIR computation.

A maximum of eight channel bonding groups are supported.

Upstream Logical Channels

The concept of a logical channel refers to the time-division multiplexing (TDM) of the same radio frequency (RF) spectrum allocated to one physical upstream port. All logical upstream channels defined within a physical upstream port share the same upstream RF spectrum or the bandwidth.

Using the Logical Channel Support feature, cable system operators can segment and time-multiplex one spectrum for supporting the legacy modems, near and far modems, and new DOCSIS 3.0 modems with various service levels.

CMTS supports upstream logical channels for better bandwidth management. The bandwidth of the physical channel is divided between logical channels. But, the bandwidth of one logical channel is always equal to the bandwidth of the physical channel.

In the following example, the MAC domain have five upstream channels, each split into two logical channels. The domain also has tow bonding groups and the logical channels are grouped.

```
CMTS: 10.52.206.2
Mac Domain - Cable 5/0/0 (ifIndex 1780)
   US 0 (BW: 2000)
       US 0.0 (BW 2000) (ChId 13)
       US 0.1 (BW 500) (ChId 14)
   US 1 (BW: 1500)
       US 1.0 (BW 1500) (ChId 15)
       US 1.1 (BW 1000) (ChId 16)
   US 2 (BW 2500)
       US 2.0 (BW 2500) (ChId 17)
       US 2.1 (BW 1500) (ChId 18)
   US 3 (BW 3000)
       US 3.0 (BW 3000) (ChId 19)
       US 3.1 (BW 500) (ChId 20)
   US 4 (BW 2500)
       US 4.0 (BW 2500) (ChId 21)
       US 4.1 (BW 1000) (ChId 22)

BG -131 :  13, 15, 18, 22
BG -132 :  14, 16, 18, 21
```

In this example, upstream channel 3 (US 3) is not part of any bonding group and the channel is not overlapped. Channel 18 is overlapped in bonding group 131 and 132.

Example of VLINK configuration for this upstream logical channel configuration:

```
virtual index=1, name=codc_Cable5/0/0-US3, pir= 3000, cir=16, al=5, dynamic agc index=1
channel index=1, name=codc_Cable5/0/0-US3, pir=3000, cir=16, al=5, agc index=1
```

```
virtual index=2, name=codc_Cable5/0/0-US, pir= 8500 (2000+1500+2500+2500) , cir=16, al=5,
dynamic agc index=2

channel index=3, name=codc_Cable5/0/0-US0, pir=2000, cir=16, al=5, agc index=3
channel index=4, name=codc_Cable5/0/0-US1, pir=1500, cir=16, al=5, agc index=4
channel index=5, name=codc_Cable5/0/0-US2, pir=2500, cir=16, al=5, agc index=5
channel index=6, name=codc_Cable5/0/0-US4, pir=2500, cir=16, al=5, agc index=6
channel index=7, name=codc_Cable5/0/0-BG-131, pir=6000  (2000+1500+1500+1000), cir=16,
al=5, agc index=7
channel index=8, name=codc_Cable5/0/0-BG-132, pir=5500  (500+1000+1500+2500), cir=16,
al=5, agc index=8
```

This is the mapping table for this upstream logical channel configuration:

```
10.52.206.2_1780_13=3
10.52.206.2_1780_14=3
10.52.206.2_1780_15=4
10.52.206.2_1780_16=4
10.52.206.2_1780_17=5
10.52.206.2_1780_18=5
10.52.206.2_1780_19=1
10.52.206.2_1780_20=1
10.52.206.2_1780_21=6
10.52.206.2_1780_22=6
10.52.206.2_1780_13151822=7
10.52.206.2_1780_14161821=8
```

Overlapped Bonding Groups

In Overlapped Bonding Groups, a single channel can be part of more than one bonding group.

If channels are overlapped across the bonding groups, the Cisco SCE models those bonding groups under the same VLINK. If the channels are not overlapped, then the Cisco SCE models those bonding groups as separate VLINK.

The computation of the PIR and the CIR values for the VLINK and Channels are done by retrieving the percentage of channel BW allocated to DOCSIS 3.0 traffic that are part of overlapped bonding groups and also the percentage that is allocated to DOCSIS 2.0 traffic from those channels.

Note   Channels and Bonding Groups that are overlapped across MAC domains are not supported.

Example:

In this example, taken from the SNMP output, the Downstream bonding group and the overlapped bonding groups are shown. There are 4 bonding groups—the first two are mapped to 5/0/0 and another two are mapped to 6/0/0. Channel 2 and 3 are overlapped.

```
Cable5/0/0-downstream
        35: ifDescr(2).1121 (octet string) Wideband-Cable1/0/0:0
                Modular-Cable1/0/0:0
                Modular-Cable1/0/0:2
                Modular-Cable1/0/0:3
        36: ifDescr(2).1122 (octet string) Wideband-Cable1/0/0:1
                Modular-Cable1/0/0:1
                Modular-Cable1/0/0:2
                Modular-Cable1/0/0:3
```

```
Cable6/0/0-downstream
        37: ifDescr(2).1123 (octet string) Wideband-Cable1/0/0:2
                Modular-Cable1/0/0:4
        38: ifDescr(2).1124 (octet string) Wideband-Cable1/0/0:3
                Modular-Cable1/0/0:5
```

These are the list of channels and radio frequency bandwidth allocation for each channel on each wideband interface:

```
1121.1005.0 (gauge) 25 (25% of ifSpeed 4750) 6650
1121.1005.2 (gauge) 50 (50% of ifSpeed 9500) 13300
1121.1005.3 (gauge) 20 (20% of ifSpeed 3800) 5320
1122.1005.1 (gauge) 50 (50% of ifSpeed 9500) 13300
1122.1005.2 (gauge) 50 (50% of ifSpeed 9500) 13300
1122.1005.3 (gauge) 20 (20% of ifSpeed 3800) 5320
1123.1005.4 (gauge) 25
1124.1005.5 (gauge) 50
```

The following example provides details of the logic for IPDR and DHCP mapping:

```
- virtual index=1, name=Cable5/0/0-downstream, pir= 76000 , cir=16, al=5, dynamic agc
index=1
- channel index=1, name=Cable5/0/0-downstream-L0, pir=19000, cir=14250, al=5, agc index=2
- channel index=2, name=Cable5/0/0-downstream-L1, pir=19000, cir=9500, al=5, agc index=3
- channel index=3, name=Cable5/0/0-downstream-L2, pir=19000, cir=16, al=5, agc index=4
- channel index=4, name=Cable5/0/0-downstream-L3, pir=19000, cir=11400, al=5, agc index=5
- channel index=8, name=Cable5/0/0-downstream-W0, pir=57000, cir=18050, al=5, agc index=9
- channel index=9, name=Cable5/0/0-downstream-W1, pir=57000, cir=22800, al=5, agc index=10
- channel index=7, name=Cable5/0/0-downstream-W, pir=76000, cir=40850, al=5, agc index=8
```

Bonding Groups with Multiple Primary Channels

To support backward compatibility, the individual channels in the bonding groups can be used in parallel by legacy cable modems that work in earlier versions of DOCSIS. In this mode, there is a mix of legacy cable modems and DOCSIS 3.0 cable modems working on the same channels.

Primary channels of a CMTS are those channels that are capable of supporting legacy or DOCSIS 2.0 modems.

Channels that are configured to support legacy or DOCSIS 2.0 cable modems must be configured as a primary channel. Also, each bonding group must include at least one channel that is defined as a primary channel.

The basic Cisco SCE - CMTS integration supports only a single Primary channel for each bonding group. The basic integration supports a mix of DOCSIS 2.0 and DOCSIS 3.0 cable modems on the primary channel but it is limited to single channel on each bonding group. The main reason for the single primary limitation is the DHCP protocol. The Cisco SCE - CMTS integration contains SNMP polling to get the CMTS configuration and DHCP sniffing for mapping of cable modem to virtual link inside the Cisco SCE. The CMTSs report, through the DHCP protocol, about single Primary channel only.

With the IPDR LEG, Cisco SCE supports multiple primary channels. The IPDR records includes the required information for mapping cable modems and CPEs to virtual links. A maximum of eight channels bonded (BG with 8 channels) are supported.

The Cisco SCE supports bonding groups by creation of virtual-links hierarchy. Figure 2- describes the Cisco SCE configuration to support bonding groups. The bonding group is associated with aggregate global controller (AGC) in the top level. Under the top-level AGC, there is one AGC that aggregates all the DOCSIS 3.0 cable modems in the bonding group, and another AGC for the DOCSIS 2.0 cable modems. From release 3.7.0, if there are more than one primary channel in the bonding group, a legacy

AGC is created for each primary channel. For example, in Figure 2-2 there are two primary channels and two corresponding legacy AGCs.

Figure 2-2   ***Bonding Group With Two Primary Channels***
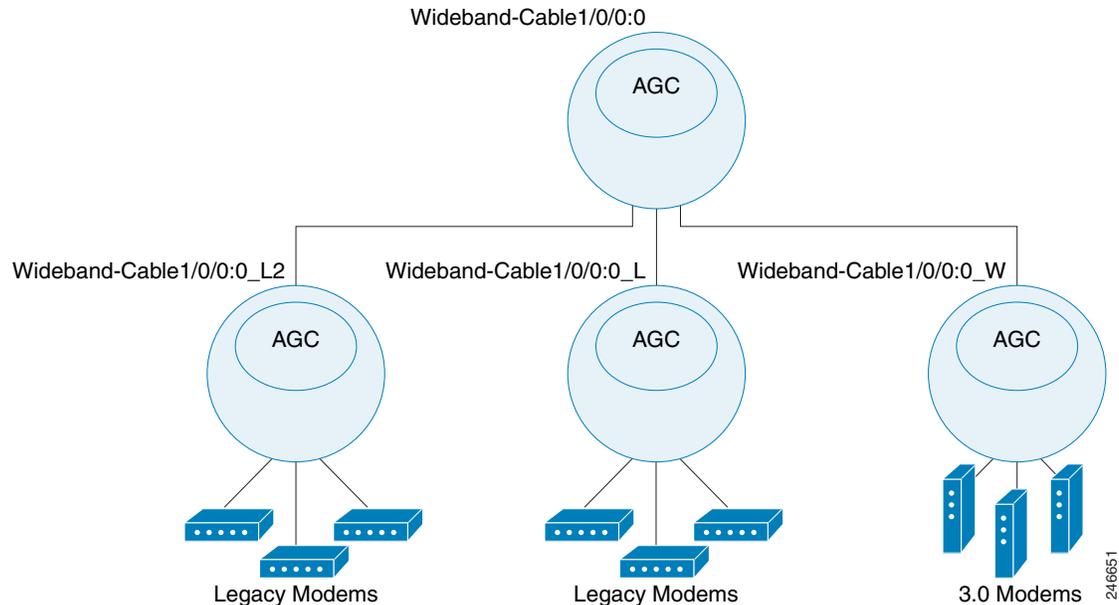
In a multiple primary channels s scenario, the specific mapping is required only for the DOCSIS 2.0 cable modems since they are limited to the specific physical channel. DOCSIS 3.0 cable modems can generate traffic over all channels.

The exact primary channel can be identified by the IPDR messages. In this example, 13 is the downstream channel index and 3 is the upstream channel index.

```
<CmMacAddr>MAC-ADD:00-00-00-18-9b-8d-fc-cd</CmMacAddr>
<CmIpv4Addr>IP_V4:10.12.150.138</CmIpv4Addr>
<CmtsMdIfName>'Cable6/0/0'</CmtsMdIfName>
<CmtsMdIfIndex>1031</CmtsMdIfIndex>
<CmtsRcsId>13</CmtsRcsId>
<CmtsTcsId>3</CmtsTcsId>
```

Dynamic Channel Change of Cable Modem

For load balancing the cable modems on the available interfaces, a CMTS can dynamically change the channels assigned to a cable modem. During a dynamic channel change, a cable modem does not process a new DHCP login process.

Note   Dynamic Channel Change using the **dcc** command does not work in versions earlier than Cisco IOS Release 12.2S.

If enabled, Cisco SCE uses IPDR LEG to identify the channel changes.

IPDR messages are generated by CMTS for each cable modem when the modem gets associated with different channels on the CMTS. This IPDR message includes information on the channel assigned to the cable modem. The VLM monitors the channels and updates the cable modem to virtual link mapping when a channel changes.

IPDR LEG registers CM Registration and DOCSIS Type templates and looks for the corresponding IPDR messages from the CM-STATUS and SAMIS TYPE-1 type templates.

This is an example of the IPDR message:

```
<CmMacAddr>00-00-00-18-9b-8d-fc-cd</CmMacAddr>
<CmIpv4Addr>IP_V4:10.12.150.138</CmIpv4Addr>
<CmtsMdIfName>'Cable6/0/0'</CmtsMdIfName>
<CmtsMdIfIndex>1031</CmtsMdIfIndex>
<CmtsRcsId>53</CmtsRcsId>
<CmtsTcsId>3</CmtsTcsId>

  <CMTSupIfName>'Ca7/0/0-upstream1'</CMTSupIfName>
  <CMTSdownIfName>'Ca7/0/0-downstream'</CMTSdownIfName>
```

In the above example 53 is the downstream channel index and 3 is the upstream channel index in which the cable modem (00-00-00-18-9b-8d-fc-cd) is associated with the CMTS.

The CMTS sends IPDR messages for each cable modem association and channel changes to the collector. The IPDR LEG gets the mapping of the latest channel changes and updates the Cisco SCE.

Support for Non-Cisco CMTS

Cisco Cisco SCE supports integration of non-Cisco CMTSs in an Cisco SCE-CMTS integration scenario. For the integration, Cisco SCE uses the IPDR LEG.

The structure of the DHCP messages varies between various CMTS vendors, but the IPDR records or messages are defined as part of the DOCSIS standard and are identical over all the vendors.

For non-Cisco CMTS, The VLM supports SNMP polling to get the CMTS configuration from these CMTS.

Mapping of Cable Modems Through DHCP Sniffing

The narrowband channels are updated in the IfIndex in option 82, where the IfIndex is used for both legacy and 3.0 modems. In Cisco SCE, wideband channels are associated with three AGCs in a two-level hierarchy and the mapping of the modems to appropriate AGCs depends on these factors:

- In the VLM mapping table, the modems are mapped from the narrowband IfIndex to the wideband group.
- Modems are linked to the appropriate AGC based on their type.

Detecting 3.0 Modems

The legacy and 3.0 modems are distinguished based on the information in the bootfile. The operators use the bootfile name to identify the modem type and the service package for the subscriber. The service packages are used to map the modems to the right VLM.

The bootfile name is configured using these options:

- Option 67 in DHCP is called the *Bootfile name*, the information configured in this field is extracted and sent to the DHCP sniffer.

- DHCP header contains a field called *Bootfile name* in the DHCP header.

  DHCP login event generator (LEG) includes regular expression capabilities that are used to configure specific information in the Bootfile name, which is used for mapping.

The VLM extracts the DHCP sniffer query results indicating the modem type (legacy or 3.0). Based on the DHCP sniffer output, VLM maps the modems to either primary or secondary channels.

Mapping of Cable Modems Through Internet Protocol Details Report (IPDR) Streaming Protocol

Whenever a legacy modem registers with a CMTS, the modem sends a CM REG TYPE IPDR message which contains CmtsTcsId and CmtsRcsId. These IDs are used for upstream and downstream index mapping.

For a DOCSIS 3.0 modem, mappings are updated on receiving a periodic SAMIS TYPE1 message from the CMTS for a modem. The value of ServiceFlowChSet in the message is used for mapping the upstream and downstream indices.

Detecting 3.0 Modems

The value of ServiceFlowChSet in the SAMIS TYPE1 message is used to detect a DOCSIS 3.0 modem. If the value is greater than 255, then it is a DOCSIS 3.0 modem; else it is a legacy modem.

Learning Interface Topology and Association

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Introduction

This chapter describes learning of interface topology and association of the remote cable MSO links solution.

Learning Interface Topology

To control and report traffic in the context of a remote interface, you must map the topology in terms of the available CMTS interfaces and their associated bandwidth. This map must include keys that the Cisco SCE uses to associate subscriber traffic with specific interfaces.

The Cisco SCE learns the interface topology by retrieving the CMTS configuration by using the Simple Network Management Protocol (SNMP) and converting the configuration to a virtual links map. Virtual links are provisioned to the relevant Cisco SCEs.

VLM queries the CMTS device and learns the upstream and downstream channels, their names, and their rates. VLM supports multiple primary channels for each wideband group. For primary channels within a wideband group, VLM queries the CMTS for resource allocation that is reserved for legacy modems.

For downstream channels, VLM obtains the mapping information of the channels to wideband groups. For the wideband channels, VLM extracts the:

- Wideband to narrowband mapping to detect a primary channel
- Wideband name from the Interface MIB
- Mapping of channels that belong to the wideband group and their rates to calculate the wideband rate

The parameters for the primary and secondary channels include:

- PIR
- CIR

Table 3-1 lists the parameters and their values for primary and secondary channels and the dynamic AGCs.

Table 3-1   Parameter Values

Parameters	Values for Primary Channels	Values for Secondary Channels	Values for Dynamic AGC
PIR	The values are extracted from the interface rate of the primary channel of the wideband.	The values are extracted from the total rate of the wideband channel.	The values are extracted from the total rate of the wideband channel.
CIR	The values are calculated from the CMTS configurations.	CIR = 0	CIR = 0

Learning Interface Association

Interface association awareness is achieved through DHCP integration. The CMTS IP (specifically, the Relay-Agent IP, or giaddr) is part of the DHCP dialog and upstream and downstream interface IDs are included in the **Relay-Agen**t option (for example, option 82 [encoded in sub option 1, the circuit ID]). This information allows the Cisco SCE to uniquely identify upstream and downstream interfaces to which a subscriber is mapped, even in cases in which more than one CMTS is connected to an Cisco SCE.

The Cisco Service Control Subscriber Manager learns the interfaces automatically from the CMTSs and provisions the vlinks to the Cisco SCE on the following events:

- Each configured device query interval
- Manual device query
- Re-sync with Cisco SCE
- Applying policy on Cisco SCE
- Cisco Service Control Subscriber Manager restart
- Cisco Service Control Subscriber Manager load configuration
- Cisco SCE reload

During these events, the Cisco Service Control Subscriber Manager creates new Vlinks learnt from the CMTSs, updates the existing Vlinks if the SM observed any changes, and removes the unwanted Vlinks to make sure that the SM has synchronized completely with the CMTS interfaces to reserve the unused Vlinks for the new interfaces. During this process, the Cisco Subscriber Manager removes all Vlinks created directly in an Cisco SCE using CLI or any other source without the knowledge of the Cisco Service Control Subscriber Manager.

Note If multiple CMTS devices connected to an Cisco SCE have the same SNMP SysName, the VLM fails to identify the duplication and this results in unpredictable behavior.

The Cisco SCE DHCP sniffer LEG extracts the CMTS IP and reports it to the Subscriber Manager, which performs the appropriate virtual-link association, allowing the Cisco SCE to manage the traffic correctly.

Wideband channels are associated with three AGCs in a two-level hierarchy and the cable modems are mapped to their respective AGCs. For information on the AGC mapping, see the "Bandwidth Control Enhancements" section on page 2-4 and the "Mapping of Cable Modems Through DHCP Sniffing" section on page 2-9.

Dynamic GIADDR Learning

When the VLM queries the CMTS device, it reads all the IP addresses from the CMTS device IP table and creates the mapping table that is used to map IP addresses to the CMTS device to which they are related. Many of the IP addresses that are read from the CMTS device are not used by subscribers, which can cause the mapping table to become too large and unmanageable. To prevent this, the VLM dynamically selects and releases the giaddr values from the IP table. VLM ignores IP addresses that starts with 127 because these IP addresses are considered as the loop back IP addresses.

When a subscriber logs in, the CMTS device appends the giaddr to the DHCP transaction. For a giaddr that is new to the DHCP LEG (or an existing giaddr that was not used during previous logins):

- If the login giaddr value is known to the VLM (related to one of the CMTS devices), the VLM updates the DHCP LEG with the policy mapping table related to the login giaddr value.

- If the login giaddr value is unknown to VLM (if the IP is not related to any device in the VLM), the VLM opens the SNMP connection using the login giaddr value as an IP address, and queries the SNMP connection to get the device host-name (sysName OID):

   – If a device exists with the same host-name, it indicates that a new IP was added to the device:

- The VLM queries the device to learn the new updates

- The VLM updates the policy mappings based on the query output and updates the LEG

- Login operations continue on the device

   – If the device host-name is invalid, it indicates one of these causes:

- Device is not configured as expected (sysName MIB value is not set).

- Device was not intended to be part of the VLM solution.

- Subscriber is logged in without a virtual link policy mapping.

   – If the device host name is valid, the name is new to the VLM, and the dynamic device feature is enabled:

- VLM creates a new device by using the device host-name.

- Login operations using the same giaddr value are blocked by the LEG.

- VLM starts querying the new device and updates its policy mappings accordingly.

- Login operations continue on the device.

   From Service Control Application for Broadband Release 3.6.5, for a static device configuration, you can disable learning new giaddr during login. After you disable learning new giaddr, if the Subscriber Manager identifies that the relay agent does not belong to any known CMTS, the SM continues to log in instead of doing a query. During periodic queries, the Cisco Subscriber Manager continues to learn new giaddrs. To disable learning new giaddr during login, set enable_dynamic_giaddrs_learning to false.

- For giaddr that is known to the DHCP LEG (or an existing giaddr that was in use during the previous logins):

   – If the policy mappings are found, a subscriber is created by using the policy mappings.

> – During a login operation, if the policy mappings are not found:

- All login operations related to the device that belongs to the giaddr are put on hold by the DHCP LEG.

- Based on the giaddr value received from DHCP, the VLM identifies the device associated with the giaddr, and queries the device.

- After the query is completed, the policy mappings are updated in the LEG.

✎

Note When the VLM queries a device, all login operations of the affected device are stored in a queue. After completing the query operations, the login process resumes and there is no loss of login operations. Each subscriber is logged in with their respective mappings.

- VLM defines a lease time for each dynamic giaddr. If no further login operations occur during the lease time period:

  - VLM removes the giaddr from its list of giaddr values.

  - IP value is no longer a giaddr in the CMTS device (when performing **p3vlink --show-device -d** *<device>*, the giaddr attribute does not contain the removed IP).

  - LEG removes the entries from the mapping table that are related to the giaddr.

  - For each subscriber, the VLM checks if the subscriber giaddr custom property is the same as the removed giaddr and if so, changes the property to be the IP address of the CMTS device.

    This example shows the current details of a subscriber:

    ```
    p3subs --show -s lynn_jones
    Name:          lynn_jones
    Domain:        subscribers
    Mappings:
           IP: 1.1.1.13/32
    Properties:
           downVlinkId=7    Name=device1_1_Cmts8/1-downstream1
           upVlinkId=4      Name=device1_1_Cmts8/1-upstream1
    Custom Properties:
           giaddr=1.1.1.1
    Command terminated successfully


    If the IP address 1.1.1.1 is the removed giaddr and 2.2.2.2 is the CMTS device IP
    address, the result of the lease time operation is as follows:
    p3subs --show -s lynn_jones

    Name:          lynn_jones
    Domain:        subscribers
    Mappings:
           IP: 1.1.1.13/32
    Properties:
           downVlinkId=7    Name=device1_1_Cmts8/1-downstream1
           upVlinkId=4      Name=device1_1_Cmts8/1-upstream1
    Custom Properties:
           giaddr=2.2.2.2
    Command terminated successfully
    ```

- When a CMTS device reboots, the CMTS allocates new ifIndex values for the interfaces, specifically when the downstream ifIndex values are changed and the VLM mappings are no longer synchronized. The VLM monitors the upstream and downstream parameters of option 82 and compares the values against the mapping tables. If a mismatch is found in the DHCP transaction parameters, VLM initiates a synchronization process with the CMTS device. During this process:

- – DHCP transactions of the affected CMTS device are placed on hold. The VLM buffer can store 100,000 DHCP events per CMTS.

- – LEG queues up the subscriber login request.

- – On completion of device query operation, the VLM notifies the LEG.

- – LEG removes the stored messages in the queue and restarts the login operation.

- – DHCP transactions of any newly detected CMTS device are stored in the queue until VLM queries the new CMTS information.

Learning Cable Interfaces Associated Directly to a MAC Domain

In releases earlier than Cisco Service Control Subscriber Manager Release 3.8.5, VLM learns integrated or modular interfaces if the interfaces are associated with wideband interfaces.

From Cisco Service Control Subscriber Manager Release 3.8.5, VLM learns integrated cable interfaces or modular cable interfaces if they are directly associated to a MAC domain even if they are not associated under wideband interfaces.

Auto Convergence of Subscriber-GIADDR Association from the CMTS

From Cisco Service Control Subscriber Manager Release 3.8.5, the Cisco Service Control Subscriber Manager has an option to retrieve the cable modem MAC address from the CMReg MIBs received from the CMTS. The retrieved list of cable modem MACs is added to the Subscriber Manager Database as Subscriber ID, with the device IP address as giaddr.

To enable this option, use the CLU **p3vlink --import-subs-into-db** command. For details about the CLU, see the "Monitoring Using the p3vlink Utility" section on page 5-2.

If the VLM detects that a new CMTS is added as part of the device-add operation, the Cisco Service Control Subscriber Manager can trigger an import of the MAC addresses of all the cable modems associated to the IP address of the CMTS to the Subscriber Manager Database.

To enable the import option, configure the import-subs-into-db-on-device-add parameter in the vlink.cfg file.

Refreshing Vlinks on Receiving CPE Messages

From Cisco Service Control Subscriber Manager Release 3.8.5, the Cisco Service Control Subscriber Manager has an option to add the cable modem to the primary queue for every CPE login, regardless of whether the subscriber has a Vlink ID. Cable modem is added to the primary queue even if it is fully mapped.

To use this feature, configure the enable_bg_query_on_cpe parameter in the IPDR LEG. For details about configuring the IPDR LEG, see the *Cisco Service Control Subscriber Manager LEGs User Guide*.

Refreshing VLinks Periodically on Polling CMTS

From Cisco Service Control Subscriber Manager Release 3.8.5, the Cisco Service Control Subscriber Manager has an option to enable periodic bulk query for all subscribers at different vlink modes and subscribers at different DOCSIS versions.

Valid vlink modes are:

- Partial vlink mappings—Subscribers with partial or no vlink mappings.
- Full vlink mappings—Subscribers with both upvlink and downvlink associations.
- All—All the subscribers belonging to a device.

Valid DOCSIS versions are:

- DOCSIS 2.0
- DOCSIS 3.0

To enable the option to periodic bulk query for all subscribers at different vlink modes and subscribers at different DOCSIS versions, configure the following parameters in the vlink.cfg file:

- time_interval_for_periodic_snmp_bg_query
- vlink_mode_for_periodic_snmp_bg_query
- subscriber_mode_for_periodic_snmp_bg_query

For details on configuring these parameters, see the "Configuring the Virtual Links Manager" section on page 4-13.

To query the CMTS on a need basis for converging all subscribers with proper UpVlink and DownVlink ID, use the CLU **p3vlink --snmp-bg-query** command. For details about the CLU, see the "Monitoring Using the p3vlink Utility" section on page 5-2.

Refreshing Vlinks of Active Subscribers

The Cisco Service Control Subscriber Manager queries Vlinks of all the subscribers with full, partial, and no Vlink mappings. This periodic Vlink refreshment is performed on the Cisco Service Control Subscriber Manager database for subscribers regardless of whether they are active or inactive in Cisco SCE (introduced or unintroduced).

Effective with Cisco SCE Release 4.1.0, the Cisco Service Control Subscriber Manager can query the database only for the active subscribers. Cisco SCE Release 4.1.0 introduces the subscribers_for_snmp_bg parameter in the vlink.cfg file. This feature is enabled if you configure the parameter as introduced and is applicable if the Cisco Service Control Subscriber Manager is configured in pull mode. For more details, see the "Configuring the Virtual Links Manager" section on page 4-13.

Refreshing Subscribers with Default VLink IDs on Learning New Interfaces

During a periodic query, if the Subscriber Manager detects that some of the interfaces are removed, it assigns the associated subscribers to Vlink ID 0. But during the next topology learning, these interfaces may get detected and may be added back to the Cisco Subscriber Manager database. In this scenario, the subscribers who belong to a specific interface that was removed can get back the correct vlink IDs only after the Subscriber Manager receives the IPDR messages or after a manual trigger of the partial vlink query for that device.

From Cisco Service Control Subscriber Manager Release 3.8.5, if new interfaces are learned, the subscribers that are associated with the default vlinks are queried for UpVlink and DownVlink associations.

VLink Association of Subscribers Introduced Through the DHCP Lease Query LEG

From Cisco Service Control Subscriber Manager Release 3.8.5, the Cisco Service Control Subscriber Manager allows vlink association of subscribers introduced through DHCP Lease Query LEG and the DHCPv6 Lease Query LEG.

Subscribers introduced through DHCP Lease Query LEGs or DHCPv6 Lease Query LEGs are added to the Cisco Subscriber Manager database. The cable modem MAC of the corresponding Subscribers are added to the SNMP BG queue for vlink association if the subscribers are updated with the giaddr of the corresponding CMTS.

To enable the vlink association of subscribers introduced through the DHCP Lease Query LEG feature, configure the enable_snmp_bg_for_vlinks parameter in the DHCP Lease Query configuration file. For details about configuring the DHCP Lease Query LEG, see the *Cisco Service Control Subscriber Manager LEGs User Guide*.

Ignoring IP Addresses Updated Through the IPDR LEG

This feature is applicable in scenarios where the DHCP Lease Query LEG introduces the subscribers with IP mapping and lease time, and the IPDR LEG is used to update the vlink association of each of these subscribers.

From Cisco Service Control Subscriber Manager Release 3.8.5, you can configure the global_ignore_subscriber_ip parameter or the ignore_subscriber_ip parameter in the IPDR configuration file to ignore the IP mapping of the subscribers who log in through the IPDR LEG. By enabling these parameters, updation of the lease time for IP mappings for each IPDR login is also prevented.

For details about configuring the IPDR LEG, see the *Cisco Service Control Subscriber Manager LEGs User Guide*.

Managing Control and Reporting

Cisco SCE virtual links emulate the physical interfaces of the CMTSs and the VLM provisions the links with the bandwidth required to control the traffic:

1. For each CMTS physical interface (either upstream or downstream), the VLM creates a virtual link on the Cisco SCE.

2. VLM maps traffic that travels from a subscriber that is associated with this interface to the virtual link.

3. To create the proper association of subscribers to virtual links, the VLM creates a mapping between the DHCP information (CMTS-ID, upstream-ID, downstream-ID) and the virtual link IDs.

   – VLM creates a channel and an upstream virtual link for every upstream-ID on a CMTS.

   – VLM creates a legacy channel or wideband and legacy channels for a downstream virtual link for every downstream-ID on a CMTS.

Subscriber management logic is required to associate subscribers with their upstream and downstream virtual links based on the attributes that the DHCP LEG extracts from the DHCP traffic.

For a downstream virtual link, the Subscriber Manager login determines if the subscriber is associated with legacy or wideband cable modems. Depending on the modem types, subscribers are mapped either to wideband or legacy (primary) channels:

- Subscribers with wideband cable modems are mapped to the wideband channel beneath the VLink.
- Subscribers with legacy modems are mapped to legacy channels beneath the VLink.

In addition to the virtual links association, the subscriber is also assigned a package. In terms of bandwidth management, you can use only schemes that use one virtual-link-controller per direction; therefore, you should design the bandwidth controller architecture (committed information rate, peak information rate, and assurance level) accordingly.

Note You can disable periodic topology learning using VLM. For more details, about this, see the "Configuring the Virtual Links Manager" section on page 4-13.

VLM Device Learning—Limitations

These limitations are applicable to the VLM device learning feature:

- VLM device learning does not support static bandwidth sharing if the wideband channel or bonding group is configured by using the **no cable dynamic-bw-sharing** command.
- VLM device learning does not support overlapping same set of channels under a MAC domain.
- VLM device learning does not support channels and bonding groups that overlap across MAC domains.
- While learning the RF channel width of a wideband, the Cisco Service Control Subscriber Manager checks for the entPhysicalName of the card. The Cisco Service Control Subscriber Manager expects the entPhysicalName value to be in the format *SPA bay <slot>/<subslot>* or *Cable<slot>/<subslot>-RF<rf-port>,* or includes *3GX60.* Based on the card type, the interface descriptor (ifDescr) is derived. You can change the default format of the ifDescr value in the vlink configuration file vlink.cfg. For the ifDescr matching, the port information must be in the format *<slot/subslot/port>,* in the same order and as a single string. The channel number can be any where in the value, based on the format configured in the vlink.cfg file.
- The VLM device learning may fail if there is an overlap of the IP address learned from ipAddrTable across all configured CMTS. The IP address overlapping between CMTS is usually observed in MPLS VPN-based network deployments where VRF is used.
- The VLM can correctly associate the Vlinks with a subscriber only when the service flows of the cable modem are all connected to the same channel or channel set.
- The VLM does not learn the bandwidth sharing of upstream channels that overlap the wideband interfaces.

The following VLM device learning limitations are applicable only to Cisco Service Control SM Releases earlier than Release 3.8.5:

- The VLM device learning does not learn Dynamic Bonding Group configuration except on Arris CMTSs.
- VLM device learning feature does not support modular or integrated interfaces that are directly associated to a MAC domain; it only supports interfaces associated through a bonding group.

Configuring the Remote Cable MSO Links Solution

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Introduction

This chapter describes:

- Basic topology for managing remote cable MSO links and the high-level steps to configure the solution—"Solution Topology" section on page 4-2

- Prerequisites for configuring a solution that uses traffic optimization on remote links with the VLM—"Prerequisites" section on page 4-3

- Configuring the VLM by using the configuration files contained in the Subscriber Manager installation—"Configuring the Solution" section on page 4-4

Solution Topology

Figure 4-1 shows a system that can be configured for managing remote cable MSO links.

Figure 4-1   ***Traffic Optimization on Remote Links Topology***
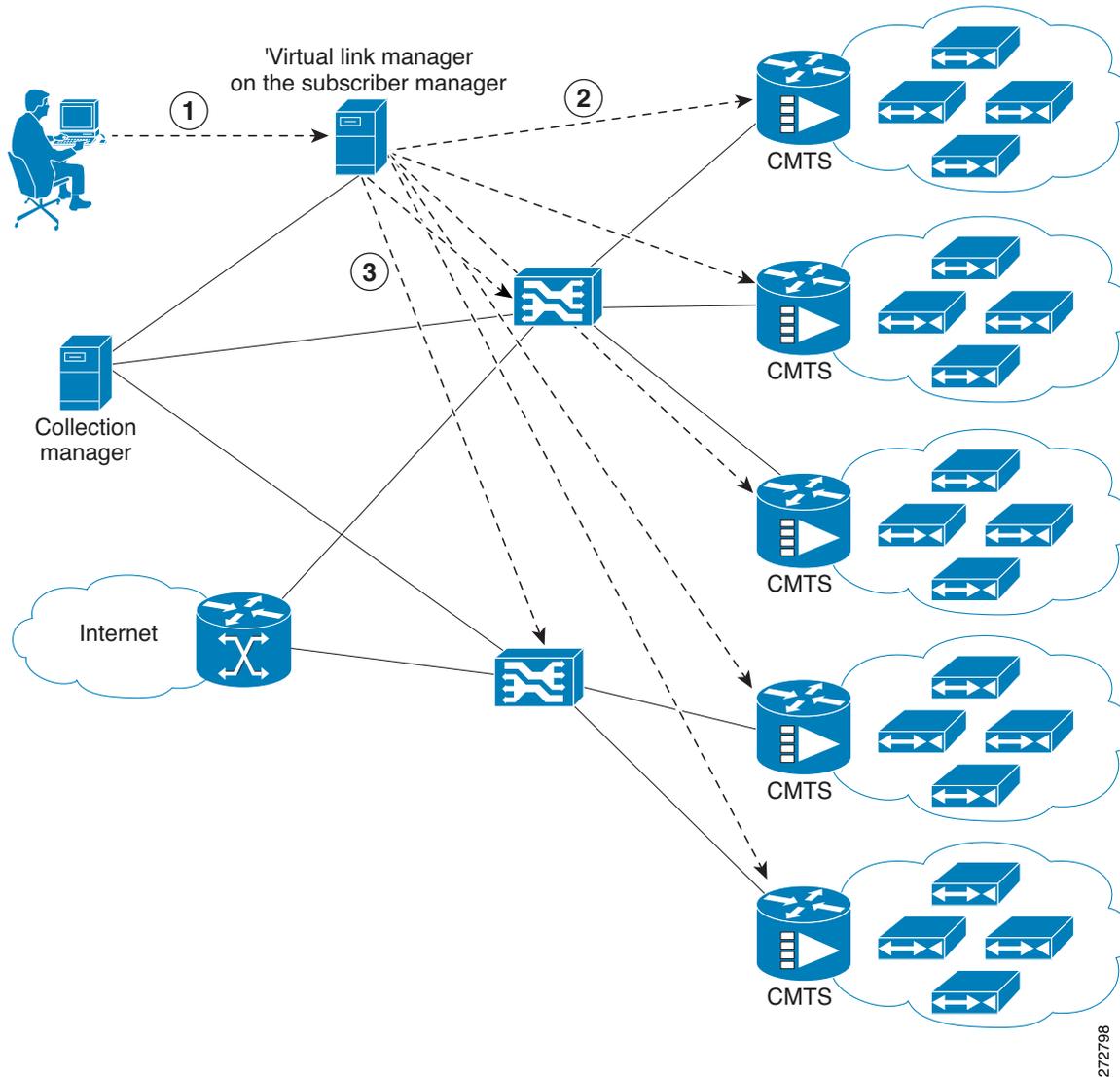
> **Note**   Using a Collection Manager is optional and is not required for the solution to work. To work with the
> Collection Manager, you must associate the Cisco Service Control Collection Manager with the Cisco
> SCE and also with the Subscriber Manager. However, it is not mandatory to associate the Collection
> Manager with the Subscriber Manager. In this case, the Collection Manager receives the Raw Data
> Records (RDRs) but does not automatically receive the index to the vlink name mappings.

The operator configures the IP addresses of the CMTS devices, the Cisco SCEs, the Collection Manager, and their interrelations on the Cisco Subscriber Manager (1). The Cisco Subscriber Manager queries each CMTS device through SNMP to determine its sysname, interfaces, and their corresponding interface speeds (2). The Cisco Subscriber Manager provisions the Cisco SCE virtual links (3).

CMTS Device Compatibility

This traffic optimization on remote links solution supports these devices at present:

- Cisco CMTS Universal Broadband Router (uBR)
    - uBR10K
    - uBR7246
- Non-Cisco CMTS
    - Arris CMTS

To use other CMTS devices, you must ensure that these conditions are met:

- Upstream and downstream interface IDs are encoded as part of option 82, sub option 1 (the circuit ID) and appears in the DHCPACK message.
- CM-MAC, which is used as the Subscriber-ID, is encoded as option 82, suboption 2 (the remote ID) and appears in the DHCPACK message.
- DHCP traffic flows through the Cisco SCE.
- To use Cisco CMTS and non-Cisco CMTS devices for IPDR, you must ensure that these conditions are also met:
    - The Upstream IDs are retrieved or identified by using CmtsIpv4Addr, CmtsMdIfIndex and CmtsTcsId fields, which is a part of CM registration IPDR messages.
    - The Downstream IDs are retrieved or identified by using CmtsIpv4Addr, CmtsMdIfIndex and CmtsRcsId fileds, which is a part of CM registration IPDR messages.
    - The Cable Modem MAC address, which is used as Subscriber-ID, is retrieved or identified by CMmacAddress field that is a part of the Cable Modem Registration IPDR messages.

Traffic optimization on the remote links solution uses DOCSIS MIBs and standard MIBs.

Prerequisites

Before you set up the managing remote cable MSO links solution, you must complete these tasks:

- Install the Cisco Service Control Subscriber Manager, Cisco Service Control Collection Manager (optional), and Cisco SCE.
- Install the Cisco SCA BB (the Engage pqi file) on the Cisco SCEs used in the solution. See the "How to Install PQI Files on Cisco SCE Devices" section in the "Using the Network Navigator" chapter, of *Cisco Service Control Application for Broadband User Guide*.

Configuring the Solution

This section describes how to configure the solution.

Configuring Virtual Link Global Controllers

Step 1   Start the Cisco SCA BB console by choosing **Start** > **All Programs** > **Cisco SCA** > **SCA BB Console 5.0.x** > **SCA BB Console 5.0.x**.

The Cisco SCA BB Console splash screen appears. After the Console loads, the main window of the Console appears. The first time that you launch the Console, the Welcome view is open in the main window.

Step 2   To close the Welcome view, click **Go to the console**. The Welcome view closes. The Network Navigator tool is open in the Console.

Step 3   From the Console main menu, choose **Tools** > **Service Configuration Editor**.

If no service configurations are open when you open the Service Configuration Editor tool, a No Service Configuration Is Open dialog box appears:

a.   To create a new service configuration, click **Yes**. A New Service Configuration Settings dialog box appears.

b.   Select an operational mode for the service configuration.

c.   Click **OK**.

The new service configuration is added to the Console window (Figure 4-2) that becomes the active service configuration.

Figure 4-2   Console Window
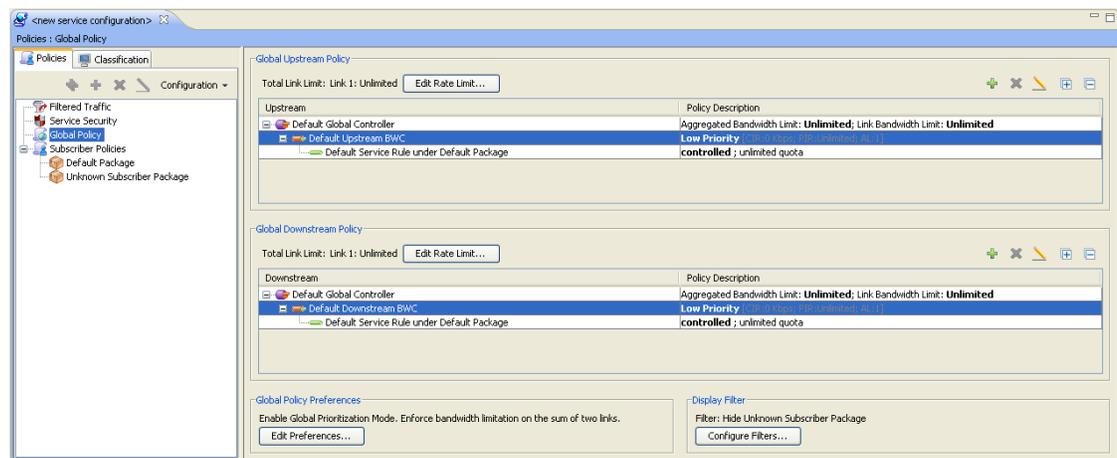
Step 4   In the Global Policy Preferences area, click **Edit Preferences**.

The Global Controllers mode dialog box appears (Figure 4-3).

Figure 4-3   Global Controllers Mode Dialog Box

![Note icon]
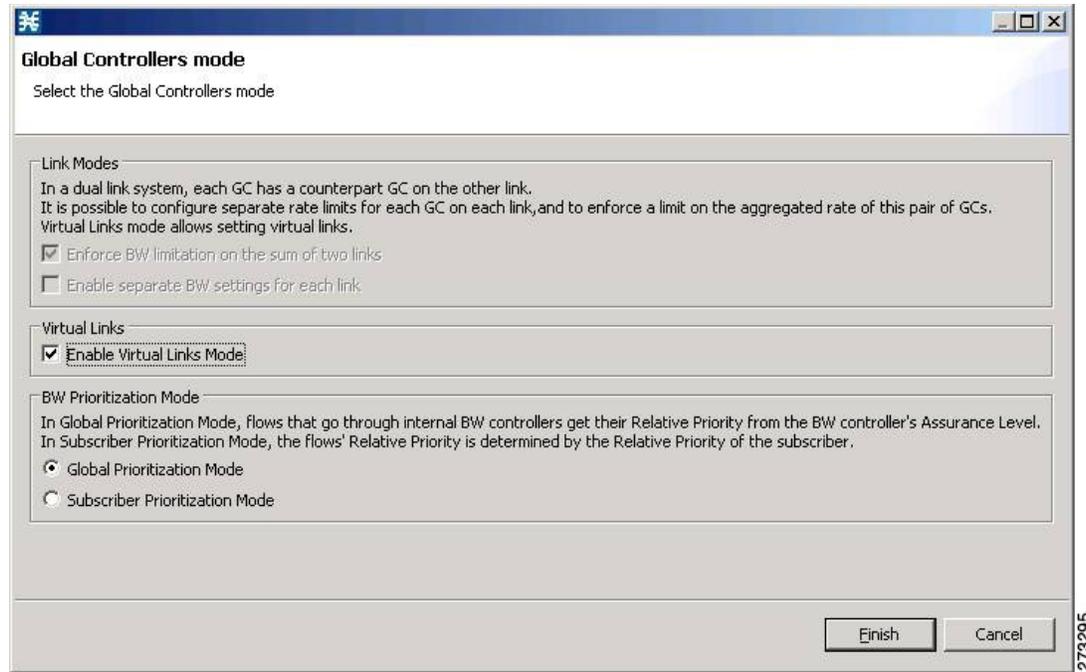
Note   The Virtual Link Mode works only in Subscriber Prioritization Mode by default.

Step 5   Check the **Enable Virtual Links Mode** check box.

The Apply Template rate limits to all Virtual Links? dialog box appears (Figure 4-4).

Figure 4-4   Virtual Links? Dialog Box

Step 6   Click **Reset all Virtual Links to Template rate limits** when you change the number of Global Controllers.

If you are applying the template for the first time, always select Rest all Virtual Links. Whenever the template is getting changed with respect to the AGC and the BWC, then use **Reset all Virtual Links to Template rate limits**. Otherwise, to retain the modified template, use the **Keep Virtual Link rate limits unchanged**.

Click **Keep Virtual Link rate limits unchanged** to retain the current Virtual Links rate limits. Only the defined virtual link is set to the new template rate limit.

Step 7   Click **Finish**.

The new service configuration window appears (Figure 4-5).

Figure 4-5   ***New Service Configuration Window***
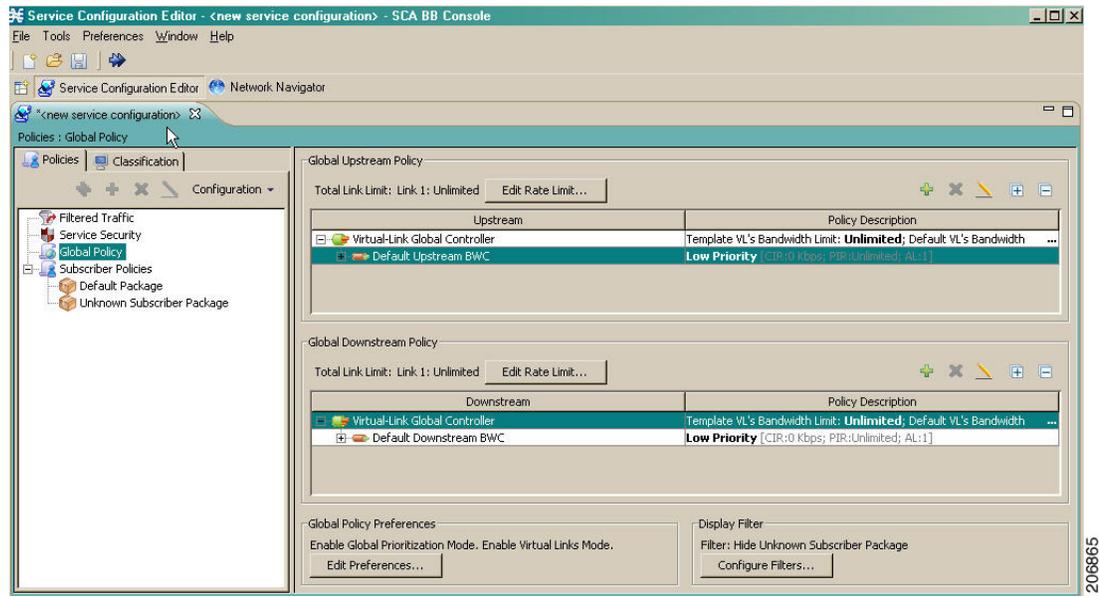
For more information on the Service Configuration Editor, see the *Cisco Service Control Application for Broadband User Guide.*

Virtual link global controllers can be added, edited, and deleted in the same way as regular global controllers. For more information, see these sections:

How to Add Global Controllers

Note   You can edit the default global controller settings, however, the default instance of global controller cannot be deleted.

Step 1   In the Policies tab, click **Global Policy**.

The Global Bandwidth Settings dialog box is displayed in the right (Rule) pane.

Step 2   Above the area (Upstream or Downstream) of the desired interface, click the **Add** ✚ icon.

The Select Addition mode dialog box appears (Figure 4-6).

Figure 4-6   Select Addition Mode
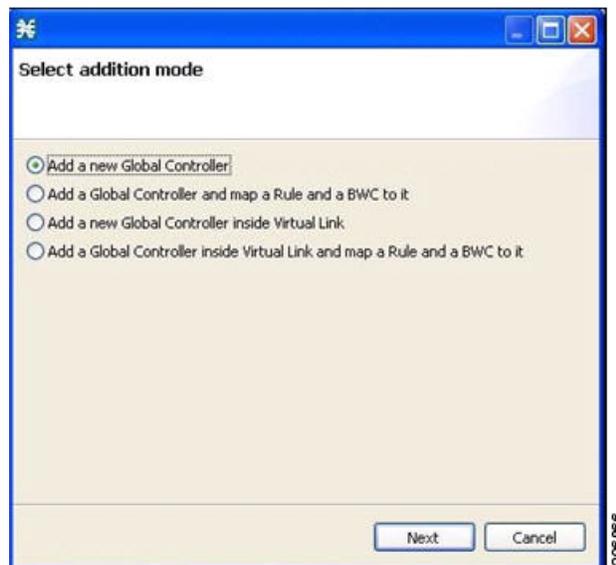
Step 3   To add a new global controller, click the **Add a new Global Controller** radio button.

Step 4   Click **Next**.

The Global Controller Settings dialog box appears. See Figure 4-7.

Note   The display in Figure 4-7 depends on the global controller mode setting.

Figure 4-7   Upstream Global Controller Settings

Step 5   In the **Name** field, enter a meaningful name.

Step 6   Edit the maximum bandwidth of the aggregate and per link global controller rate limits.

Step 7   Click **OK**.

Your changes are saved.

The Global Controller Settings dialog box closes.

How to Add Global Controllers Inside Virtual Link

You can create AGCs inside a virtual link global controller.

Note   You can edit the default global controller settings, however, the default instance of global controller cannot be deleted.

Step 1   In the Policies tab, click **Global Policy**.

The Global Bandwidth Settings dialog box is displayed in the right (Rule) pane.

Step 2   Above the area (Upstream or Downstream) of the desired interface, click the **Add** ✚ icon.

The Select addition mode dialog box appears (Figure 4-8).

Figure 4-8   *Select Addition Mode*
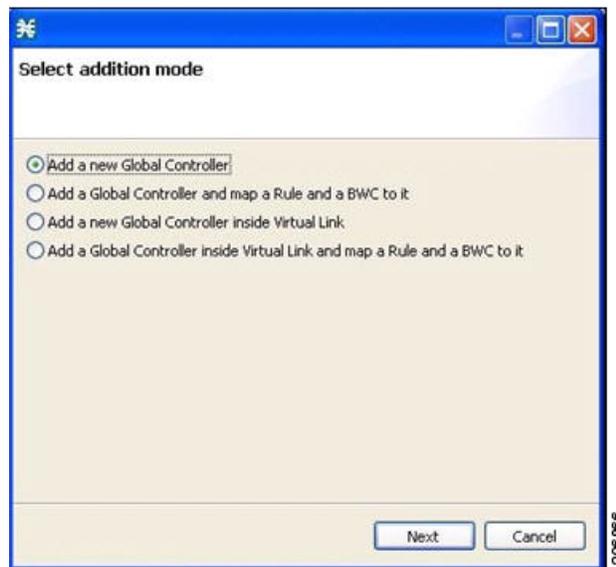
Step 3   To add a new global controller within a virtual link, click the **Add a new Global Controller inside Virtual Link** radio button.

Step 4   Click **Next**.

The Global Controller Settings dialog box appears. See Figure 4-9.

Note   The display in Figure 4-9 depends on the global controller mode setting.

Figure 4-9   *Upstream Global Controller Settings*

Step 5   In the **Name** field enter a meaningful name.

Step 6   Edit the maximum bandwidth of the template and the default values rate limit

Step 7   Click **OK**.

Your changes are saved.

The Global Controller Settings dialog box closes.

How to Edit Package Subscriber BWCs

Step 1   In the Policies tab, click **Global Policy**.

The Global Bandwidth Settings dialog box is displayed in the right (Rule) pane.

Step 2 In the right (Rule) pane, select a BWC and click the **Edit** ⬊ icon.

The Package Settings dialog box appears.

Step 3 In the Package Settings dialog box, click the **Subscriber BW Controllers** tab.

The Subscriber BW Controllers tab opens. See Figure 4-10.

Figure 4-10 Subscriber BW Controllers Tab
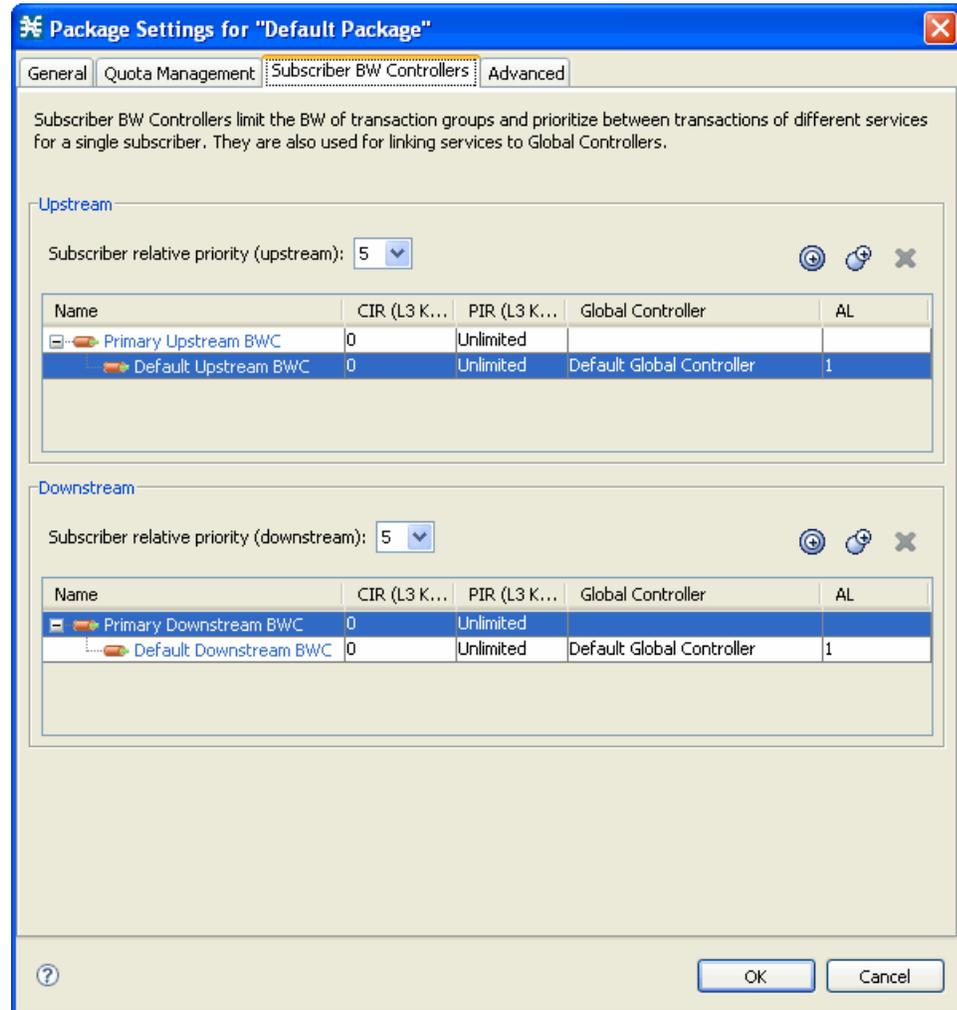
Step 4 Set your requirements for upstream bandwidth control in the Upstream area of the dialog box.

   a. Select a value from the Subscriber relative priority drop-down list.

   b. Set the parameters for the Primary Upstream BWC.

      – In the CIR field, enter the BWC CIR in Kbps.

      – In the PIR field, select **Unlimited** from the drop-down list, or enter the BWC PIR in Kbps.

   c. To add BWCs to the package, click the **Add a sub BW Controller** ⊕ icon once for each additional BWC.

   d. To add Extra BWCs to the package, click the **Add an extra BW Controller** ⊕ icon once for each additional BWC.

e.   Set the parameters for each BWC (including the Primary and Default BWCs).

–   (Optional) In the Name field, enter a meaningful name for each BWC. (You cannot rename the Primary or Default BWCs.)

–   In the CIR field, enter a value for the BWC CIR in Kbps.

–   In the PIR field, select **Unlimited** from the drop-down list, or enter a value for the BWC PIR in Kbps.

–   To set the global controller with which this BWC is associated, click in the Global Controller cell of the BWC, and then click the **Browse** button that appears.

The Select a Global Controller dialog box appears. See Figure 4-11.

Figure 4-11   Select a Global Controller Dialog Box
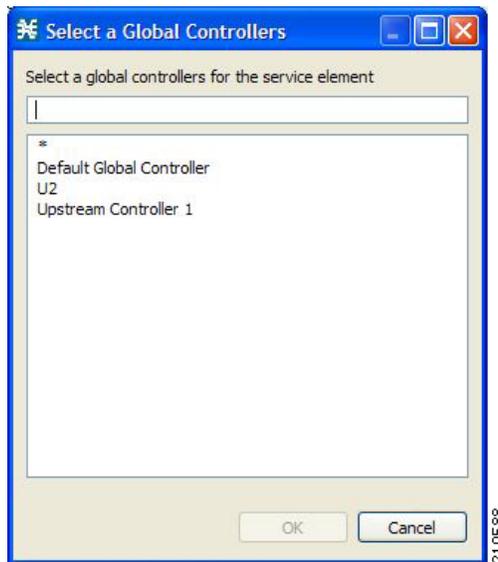
–   Select a global controller and click **OK**.

–   Select a value from the AL drop-down list.

Step 5   Repeat Step 3 for downstream bandwidth control in the Downstream area of the dialog box.

Step 6   Click **OK**.

The Package Settings dialog box closes.

All changes to the BWC settings are saved.

Applying Service Configurations to Cisco SCE Platforms

Step 1   Using the Network Navigator tool, in the Site Manager tree, right-click an Cisco SCE device. A popup menu appears.

Step 2   From the menu, choose **Apply Service Configuration**.

The Choose Policy dialog box appears, listing all service configurations that are open in the Service Configuration Editor.

> ✎
> **Note**   If only one service configuration is open in the Service Configuration Editor, a Password Management dialog box appears. Go to Step 5.

> ✎
> **Note**   If the open policy is a virtual links policy, the Apply Template Virtual Links Values dialog box prompts you to apply the template virtual links value to the existing virtual links. Go to Step 4.

Step 3   Select a service configuration from the list.

Step 4   Click **OK**.

To apply the template virtual links value to the existing virtual links, click **Yes**.

A Password Management dialog box appears.

Step 5   Enter the appropriate password.

Step 6   Click **Apply**.

The Password Management dialog box closes. An Applying service configuration to Cisco SCE progress bar appears. The service configuration is applied to the selected Cisco SCE platform.

Configuring the Virtual Links Manager

Step 1   On the Subscriber Manager machine, open the p3sm.cfg configuration file, which is located in the ~pcube/sm/server/root/config/ directory.

For details about making configuration changes in the p3sm.cfg file, see the "Configuration Files Options" chapter of *Cisco Service Control Management Suite Subscriber Manager User Guide*.

a.   Create a section for any Cisco SCE devices and define the IP address and optionally the port values of the Cisco SCE devices. This example shows the Cisco SCE sections created for two Cisco SCE devices named SCE1 and SCE2:

```
[SCE.SCE1]
ip=209.165.201.2
[SCE.SCE2]
ip=209.165.201.3
```

b.   (Optional) Create a section for the Collection Manager and define the IP address and the connected Cisco SCE devices. Defining the Collection Manager port value is optional; if a value is not defined, the default value of 14375 is used.

The following example shows the Collection Manager section created that receives the RDRs for two Cisco SCE devices named SCE1 and SCE2:

```
[CM.CM1]
ip=209.165.202.129
port=14375
sce_list=SCE1,SCE2
```

✎

Note   Using a Collection Manager is optional and is not required for the solution to work. However, if you do not use a Collection Manager, all the virtual link reports can be selected only by the virtual link index and not by the virtual link name.

Step 2   Save and close the p3sm.cfg configuration file.

Step 3 to Step 6 are applicable only to DHCP Sniffer LEG configuration. If you are using IPDR LEG, proceed to Step 7. Step 7 and Step 8 are applicable only to IPDR LEG.

Step 3   (Only for DHCP Sniffer LEG) On the Subscriber Manager machine, open the dhcpsnif.cfg configuration file, which is located in the ~pcube/sm/server/root/config/ directory.

For details about making configuration changes in the dhcpsnif.cfg file, see the "SCE-Sniffer DHCP LEG" section in "Configuring the SCE-Sniffer DHCP LEG" chapter of *Cisco Service Control Subscriber Manager LEGs User Guide*.

a.   In the [SCE-Sniffer DHCP LEG] section, set the start value to **yes**.

```
[SCE-Sniffer DHCP LEG]
start=yes
```

All the other values can be left at the default values.

b.   In the [Subscriber ID] section, set the dhcp_option to the DHCP option that contains the subscriber ID and set the dhcp_option_type to binary. For example:

```
[Subscirber ID]
dhcp_option=82:2
dhcp_option_type=binary
```

All the other values can be left at the default values.

Step 4   (Only for DHCP Sniffer LEG) Save and close the dhcpsnif.cfg configuration file.

Step 5   (Only for DHCP Sniffer LEG) On the Subscriber Manager machine, open the dhcp_pkg.cfg configuration file, which is located in the ~pcube/sm/server/root/config/ directory.

For details about modifying configuration in the dhcp_pkg.cfg file, see the "SCE-Sniffer DHCP LEG" section, in "Configuring the SCE-Sniffer DHCP LEG" chapter of *Cisco Service Control Subscriber Manager LEGs User Guide*.

a.   Define a downstream virtual link policy by setting the parameters:

```
[DHCP.Policy.VirtualLinkDownstream]
policy_property_name=downVlinkId
options_order_for_policy_name=giaddr,82:1
options_type=integer,binary
allow_login_with_no_policy=true
use_default=false
default_policy=0
```

✎

Note   Do not define the mapping_table parameter.

b. Define an upstream virtual link policy by setting the parameters:

```
[DHCP.Policy.VirtualLinkUpstream]
policy_property_name=upVlinkId
options_order_for_policy_name=giaddr,82:1
options_type=integer,binary
allow_login_with_no_policy=true
use_default=false
default_policy=0
```

Note   Do not define the mapping_table parameter.

c. Detect if the subscriber is related to the DOCSIS 3.0 wideband interface

– The attribute related to [DHCP.Policy.VirtualLinkUpstream] and
[DHCP.Policy.VirtualLinkDownstream] parameters is docsis_3_cm_detection. The value of
attribute is Modem_Type.DOCSIS3.0.

Note   It is mandatory to enter values for the Modem_Type.DOCSIS3.0 field.

```
docsis_3_cm_detection=Modem_Type.DOCSIS3
```

d. Set the rules to define DHCP data coming from the DOCSIS 3.0 cable modem interface

– To identify if DOCSIS 3.0 is the cable modem type, use this parameter:

```
[Modem_Type.DOCSIS3.0]
```

This parameter has two attributes—option and option_type.

The format of the parameter is the option number itself. But for DHCP options with sub-options,
the format is the DHCP option and sub-option type separated by a colon.

For example:

```
# 43:123 or 61
(default option 67, "Boot filename")
option=67
```

– The format type of DHCP option is defined by the 'dhcp_option' parameter. Optional values are
'binary' (binary string that is converted to an ASCII hexadecimal string) or 'string' (ASCII
string). The default value is string.

```
option_type=string
```

– The parameter to define the search pattern to verify that the cable modem belongs to
DOCSIS 3.0 is option_pattern. The value for this parameter is a single regular expression
pattern per dhcp_option. If there are more than one dhcp_option, the values for option_pattern
is a list of regular expression patterns (one pattern per option) separated by comma. The default
value is 3.0.

```
option_pattern=3.0
```

Step 6   (Only for DHCP Sniffer LEG) Save and close the dhcp_pkg.cfg configuration file.

Note   When the VLM is activated, the DHCP sniffer adds a custom property to each subscriber with
the value of the giaddr option, which is one of the CMTS IP addresses.

Step 7   (Only for IPDR LEG) Configure the file <pcube>/sm/server/root/config/ipdr.cfg.

CM Mac Address will be the default Subscriber ID. The CMTS Name should be mapped to the CMTS Name configured in vlink.cfg.

IPDR LEG supports both static and dynamic mappings. If there are any conflicts, dynamic mappings learnt from the CMTS will be considered for subscriber association. The start parameter in the IPDR LEG configuration section defines whether the VLM is enabled or disabled. The default value is "no". If you enable VLM, the VLM starts learning the device topology defined in the configuration file and starts the dynamic VLINK assignments on the relevant Cisco SCEs. You must manually create the VLINKs and AGCs in the Cisco SCE, for the static mappings you configure in the ipdr.cfg.

This is an example of the configuration:

```
[IPDR LEG]
start=yes
log_failures=yes
log_all=no
# Enable the below option to log the receiving IPDR messages
# (Default value: false)
# log_subs_details=false

# Enable the below option to log the mapping table information
# (Default value: false)
# log_mapping_table=false

# Enable the below option to log the subscribers who are partially logging in
# (Default value: false)
# log_login_partial_subs=false

cm_mode=no

#CM Mac Address will be the default Subscriber ID
[IPDR.Subscriber ID]
fields=CMmacAddress

[IPDR.Field.CMmacAddress]
ipdr_key=CmMacAddr
ipdr_key_type=string

#Configure IPDR Exporter
# [IPDR.Exporter.<CMTS NAME>]
# The CMTS Name should mapped to the CMTS Name configured in vlink.cfg

[IPDR.Exporter.CMTS1]
start_exporter=yes
exporter_connection_type=active
connection_time_out=100
keep_alive=15
port=4737
# Configure the sesion ids specified in the exporter.
#session_id=<session_id>,<session_id>
session_id=2,3,4
```

Step 8   (Only for IPDR LEG) If the host entry is not added in the Subscriber Manager, then add the IPDR Collector IP address to the ipdr.cfg.

Example:

```
CMTS(config)# ipdr collector dt-sm-linux 10.78.242.22
```

Step 9   On the Subscriber Manager machine, open the vlink.cfg configuration file, which is located in the ~pcube/sm/server/root/config/ directory.

a.   In the [General] section, configure these parameters:

– start—Setting the start parameter to yes instructs the Subscriber Manager to start the VLM when the Subscriber Manager starts. Possible values for this parameter are yes and no.

✎
Note   When the start parameter is set to no, the data stored in the database for all CMTS devices is deleted.

– monitoring_period—Determines the interval in minutes at which the VLM queries the CMTS devices for any interface changes. Setting this parameter to 0 stops the VLM querying the CMTS devices, but does not stop the VLM. The default value is 60.

– ignore_duplicate_ip—Ignores the duplicate IP in the ipAddrTable of the configured CMTS. The default value is false. Possible values are true and false.

– upstream_vlink_factor—Determines the percentage of the interface bandwidth that Cisco SCE allows to be sent from the CMTS device to the Internet. The default value is 95.

– downstream_vlink_factor—Determines the percentage of the interface bandwidth that the Cisco SCE allows to be sent from the Internet to the CMTS device. The default value is 95.

✎
Note   When defining the upstream_vlink_factor and downstream_vlink_factor parameters, take precaution. Setting a very low value causes wastage of bandwidth capacity. Setting a very high value causes data loss because of dropped packets.

✎
Note   Whenever you change the default values of upstream_vlink_factor and downstream_vlink_factor, you must manually resync the vlink information by using the **p3vlink --resync-all** command to reflect the changes on all Cisco SCEs.

– log_all—Setting the log_all parameter to true causes the system to dump log messages to the user log.

– upstream_global_controller_list—Determines the list of non default upstream global controllers, which are defined in the template and managed by VLM.

– downstream_global_controller_list—Determines the list of non default downstream global controllers, which are defined in the template and managed by VLM.

For more information, see the "Configuring Virtual Link Global Controllers" section on page 4-4.

✎
Note   Every global controller defined in the configuration file should exist in the policy configuration.

– upstream_global_controller_pir_percentage—(Optional) Determines the percentage of the PIR values of the wideband interfaces. One or more PIR values can be configured, each value corresponds to the global controller that belongs to the global controller list.

> ✎
>
> **Note**   If the PIR values are not configured, then the default PIR values are used to determine
>   the percentage.

- **downstream_global_controller_pir_percentage**—(Optional) Determines the percentage of the PIR values of the wideband interfaces. One or more PIR values can be configured, each value corresponds to the global controller that belongs to the global controller list.

- **enable_dynamic_giaddrs_learning**—(Optional) Avoids learning new giaddrs during log in. If this value is set to false, if the Cisco Subscriber Manager identifies during the login that the relay agent does not belong to a known CMTS, the Cisco Subscriber Manager ignores the query and continues with the login. This functionality is applicable only for static device configuration. The default value is true.

- **general_default_cli_integrated**— Defines a default integrated CLI that is executed in the device. The default value is show controllers Integrated-Cable card ? association.

- **general_default_cli_modular**— Defines a default modular CLI that is executed in the device. The default value is show hw-module bay ? config wideband-channel.

- **general_default_cli_3g_60**—Defines a default 3G60 CLI that is executed in the device. The default value is show controllers Modular-Cable card ? association.

- **encrypt_cmts_credentials**— Defines whether the CMTS credentials are encrypted or plaintext. The default values is true.

- **num_of_retry_attempts_for_device_login**— Defines the maximum number of times the VLM must try to connect to the device. The default value is 3.

- **wait_for_device_uptime**—Defines the minimum period to wait after the device is restarted, in minutes. Virtual Link Manager checks the sysUpTime of the Device before starting the query, If it is less than the configured value, then the query to that device is ignored. Valid range is from 0 to 60. The default value is 0.

- **access_timeout_for_device_login**— Defines the number access timeout in milliseconds. The default value is 10000 milliseconds. If the maximum number of retry attempts is five, and the interval between retrying connections is three minutes or less, the VLM server tries to connect to the device five times with an interval of three minutes between each attempt. The VLM server does not try to connect after 15 minutes.

- **import_subs_into_db_on_device_add**—Defines whether to import all cable modem MAC addresses and the associated CMTS IP addresses to the database when the VLM detects that a new CMTS is added to the topology. Possible values are true and false. The default value is false.

- **time_interval_for_periodic_snmp_bg_query**—Defines the interval, in minutes, at which the corresponding LEG should initiate a bulk query for all subscribers at various VLink modes (partialvlinkmappings, fullvlinkmappings, all). The default value is 0 minutes. The minimum possible value is 2 minutes. By default, this parameter is disabled.

- **vlink_mode_for_periodic_snmp_bg_query**—Defines whether to query for subscribers with partial VLink mappings, full VLink mappings, and all. Possible values are none, partialvlinkmappings, fullvlinkmappings, all. The default value is none.

- **subscriber_mode_for_periodic_snmp_bg_query**—Defines whether to query all subscribers or subscribers based on the DOCSIS version. Possible values are DOCSIS2.0, DOCSIS3.0, all. The default value is all.

> **Note**   Setting log_all to true can cause performance degradation.

- subscribers_for_snmp_bg—Defines whether to query all the subscribers in Cisco Service Control Subscriber Manager or only the subscribers introduced to Cisco SCE. Possible values are all and introduced. The value introduced is used only in pull mode. If you use introduced, the Cisco Service Control Subscriber Manager queries only the subscribers introduced to the Cisco SCE. The default value is all.

  This example shows the [General] section of the vlink.cfg configuration file:

  ```
  [General]
  start=true
  monitoring_period=60
  upstream_vlink_factor=95
  downstream_vlink_factor=95
  log_all=false
  upstream_global_controller_list=agc_a, agc_b
  downstream_global_controller_list=agc_d, agc_e
  upstream_global_controller_pir_percentage=80,90
  downstream_global_controller_pir_percentage=85,85
  enable_dynamic_giaddrs_learning=true
  encrypt_cmts_credentials=true
  num_of_retry_attempts_for_device_login=3
  access_timeout_for_device_login=10000
  ```

b. Modify the Cisco SCE container such that it loads all Cisco SCE IP addresses specified in vlink.cfg as sceIPs in cache. This confirms that VLM integration is done for the DHCP packets only if the packets comes from those Cisco SCEs that are part of the VLM configuration (vlink.cfg).

c. For each CMTS device, configure a [Device.<device name>] section with these parameters:

> **Note**   <device name> of the section is used as part of the virtual link name for all virtual links associated with this CMTS device.

- device_type—Specifies whether CMTS device is a Cisco CMTS or a non-Cisco CMTS. Possible values are, cisco and arris. The default value is cisco.

- ip—Specifies the IP address of the CMTS device.

- sce_name—Specifies the name of the Cisco SCE to which the CMTS device is connected. This must match an Cisco SCE section defined in the p3sm.cfg configuration file.

- ignore_upvlink_ids—Specifies the configured UpVlink IDs to be ignored by the Cisco Subscriber Manager while removing the IDs from Cisco SCE. Users should ensure that the configured IDs are not assigned to any of the channels or virtual links by the Subscriber Manager and not provisioned to Cisco SCE. The VLink ID value must be an integer. The values can be separated by a comma (,) or can be a range of values separated by an en dash (-) can be mentioned, as shown in the following example:

  ```
  ignore_upvlink_ids= 11,12,15-20
  ```

- ignore_downvlink_ids—Specifies the configured DownVlink IDs to be ignored by the Subscriber Manager while removing the IDs from Cisco SCE. Users should ensure that the configured ID's are not assigned to any of the channels or virtual links by the Subscriber Manager and not provisioned to Cisco SCE. The VLink ID value must be an integer. The values can be separated by a comma (,). Alternatively, a range of values can be separated by an en dash (-) as shown in the following example:

```
ignore_downvlink_ids= 5-15
```

– upstream_vlink_factor—(Optional) Determines the percentage of the interface bandwidth that the Cisco SCE allows to be sent from this CMTS device to the Internet. Setting this parameter overrides the setting in the [General] section. If it is not configured, the value defined in the [General] section is used. The default value is 95.

– downstream_vlink_factor—(Optional) Determines the percentage of the interface bandwidth that the Cisco SCE allows to be sent from the Internet to this CMTS device. Setting this parameter overrides the setting in the [General] section. If it is not configured, the value defined in the [General] section is used. The default value is 95.

– log_all—Setting the log_all parameter to true causes the system to dump log messages to the user log for this CMTS device. If the log_all parameter in the [General] section is true, setting this parameter to false has no effect; if the log_all parameter in the [General] section is false, setting this parameter to true enables logging for operations related only to this CMTS device; such as, CMTS device creation and deletion.

– upstream_global_controller_list—(Optional) Determines the list of non default upstream global controllers, which are defined in the template and managed by the VLM. If it is not configured, the value defined in the [General] section is used.

– downstream_global_controller_list—(Optional) Determines the list of non default downstream global controllers, which are defined in the template and managed by the VLM. If it is not configured, the value defined in the [General] section is used.

> ✎
>
> **Note** Every global controller defined in the configuration file should exist in the policy configuration.

– upstream_global_controller_pir_percentage—(Optional) Determines the percentage of the PIR values of the wideband interfaces. One or more PIR values can be configured, each value corresponds to the global controller that belongs to the global controller list. If it is not configured, the value defined in the [General] section is used.

> ✎
>
> **Note** If the PIR values are not configured, then the default PIR values are used to determine the percentage.

– downstream_global_controller_pir_percentage—(Optional) Determines the percentage of the PIR values of the wideband interfaces. One or more PIR values can be configured, each value corresponds to the global controller that belongs to the global controller list. If it is not configured, the value defined in the [General] section is used.

– snmp_community—Specifies the SNMP community value for the VLM to communicate with the CMTS device. The default value is public.

– snmp_port—Specifies the SNMP port on which the VLM communicates to the CMTS device. The default value is 161.

– giaddr_external—For each giaddr value, the VLM creates a policy mapping table in the DHCP LEG without waiting for a login from the giaddr values. Use this parameter to insert giaddr values to the mapping table that the VLM created after querying the CMTS device. Use a comma "," delimiter between IP addresses. The default value for this parameter is empty.

- giaddr_replace—Specifies whether the VLM uses the IP addresses defined in the giaddr_external parameter as the only giaddr list of the CMTS device. When this parameter is set to no, the VLM uses the IP addresses defined in giaddr_external and the giaddr list that is found when querying the CMTS device as the CMTS giaddr list. Possible values for this parameter are yes and no. The default value is no.

- giaddr_remove—Removes a list of IPs from the mapping table that the VLM created after querying the CMTS device. For each giaddr value, the VLM creates a policy mapping table in the DHCP LEG without waiting for a login from the giaddr values. Use a comma "," delimiter between the IP addresses.

- cli_integrated—Defines an optional value the VLM uses to communicate with the device. This attribute loads the general_default_cli_integrated property in general section. The default value is show controllers Integrated-Cable card ? association.

  For parsing the CLI, the output of wideband to bonding group mapping is expected to be in a specific format. The line with wideband to bonding group information must start with "Wideband-Cable". After the wideband cable, the ifDescription and the bonding group ID separated by a space. For example, Wideband-Cable1/1/0:0 33, Wideband-Cable7/1/0:0 1057.

- cli_modular—Defines an optional value the VLM uses to communicate with the device. This attribute loads the general_default_cli_modular property in general section. The default value is show hw-module bay ? config wideband-channel.

- cli_3g60—This attribute overloads the general_default_cli_3g_60 property in general section. The default value is show controllers Modular-Cable card ? association.

- integrated_interface_name—Defines the interface name format of the integrated cable that appears in the ifDescr. By default the interface name supported is Integrated-Cable7/1/0:0 (Integrated-Cable<slot/subslot/port>:<channelNo>). If the interface name is Integrated-Cable7/1/0-downstream0, configure the "integrated_interface_name" parameter as Integrated-Cable<slot/subslot/port>-downstream<channelNo>. You can also configure two or more formats by entering the values separated by a comma.

- modular_interface_name—Defines the interface name format of the modular cable that appears in the ifDescr. By default the interface name supported is Modular-Cable1/0/0:0 (Modular-Cable<slot/subslot/port>:<channelNo>). If the interface name is Modular-Cable1/0/0-downstream0, configure the "modular_interface_name" parameter as Modular-Cable<slot/subslot/port>-downstream<channelNo>. You can also configure two or more formats by entering the values separated by a comma.

> ✎
>
> **Note** In a multiple format configuration, the Cisco Service Control Subscriber Manager supports only one format at a time for a given channel. It is expected that an integrated or modular cable channel has any one of the formats configured with the integrated_interface_name and modular_interface_name parameters. The Cisco Service Control Subscriber Manager does not support a channel name with more than one format.

- ignore_periodic_device_query—Defines whether to enable the VLM periodic SNMP query for topology learning for a specific CMTS. The default value is false.

- vlink_mode_for_periodic_snmp_bg_query—Defines whether to query for subscribers with partial VLink mappings, full VLink mappings, and all. Configuring this parameter overrides the global configuration for the device. Possible values are none, partialvlinkmappings, fullvlinkmappings, all. The default value is none.

– enable_dynamic_bg—(Applicable only for Arris CMTS) Defines whether to learn dynamically created bonding group. Possible values are true and false. The default value is false.

> ✎
> **Note**   Because the channels in a MAC domain may be shared with more than one dynamic bonding group, we recommend that you check the vlink reports at the MAC domain level. We also recommend that you set the number of bonding groups or channels within the Cisco SCE limit.

– show_vlink_with_macdomain_name—Defines whether to show the name of the MAC domain or the index of the MAC domain in vlink names and channel names. Possible values are true or false.

This example shows the [Device.<device name>] section of the vlink.cfg configuration file:

```
[Device.CMTS1]
ip=192.0.2.10
sce_name=SCE1
ignore_upvlink_ids=11,12,15-20
ignore_downvlink_ids=5-15
log_all=false
upstream_global_controller_list=agc_a, agc_b
downstream_global_controller_list=agc_d, agc_e
upstream_global_controller_pir_percentage=80,90
downstream_global_controller_pir_percentage=85,85
```

This example shows the option for disabling periodic topology learning of VLM:

```
[Device.CMTS1]
ip=<192.0.2.10>
sce_name=<SCE1>
log_all=true
port=161
snmp_community=public
ignore_periodic_device_query=true
```

d. To support DOCSIS 3.0 channel in Cisco devices, VLM queries the devices for bonding group association by using Telnet or SSH. To query the devices, VLM requires the device credentials. To provide the VLM with device credentials, complete the next two steps:

– Create an input CSV file, (for example, import.csv), with values in the format CMTS_IP,username,password,enable_password,protocol,port with separate line for each device.

– Import the credentials to VLM by using the **p3vlink --import-cmts-details** CLU.

If the credentials are wrong, or if the device is not reachable on the configured port using the configured protocol, then the VLINK for DOCSIS 3.0 interfaces is not created and the CMTS supports only DOCSIS 2.0.

This example shows a sample input CSV file with 2 devices configured.

```
#cmtsip,username,loginpass,enablpass,protocol,port
10.52.26.22,cisco,cisco,cisco,telnet,23
10.52.26.21,cisco,cisco,cisco,telnet,23
```
If there is no enable password, the enable_password field can be " 0 ".

e. Configure a device template that enables the users to define the dynamic device behavior. For more information on creating dynamic device, see the "Dynamic GIADDR Learning" section on page 3-3.

The required parameters are:

- – start—Setting the start parameter to yes instructs the VLM to create a dynamic device template. Possible values for this parameter are yes and no.

  If start is set to false, the VLM does not create a dynamic device. Changing the start value from true to false, disables the creation of dynamic device and the VLM deletes all the dynamic devices and their relevant data from the database.

- – log_all—Setting the log_all parameter to true causes the system to dump log messages to the user log for this CMTS device. If the log_all parameter in the [General] section is true, setting this parameter to false has no effect; if the log_all parameter in the [General] section is false, setting this parameter to true enables logging for operations related only to this CMTS device, such as, CMTS device creation and deletion.

- – snmp_port—(Optional) Specifies the SNMP port value for the VLM to communicate with the CMTS device. The default value is 161.

- – snmp_community—(Optional) Specifies the SNMP community value for the VLM to communicate with the CMTS device. The default value is public.

Note   The ip and sce_name are not defined; they are retrieved from the DHCP data during login operations. IPDR LEG does not support this feature.

Step 10   Save and close the vlink.cfg configuration file.

Step 11   Load the configuration to the Cisco Subscriber Manager by running the `>p3sm --load-config` command as the user pcube on the Cisco Subscriber Manager machine from the bin directory.

Note   Remove Cisco SCE from the VLM solution using the **p3sm --load-config** command after changing the configuration file while the Subscriber Manager is running; otherwise, the Subscriber Manager might not delete Cisco SCE and the corresponding Vlinks from the database.

To load the configuration changes, after updating the configuration in the vlink.cfg file, it is necessary to run the **p3sm --load-config** command before restarting the Cisco Service Control Subscriber Manager. The configuration changes may have to be performed for any of the following tasks:

- Add a new CMTS.
- Remove a CMTS.
- Move CMTS across Cisco SCEs.
- Change the Cisco Service Control Collection Manager associated to Cisco SCE

Managing the Remote Cable MSO Links Solution

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Introduction

This chapter describes the three monitoring mechanisms that you can use to monitor the traffic optimization on remote links solution:

- p3vlink command line utility (CLU)
- Cisco SCE command line interface (CLI)

Virtual Link Names

Each virtual link represents a single interface on the CMTS device and the virtual link name comprises the CMTS device name and the interface name. The virtual links are named according to the following naming convention:

<Device name>_<Interface name>

- <Device name>—This portion of the name is set when configuring the CMTS in the vlink.cfg configuration file.
- <Interface name>—This portion of the name identifies the specific CMTS interface including the direction and the interface index. This information is how the CMTS describes the interface internally and it is retrieved from the CMTS device by using SNMP.
    - The direction portion of the virtual link name indicates the virtual link direction. Values can be upstream or downstream.
    - The interface index indicates the specific interface on the CMTS of the virtual link.

This is a sample virtual link name for a CMTS device named Device-1:

```
Device-1_CMTS1/0-upstream 1
```

If a downstream virtual link contains two channels, then the virtual link names are displayed as:

<Device name>_<Interface name>-L<index of the primary channel>

or

<Device name>_<Interface name>-W

Monitoring Using the p3vlink Utility

The p3vlink utility provides the ability to show virtual link configurations and metrics related to the virtual links. The command format is:

p3vlink *OPERATION [OPTIONS]*

Table 5-1 and Table 5-2 lists the p3vlink operations and options, respectively.

Table 5-1   p3vlink Operations

Operation	Description	Notes
--show	Displays the current general configuration, CMTS device list, and CMTS device information.	—
--show-device	Displays general configuration of the specified CMTS device that is known to the VLM. This includes non-Cisco CMTS devices also. To specify the CMTS device, use the **-d** option. To show all the links related to the CMTS device, specify the **--detail** option.	—
--resync	Gets all the Cisco SCE virtual link configurations and sends it to the Cisco SCE, Cisco SCE-Sniffer DHCP LEG, and CM. To specify the Cisco SCE, use the **-n SCE_NAME** option. To specify a Collection Manager, use the **-n CM_NAME** option. In this case, the VLM gets all the Cisco SCE virtual links that are related to the specified Collection Manager and sends the data to the Collection Manager.	This is a nonblocking command. Query operation and synchronization operation are activated in the background.
--resync-all	Gets all the Cisco SCE virtual link configurations for each Cisco SCE and sends them to the Cisco SCE, Cisco SCE-Sniffer DHCP LEG, and Collection Manager.	This is a nonblocking command. Query operation and synchronization operation are activated in the background.
--start-query	Starts the on demand query operation (and the CMTS device synchronization operation) for one CMTS device or more separated by ",". To specify the CMTS device to be queried, use the **-d <device name>** option.	This is a nonblocking command. Query operation and synchronization operation is activated in the background.

Table 5-1   p3vlink Operations (continued)

Operation	Description	Notes
--show-vlinks	Shows the virtual links, virtual link indexes, and bonding group information related to the specified Cisco SCE. To specify the Cisco SCE, use the **-n <SCE name>** option. (Optional) To specify the prefix of the virtual links that you want this command to show, use the **--prefix=<vlink prefix>** option.	—
--show-vlink-data	Shows all the data related to the specified link. To specify the vlink, use one of these options: **--vlink-name=<name>** **--vlink-id=<id>**, **--ne-name**, and **--direction**	—
--show-vlink-details	Shows the maximum number of upstream and downstream vlinks, the number of existing, and free vlinks in a Cisco SCE device. Use the **-n** *SCE name* option to specify the Cisco SCE.	—
--show-vlink-mappings	Shows the upstream and downstream vlink mappings that the virtual link manager learnt from all configured CMTSs.	—

Table 5-1   p3vlink Operations (continued)

Operation	Description	Notes

--show-subs	This command has four uses:
	
	• Shows all subscribers connected to a specific CMTS device.
	
	  – To specify the CMTS device, use the **-d \<device name>** option.
	
	  – (Optional) To specify the virtual link ID, use the **--vlink-id=\<id>** option.
	
	  – (Optional) To specify the virtual link direction, use the **--direction=\<up|down>** option.
	
	  – (Optional) To specify the prefix of the virtual links that you want this command to show, use the **--prefix=\<vlink prefix>** option.
	
	• Shows all subscribers connected to a specific CMTS device interface, or related to a specific CMTS device.
	
	  – To show all subscribers related to the vlink, use **--vlink-name=\<name>**.
	
	    Because each vlink represents one CMTS device interface, this command enables you to see all subscribers traveling from a specific CMTS device interface.
	
	• Shows the bonding group if the cable modems are DOCSIS 3.0 modems.
	
	• Shows the channelID, all subscribers who are associated to this channelID, and the direction of the channel, when the DOCSIS 2.0 modem is assigned to a single primary channel.
	
	  – To show the channel ID and the directon of the channel, use **--channel-name=\<channel name>**.
		This command retrieves subscribers whose giaddr attribute is one of the CMTS devices giaddr attributes.
		
		The result can be filtered by using:
		
		• Prefix (first use only)
		
		• Vlink-id (first use only)
		
		• Direction

--remove-device	Removes a dynamic device from the VLM. To specify the CMTS device, use the **-d \<device name>** option.	After the device is removed, VLM deletes all virtual links related to the device from the Cisco SCE. The subscribers of the affected device are logged in with default vlink mappings.

Table 5-1   ***p3vlink Operations (continued)***

Operation	Description	Notes
--enable-logging –d <device name>	Enables login on a specific device. To specify the CMTS device, use the **-d <device name>** option.	This command sets the log_all flag related to the device to true. During load-config and the Cisco Subscriber Manager restart operations, the value of log_all is reset to the value defined in the configuration file.
--disable-logging –d <device name>	Disables login on a specific device. To specify the CMTS device, use the **-d <device name>** option.	This command sets the log_all flag related to the device to false. During load-config and the Cisco Subscriber Manager restart operations, the value of log_all is reset to the value defined in the configuration file.
--import-cmts-details --file-name= <Complete path of the file>	Imports the CMTS credentials from a file.	This command imports the device credentials to VLM. The device credentials are imported from the file mentioned in the --file-name. After importing, creates a CSV file in encrypted format.
--import-queue <file name>	Imports the subscribers from a given file to the SNMP BG primary queue.	
--import-subs-into-db -d <device name>	Queries the CMReg table and imports the subscribers into the database with GIADDR.	Supported CMTS type: Cisco and ARRIS. If GIADDR exists in the database, it is updated with that of the device.
--import-subs-into-db -d <device name> -o <file name>	Queries the CMReg table and exports the subscriber details to an output file.	Supported CMTS type: Cisco and ARRIS.
--snmp-bg-query -d <device-name> -m <mode>	Queries the subscribers in various modes from the database and adds these subscribers to the primary queue of the SNMP bonding group process. Cisco Service Control Subscriber Manager queries the CMTS on a need basis for bringing together all the subscribers with proper Up and Down VLink IDs.	Supported CMTS Type: Cisco and ARRIS. Valid modes are: • Partial—Retrieves subscribers with partial or no Vlink mappings. • Full—Retrieves only subscribers with upvlink and downvlink associations. • All—retrieves all subscribers belonging to a device.
--show-subs-partial-vlink -d <device name>	Queries the database for subscribers with partial, no, and 0 vlink mappings, and displays the details on the console.	Supported CMTS Type: Cisco and ARRIS. If the subscribers_for_snmp_bg parameter in the vlink.cfg file is configured as introduced, the command queries only for the active subscribers in Cisco SCE.
--query-subs-partial-vlink -d <device name>	Queries the database for subscribers with partial, no, and 0 vlink mappings, and adds them to the SNMP BG queue to retrieve the Vlink associations.	Supported CMTS Type: Cisco and ARRIS. If the subscribers_for_snmp_bg parameter in the vlink.cfg file is configured as introduced, the command queries only for the active subscribers in Cisco SCE.

Table 5-2   p3vlink Options

SM Option	Abbreviation	Description
--channel-name=*NAME*	—	Specifies the channel name. To list the subscribers on a specific channel, use this option with the **--show-subs** operation.
--direction=*up/down*	—	Specifies the direction of the virtual link.
--detail	—	(Optional) To display additional information, use this option with the **--show-device** operation.
--device=*DEVICE*	**-d** *DEVICE*	Specifies the logical name of the CMTS device.
--file-name= <Complete path of the file>	-o *FILE NAME*	Specifies the complete path of the file to import or export the device credentials, Used with **--import-cmts-details** and **--import-subs-into-db -d** operations.
--m *MODE*	-m *MODE*	Specifies the mode of the subscriber.
--ne-name=*NAME*	**-n** *NAME*	Specifies the logical name of the Cisco SCE platform or CM.
--prefix=*vlink prefix*	—	Specifies the virtual link prefix.
--vlink-name=*vlink name*	—	Specifies the virtual link name.
--vlink-id	—	Specifies the index of the virtual link.

p3vlink Utility Examples

To show the CMTS device general configuration, CMTS device list, and CMTS device information:

```
p3vlink --show
General data:
-------------
Version : 4.1.0 Build 123
Start : Yes
Monitor Every : 5 minutes
BW Up Factor : 95
BW Down Factor : 95
Next query operation : Tue Dec 17 14:17:24 IST 2013
Next ip removal operation : Tue Dec 31 14:12:24 IST 2013
Enable Device Learning : true
Enable Dynamic Giaddrs Learning : true
Upstream Global Controllers : None
Downstream Global Controllers : None
Ignore Duplicate IP : false
periodic SMNP BG query interval : 3 Minutes
Global SNMP BG query mode : all
SNMP BG subscriber mode : all
Import subscriber in to DB from device : false
Subscribers list for SNMP BG query : all

Device list
-----------
1) Name: ArrisNOVACMTS, Host Name: ArrisNOVACMTS, Type: Static, Query state: Failure, Last
successful query:
```

```
Command terminated successfully
>
```

To show the general configuration of a specified CMTS device:

p3vlink --show-device -d CMTS1 --detail

```
Device Name: cmts1
Host Name: cmts1
IP: 10.78.242.201
Type: Static
SCE Related: sce
Upstream factor: 95
Downstream factor: 95
Ignore Periodic Device Query: false
Last success Query: Tue Dec 17 14:53:34 IST 2013
Last Query Attempt: Tue Dec 17 14:53:34 IST 2013
Last Query Status: Completed
Sync state with SCE: Not-done
Sync state with CM: N/A
Giaddr List: 10.78.242.201;
Upstream Global Controllers: None
Downstream Global Controllers: None
isLogAll: false
Num of up interfaces: 100
Num of down interfaces: 17


VLink Information:
1) Name: cmts1_Cable5/1/0-upstream0, Vlink Id: 244, Direction: UP, PIR: 5120 kbps
2) Name: cmts1_Cable5/1/0-upstream1, Vlink Id: 239, Direction: UP, PIR: 2560 kbps
3) Name: cmts1_Cable5/1/0-upstream2, Vlink Id: 233, Direction: UP, PIR: 5120 kbps
4) Name: cmts1_Cable5/1/0-upstream3, Vlink Id: 278, Direction: UP, PIR: 2560 kbps
5) Name: cmts1_Cable5/1/1-upstream0, Vlink Id: 226, Direction: UP, PIR: 2560 kbps
6) Name: cmts1_Cable5/1/1-upstream1, Vlink Id: 222, Direction: UP, PIR: 2560 kbps
7) Name: cmts1_Cable5/1/1-upstream2, Vlink Id: 247, Direction: UP, PIR: 2560 kbps
8) Name: cmts1_Cable5/1/1-upstream3, Vlink Id: 229, Direction: UP, PIR: 2560 kbps
9) Name: cmts1_Cable5/1/2-upstream0, Vlink Id: 273, Direction: UP, PIR: 2560 kbps
10) Name: cmts1_Cable5/1/2-upstream1, Vlink Id: 228, Direction: UP, PIR: 2560 kbps
11) Name: cmts1_Cable5/1/2-upstream2, Vlink Id: 211, Direction: UP, PIR: 2560 kbps
12) Name: cmts1_Cable5/1/2-upstream3, Vlink Id: 221, Direction: UP, PIR: 2560 kbps
13) Name: cmts1_Cable5/1/3-upstream0, Vlink Id: 195, Direction: UP, PIR: 2560 kbps
14) Name: cmts1_Cable5/1/3-upstream1, Vlink Id: 277, Direction: UP, PIR: 2560 kbps
15) Name: cmts1_Cable5/1/3-upstream2, Vlink Id: 192, Direction: UP, PIR: 2560 kbps
16) Name: cmts1_Cable5/1/3-upstream3, Vlink Id: 202, Direction: UP, PIR: 2560 kbps
17) Name: cmts1_Cable5/1/4-upstream0, Vlink Id: 193, Direction: UP, PIR: 2560 kbps
18) Name: cmts1_Cable5/1/4-upstream1, Vlink Id: 259, Direction: UP, PIR: 2560 kbps
19) Name: cmts1_Cable5/1/4-upstream2, Vlink Id: 256, Direction: UP, PIR: 2560 kbps
20) Name: cmts1_Cable5/1/4-upstream3, Vlink Id: 210, Direction: UP, PIR: 2560 kbps
21) Name: cmts1_Cable6/0/0-downstream, Vlink Id: 355, Direction: DOWN, PIR: 42885 kbps
22) Name: cmts1_Cable6/0/0-downstream:WB-340, Vlink Id: 340, Direction: DOWN, PIR: 200000
kbps
Channel Name: cmts1_Modular-Cable1/0/0:0-L24, index: 340, PIR: 50000 kbps, CIR: 40000 kbps
Channel Name: cmts1_Modular-Cable1/0/0:1-L25, index: 341, PIR: 50000 kbps, CIR: 40000 kbps
Channel Name: cmts1_Modular-Cable1/0/0:2-L26, index: 342, PIR: 50000 kbps, CIR: 40000 kbps
Channel Name: cmts1_Modular-Cable1/0/0:3-L27, index: 343, PIR: 50000 kbps, CIR: 40000 kbps
Channel Name: cmts1_Wideband-Cable1/0/0:0-OLBG-W1, index: 344, PIR: 200000 kbps, CIR:
20000 kbps
23) Name: cmts1_Cable6/0/0-upstream0, Vlink Id: 249, Direction: UP, PIR: 5120 kbps
24) Name: cmts1_Cable6/0/0-upstream1, Vlink Id: 260, Direction: UP, PIR: 2560 kbps
25) Name: cmts1_Cable6/0/0-upstream2, Vlink Id: 263, Direction: UP, PIR: 2560 kbps
26) Name: cmts1_Cable6/0/0-upstream3, Vlink Id: 214, Direction: UP, PIR: 2560 kbps
27) Name: cmts1_Cable6/0/1-downstream, Vlink Id: 338, Direction: DOWN, PIR: 30342 kbps
28) Name: cmts1_Cable6/0/1-upstream0, Vlink Id: 181, Direction: UP, PIR: 2560 kbps
```

```
29) Name: cmts1_Cable6/0/1-upstream1, Vlink Id: 236, Direction: UP, PIR: 2560 kbps
30) Name: cmts1_Cable6/0/1-upstream2, Vlink Id: 200, Direction: UP, PIR: 2560 kbps
31) Name: cmts1_Cable6/0/1-upstream3, Vlink Id: 184, Direction: UP, PIR: 2560 kbps
32) Name: cmts1_Cable6/0/2-downstream, Vlink Id: 356, Direction: DOWN, PIR: 30342 kbps
33) Name: cmts1_Cable6/0/2-upstream0, Vlink Id: 187, Direction: UP, PIR: 2560 kbps
34) Name: cmts1_Cable6/0/2-upstream1, Vlink Id: 185, Direction: UP, PIR: 2560 kbps
35) Name: cmts1_Cable6/0/2-upstream2, Vlink Id: 209, Direction: UP, PIR: 2560 kbps
36) Name: cmts1_Cable6/0/2-upstream3, Vlink Id: 191, Direction: UP, PIR: 2560 kbps
37) Name: cmts1_Cable6/0/3-downstream, Vlink Id: 348, Direction: DOWN, PIR: 30342 kbps
38) Name: cmts1_Cable6/0/3-upstream0, Vlink Id: 217, Direction: UP, PIR: 2560 kbps
39) Name: cmts1_Cable6/0/3-upstream1, Vlink Id: 189, Direction: UP, PIR: 2560 kbps
40) Name: cmts1_Cable6/0/3-upstream2, Vlink Id: 250, Direction: UP, PIR: 2560 kbps

Command terminated successfully
>
```

The output of this command includes these four information elements:

- Num of up interfaces—Summarizes the total number of upstream virtual links related to this CMTS device. *Unknown* indicates that the VLM was not able to communicate with the CMTS device.

- Num of down interfaces—Summarizes the total number of downstream virtual links related to this CMTS device. *Unknown* indicates that the VLM was not able to communicate with the CMTS device.

- Sync state with Cisco SCE:
  - Done—The Cisco SCE is fully synchronized with CMTS device information.
  - Not-done—The Cisco SCE is not synchronized with all CMTS device data. Use the **p3vlink --resync -n** <*sce which manages the device*> command to perform the synchronization operation.
  - Sync-in-process—When VLM detects configuration changes, the change needs to be sent to the Cisco SCE. During the update process, the VLM changes the sync state to Sync-in-process.

    For successful updates, the Cisco SCE sync state is set to Done, else the value is set to Not-Done.

- Sync state with Collection Manager:
  - Done—The Collection Manager is fully synchronized with CMTS device information.
  - Not-done—The CM is not synchronized with all CMTS device data. Use the **p3vlink --resync -n** <*sce which manages the device*> command to perform the synchronization operation.
  - N/A—The Cisco SCE to which the CMTS device belongs, is not connected to any Collection Manager.
  - Sync-in-process – When VLM detects configuration changes, the change needs to be sent to the Collection Manager. During the update process, the VLM changes the sync state to Sync-in-process.

    For successful updates, Cisco SCE sync state is set to Done, else the value is set to Not-Done.

- Last Query Status:
  - Not started—Query operation for the device was not started since the last Cisco Subscriber Manager boot.
  - Completed—Last query was completed successfully.
  - Failure—Last query failed to complete.
  - Waiting for query—Query operation is in queue waiting for resources.

- In-query—Device is in the process of a query operation.

- Waiting for deletion—During the last query, if no giaddr was found, the system queues up the device for deletion. This is applicable only to dynamic devices.

To show all the virtual links for a specific network element (Cisco SCE):

```
p3vlink --show-vlinks -n sc0

device0_0_Cmts0/1-downstream1, vlink id=15, direction=DOWN
device0_0_Cmts0/1-upstream1, vlink id=8, direction=UP
device0_0_Cmts0/1-upstream2, vlink id=16, direction=DOWN
device0_1_Cmts1/1-downstream1, vlink id=11, direction=DOWN
device0_1_Cmts1/1-upstream1, vlink id=6, direction=UP
device0_1_Cmts1/1-upstream2, vlink id=12, direction=DOWN
device0_2_Cmts2/1-downstream1, vlink id=25, direction=DOWN
device0_2_Cmts2/1-upstream1, vlink id=13, direction=UP
device0_2_Cmts2/1-upstream2, vlink id=26, direction=DOWN
device0_3_Cmts3/1-downstream1, vlink id=13, direction=DOWN
device0_3_Cmts3/1-upstream1, vlink id=7, direction=UP
device0_3_Cmts3/1-upstream2, vlink id=14, direction=DOWN
device0_4_Cmts4/1-downstream1, vlink id=21, direction=DOWN
device0_4_Cmts4/1-upstream1, vlink id=11, direction=UP
device0_4_Cmts4/1-upstream2, vlink id=22, direction=DOWN
device0_5_Cmts5/1-downstream1, vlink id=1, direction=DOWN
device0_5_Cmts5/1-upstream1, vlink id=1, direction=UP
device0_5_Cmts5/1-upstream2, vlink id=2, direction=DOWN
device0_6_Cmts6/1-downstream1, vlink id=9, direction=DOWN
device0_6_Cmts6/1-upstream1, vlink id=5, direction=UP
device0_6_Cmts6/1-upstream2, vlink id=10, direction=DOWN
device1_0_Cmts7/1-downstream1, vlink id=3, direction=DOWN
device1_0_Cmts7/1-upstream1, vlink id=2, direction=UP
device1_0_Cmts7/1-upstream2, vlink id=4, direction=DOWN
device1_1_Cmts8/1-downstream1, vlink id=7, direction=DOWN
device1_1_Cmts8/1-upstream1, vlink id=4, direction=UP
device1_1_Cmts8/1-upstream2, vlink id=8, direction=DOWN
device1_2_Cmts9/1-downstream1, vlink id=27, direction=DOWN
device1_2_Cmts9/1-upstream1, vlink id=14, direction=UP
device1_2_Cmts9/1-upstream2, vlink id=28, direction=DOWN
device1_3_Cmts10/1-downstream1, vlink id=23, direction=DOWN
device1_3_Cmts10/1-upstream1, vlink id=12, direction=UP
device1_3_Cmts10/1-upstream2, vlink id=24, direction=DOWN
device1_4_Cmts11/1-downstream1, vlink id=19, direction=DOWN
device1_4_Cmts11/1-upstream1, vlink id=10, direction=UP
device1_4_Cmts11/1-upstream2, vlink id=20, direction=DOWN
device1_5_Cmts12/1-downstream1, vlink id=5, direction=DOWN
device1_5_Cmts12/1-upstream1, vlink id=3, direction=UP
device1_5_Cmts12/1-upstream2, vlink id=6, direction=DOWN
device1_6_Cmts13/1-downstream1, vlink id=17, direction=DOWN
device1_6_Cmts13/1-upstream1, vlink id=9, direction=UP
device1_6_Cmts13/1-upstream2, vlink id=18, direction=DOWN
Command terminated successfully
```

To show the vlink data of a specific link:

```
p3vlink --show-vlink-data --vlink-name=device_Cmts0/0-downstream1

VLink Name: device_Cmts0/0-downstream1
VLink Id:    1
Direction:    downstream
SCE Name:     sce0
Device Name: device
PIR:    200000000
```

```
Channels related to VLink
<name>-L, index <index>, PIR <value>, CIR <value>
<name>-W, index <index>, PIR <value>, CIR <value>


Related upstream virtual links —Lists all upstream interface related to the same MAC layer
as the selected downstream interface.
device_Cmts0/0-upstream0
device_Cmts0/0-upstream1
device_Cmts0/0-upstream2
device_Cmts0/0-upstream3
```

Note If more than one vlink has the same name, this command displays the information for all the vlinks.

To Show the maximum number of upstream and downstream vlinks, the number of existing, and free vlinks in a Cisco SCE device:

p3vlink --show-vlink-details -n sce1

```
Maximum number of upstream Channels supported     : 1023
Maximum number of downstream Channels supported   : 1023
Free upstream Channels available                  : 596
Free downstream Channels available                : 754
Number of upstream channels created               : 427
Number of downstream channels created             : 269
Command terminated successfully
```

To show the upstream and downstream vlink mappings that the virtual link manager learnt from all configured CMTSs:

p3vlink --show-vlink-mappings

```
IPDR Vlink Mapping Tables:
==========================

Upstream Table:
{10.52.206.2_1054_1=191, 10.52.206.2_1109_2=88,
10.52.206.2_1077_4=196, 10.52.206.2_1031_1=99,
10.52.206.2_1019_4=43, 10.52.206.2_1047_1=9,
10.52.206.2_1093_4=97, 10.52.206.2_1018_2=158,
10.52.206.2_1080_2=73, 10.52.206.2_1042_4=126}

Downstream Table:
{10.52.206.2_1110_185=9, 10.52.206.2_1106_169=3,
10.52.206.2_1093_153=7, 10.52.206.2_1095_161=5,
10.52.206.2_1092_149=1, 10.52.206.2_1108_177=6,
10.52.206.2_1107_173=2, 10.52.206.2_1094_157=8,
10.52.206.2_1109_181=4}
Command terminated successfully
```

To show the subscribers using virtual links:

- Use the **p3subsdb** command to list all the subscribers:

    p3subsdb --show-all

    ```
    0005ca679c20
    0005ca67f530
    0005ca6ece30
    0005ca7086e0
    0005caddbec0
    0005cae99cf0
    ```

```
00189b4938c9
00189b64fa64
001b2f8dfaad
001dcf1e48cc
001dcf1e48f4
0024b2106af4
00252e11d22e
00252ed453ca
00252ed454ee
00252ed455d8
00252ed455dc
00252ed4585a
00252ed4589e
00252ed45934
00252ed459d6
00252ed459d8
00252ed459fe
00252ed45a06
00252ed45a2a
00252ed45a42
00265b2c5200
00265b585e60
00265b588d50
0026f2132b12
Command terminated successfully
```

- Use the **p3subs** command to show the virtual links of a particular subscriber:

```
p3subs --show -s 0005ca679c20
Name:           0005ca679c20
Domain:         subscribers
Mappings:
        IP: 10.10.0.10/32
Properties:
        downVlinkId=11   Name=cmts1_Cable7/1/4-downstream
        upVlinkId=10     Name=cmts1_Cable7/0/3-upstream3
Custom Properties:
        giaddr=10.78.242.201
Command terminated successfully
```

- Use the **p3vlink** command to show the subscribers that are associated with a particular CMTS device:

```
p3vlink --show-subs -d device1_1

Subscribers related to device: device1_1 vlink-id: 4, giaddr: 1.1.1.1, direction UP
lynn_jones
Subscribers related to device: device1_1 vlink-id: 7, giaddr: 1.1.1.1, direction DOWN
lynn_jones
Command terminated successfully
```

- Use the **p3vlink** command to show the subscribers that are associated with a specific CMTS device:

```
p3vlink --show-subs -d Test0 --direction=Down --vlink-id=23

Subscribers related to device: Test0 vlink-id: 23, giaddr: 24.191.128.17, direction
DOWN0101010101060101010107
Command terminated successfully
```

- Use the **p3vlink** command to show the subscribers that are associated with a specific vlink:

```
p3vlink --show-subs --vlink-name test1_Cmts0/0-upstream2

Subscribers related to device: test1 vlink-id: 5, giaddr: 10.78.233.149, direction UP
```

```
010101010101
1 subscriber was found
Command terminated successfully
```

- Use the **p3vlink** command to show the subscribers that are associated to a channel name:

```
p3subs --show -s sub1

Name:           sub1
Domain:         subscribers
Properties:
        downVlinkId=11   Name=local_Modular-Cable1/0/0:1-L194
        upVlinkId=11     Name=local_Cable7/0/2-upstream2
Custom Properties:
        giaddr=10.78.233.233
Command terminated successfully


p3vlink --show-subs --channel-name=local_Cable7/0/2-upstream2

Subscribers related to device: local vlink-id: 11, giaddr: 10.78.233.233, direction UP
sub1
1 subscriber was found
Command terminated successfully


p3vlink --show-subs --channel-name=local_Modular-Cable1/0/0:1-L194

Subscribers related to device: local vlink-id: 11, giaddr: 10.78.233.233, direction
DOWN
sub1
1 subscriber was found
Command terminated successfully
```

To view the subscribers with partial, no, and 0 vlink mappings for a given device:

```
p3vlink --show-subs-partial-vlink -d cisco

Subscribers with partial and default vlinks in Device cisco :
============================================================
000101010d10,000101010e10
```

To imort the subscribers from a given file to the SNMP BG primary queue:

```
p3vlink --import-queue --file-name=file.csv

The following imported subscribers are added into primary queue:
============================================================
00252ed45a06,00252ed459fe,00252ed459d8,001b2f8dfaad,
00252ed45934,00252ed4589e,00252ed4585a,00252ed455dc,
00252ed455d8,00252ed454ee,00252ed453ca,00252e11d22e,
0024b2106af4,001dcf1e48f4,001dcf1e48cc,00252ed459d6

Command terminated successfully
```

Monitoring Virtual Links Using the Cisco SCE CLI

The Cisco SCE provides CLI commands to monitor the virtual links in the solution.

lists the virtual links CLI commands.

Table 5-3   *Virtual Links Commands*

Commands	Description
Show Commands	
show interface LineCard 0 virtual-links [all | changed | different-from-template]	Displays: • All the defined virtual links, when you use the **all** option. • Virtual links whose configurations have changed from the template, when you use the **changed** option. • Virtual links configurations that differ from the template, when you use the **different-from-template** option.
show interface LineCard 0 virtual-links [status | mapping]	Displays the status of virtual links and updates the log with virtual links mapping. To display the status of the virtual link, use the **status** option. To update the log with virtual link mapping, use the **mapping** option. This is a debug command.
show interface LineCard 0 virtual-links template [direction [upstream | downstream]]	Displays the virtual link template of both upstream and downstream (Optional) To show only one direction, use the **[direction [upstream | downstream]]** option.
show interface LineCard 0 virtual-links default direction [upstream | downstream] [counter | agc-mapping]	Displays the default virtual link. (Optional) To specify the agc-mapping between virtual link and the actual agc indexes, use the **agc-mapping** option. (Optional) To specify the counter along with agc-mapping, enforce rate and actual rate, use the **counter** option.
show interface LineCard 0 virtual-links [name <name> | index <index>] direction [upstream | downstream] [counter | agc-mapping]	Displays the virtual link by name or index. To display the name or index of the virtual link, use the **[name <name> | index <index>]** option. (Optional) To specify the agc-mapping between virtual link and the actual agc indexes, use the **agc-mapping** option. (Optional) To specify the counter along with agc-mapping, enforce rate and actual rate, use the **counter** option.
Add Commands	
virtual-links index <index> direction [upstream | downstream]	Adds a virtual link index. (Optional) To specify a direction, use the **[direction [upstream | downstream]]** option.
virtual-links index <index> name <name> direction [upstream | downstream]	Adds a virtual link index and specifies a name. To specify a name for the channel, use the **name** option. (Optional) To specify a direction, use the **[direction [upstream | downstream]]** option.
Remove Commands	

Table 5-3   Virtual Links Commands (continued)

Commands	Description
no Virtual-links index <index> direction [upstream | downstream]	Removes a virtual link associated with the specified index and direction.
	To specify the index, use the **<index>** option.
	To specify the direction, use the **direction** option.
no Virtual-links all direction [upstream | downstream]	Removes all the virtual links.
Set Commands	
virtual-links index <index> direction [upstream | downstream] gc <offset> set-PIR value <value>	Sets the virtual link index PIR values by gc-offset and direction.
Reset Commands	
virtual-links index <index> direction [upstream | downstream] gc <offset> reset-PIR	Resets the virtual link index PIR value by gc template offset and direction to template values.

virtual-links Command Examples

These examples show the output from the CLI virtual links commands:

```
SCE2000#> show interface Linecard 0 virtual-links template

Virtual Link enabled
Global Virtual link Global Controller, upstream:
    name = globalGC - pir: 8000000 - cir: 0 - al: 5
    name = globalGC1 - pir: 8000000 - cir: 0 - al: 5
Virtual link Global Controller, upstream Template hierarchic:
Total bandwidth limit in Virtual-Link:
    name = Virtual-Link Global Controller - pir: 8000000,8000000,8000000,8000000 - cir: 0
    - al: 5
    name = appGC - pir: 8000000,8000000,8000000,8000000 - cir: 0 - al: 5
    Global Virtual link Global Controller, downstream:
    name = globalGC1 - pir: 8000000 - cir: 0 - al: 5
Virtual link Global Controller, downstream Template hierarchic:
Total bandwidth limit in Virtual-Link:
    name = Virtual-Link Global Controller - pir: 8000000,8000000,8000000,8000000 - cir: 0
    - al: 5
    name = appGC - pir: 8000000,8000000,8000000,8000000 - cir: 0 - al: 5
    name = appGC1 - pir: 8000000,8000000,8000000,8000000 - cir: 0 - al: 5
    name = appGC2 - pir: 8000000,8000000,8000000,8000000 - cir: 0 - al: 5

SCE2000#> show interface LineCard 0 virtual-links all

Virtual Link enabled
upstream Virtual-Link:
index=1, name=virtual link 1
index=2, name=virtual link 2
index=3, name=virtual link 3
downstream Virtual-Link:
index=1, name=virtual link 1
index=2, name=virtual link 2
index=3, name=virtual link 3

SCE2000#> show interface LineCard 0 virtual-links different-from-template
```

```
Virtual Link enabled
upstream Virtual-Link:
    virtual index=1, name=virtual link 1
        channel index=1, name=virtual channel 1, pir=99999, cir=99, al=9, agc index=3
        application index=1, name=appGC-1, pir=8000000, cir=0, al=5, agc index=2
    virtual index=2, name=virtual link 2
        channel index=2, name=virtual channel 2, pir=99999, cir=99, al=9, agc index=7
        application index=1, name=appGC-2, pir=8000000, cir=0, al=5, agc index=6
downstream Virtual-Link:
    virtual index=3, name=virtual link 3
        channel index=3, name=virtual channel 3, pir=99999, cir=99, al=9, agc index=15
        application index=1, name=appGC-3, pir=8000000, cir=0, al=5, agc index=12
        application index=2, name=appGC1-3, pir=8000000, cir=0, al=5, agc index=13
        application index=3, name=appGC2-3, pir=8000000, cir=0, al=5, agc index=14

SCE8000#> show interface LineCard 0 virtual-links index 1 direction upstream agc-mapping

Virtual Link enabled
upstream Virtual-Link:
    virtual index=1, name=virtual link 1
        channel index=1, name=virtual channel 1, pir=99999, cir=99, al=9, agc index=3
        application index=1, name=appGC-1, pir=8000000, cir=0, al=5, agc index=2

SCE8000#> show interface LineCard 0 virtual-links index 1 direction upstream counter

Virtual Link enabled
upstream Virtual-Link:
    virtual index=1, name=virtual link 1
        channel index=1, name=virtual channel 1, pir=99999, cir=99, al=9, agc index=3,
        enforce rate=99999, actual rate=0
        application index=1, name=appGC-1, pir=8000000, cir=0, al=5, agc index=2, enforce
        rate=8000000, actual rate=0
```

Monitoring Virtual Links Using the Reporter

The Cisco SCA BB includes a Reporter tool that allows you to produce reports based on the traffic analysis performed by the Cisco SCE platform. The information is sent from the Cisco SCE platform and is stored in a database. The Reporter can query and retrieve information from the database and present the results in a comprehensive range of reports.

The Reporter includes the Virtual Links Monitoring group of report templates that allow you to view statistics of bandwidth or volume of traffic used by a virtual link. The reports are provided per service usage counter for the total volume used by the virtual link. The volume consumption can be displayed per service for the virtual link. The reports are provided per channel.

Each report can be filtered to focus on a virtual link ID, a virtual link name, a virtual link direction, or a combination of the virtual link identifiers.

The Virtual Links Monitoring group includes these report templates:

- VLink Bandwidth per Service—Shows the distribution of bandwidth among the different service usage counters defined in the system for all subscribers.

- VLink Aggregated Usage Volume per Service—Shows the total volume of traffic (upstream and downstream) for each service usage counter.

- VLink Bandwidth per Package—Shows the distribution of bandwidth among the different packages defined in the system for selected vlinks.

- VLink Hourly Usage Volume per Service—Shows the distribution of volume among the different service usage counters defined in the system, grouped by hour.

- VLink Daily Usage Volume per Service—Shows the distribution of volume among the different service usage counters defined in the system, grouped by day.

- Daily Peak BW for all VLinks—Shows the daily value of the maximum bandwidth (1-hour or 2-hour average) for all virtual links.

- Total Active Subscribers per VLink—Shows the number of active subscribers for a selected vlink.

- VLink Bandwidth per Channel—Shows the distribution of bandwidth among the different channels for selected vlinks.

- Top Subscribers per VLink—Shows a list of the top subscriber volume consumption in a specific hour or day for a selected vlink.

- Average Bandwidth per Subscribers per VLink—Shows the average bandwidth for a specific subscriber for a selected vlink.

- Accumulated Bandwidth Distribution per VLink—Shows the accumulated bandwidth distribution for a selected vlink.

Creating a New Report Instance Using Cisco Insight

For details on creating a new report instance using Cisco Insight, see the *Cisco Insight Reporter User Guide*.

6

Troubleshooting the Remote Cable MSO Links Solution

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Introduction

This chapter describes several problem scenarios that you may encounter when using the solution. The problem scenarios and solutions are described under these sections:

Subscriber Complaints

To troubleshoot the cause of bad service to subscribers, consider these points:

- Congestion in the backbone network may cause congestion in subscriber traffic.
- Problem with the solution, such as assigning the incorrect policy to the subscriber, or an incorrect interface association, may exist.

To make sure that the problem is not with the Cisco SCE, perform these procedures:

Verifying if the Correct Policy is Enforced on a Specific Subscriber

Step 1   Verify that the Subscriber Manager-Cisco SCE subscriber data is synchronized.

In the Cisco SCE, use the **show interface linecard 0 subscriber name** *<sub MAC>* command to verify that the upvlinkId and downVlinkId values are the same as in the **p3subs --show -s** *<sub MAC>* Subscriber Manager CLU output and that the subscriber package ID is as expected.

This example shows the output of the Cisco SCE show interface command:

```
SCE10000#>show interface LineCard 0 subscriber name lynn_jones
```

```
Subscriber 'lynn_jones' manager: SM
Subscriber 'lynn_jones' properties:
downVlinkId=10
monitor=0
new_classification_policy=0
packageId=0
QpLimit[0..17]=0*17,8
QpSet[0..17]=0*17,1
upVlinkId=10
.
.
.
```

This example shows the output of the Subscriber Manager show command:

```
>p3subs --show -s lynn_jones

Name:           lynn_jones
Domain:         subscribers
Mappings:
        IP: 5.101.5.129/32
Properties:
        downVlinkId=10   Name=dev0_9_if19-down
        upVlinkId=10     Name=dev0_9_if19-upstream0
Custom Properties:
        giaddr=5.101.254.105
Command terminated successfully
```

Step 2   Verify that the Subscriber Manager-Cisco SCE virtual links data is synchronized.

Compare the output of the Cisco SCE **show interface linecard 0 virtual-links different-from-template** command with the Subscriber Manager **p3vlink --show-vlink-data --vlink-name** *<UpVlinkId/DownVlinkId Name>* command to make sure that the PIR configuration is correct.

✎

Note   The Cisco SCE PIR value is in kilobits. You can calculate the VLM value by performing a multiplication with the relevant CMTS device factor as defined in the vlink.cfg configuration file. The CMTS device factor value appears in the output of the Subscriber Manager CLU **p3vlink --show-device -d** *<device-name>*.

The following example shows the output of the Cisco SCE show interface linecard command:

```
SCE2000#> show interface LineCard 0 virtual-links different-from-template

Virtual Link enabled
upstream Virtual-Link:
    virtual index=1, name=virtual link 1
        channel index=1, name=virtual channel 1, pir=99999, cir=99, al=9, agc index=3
        application index=1, name=appGC-1, pir=8000000, cir=0, al=5, agc index=2
    virtual index=2, name=virtual link 2
        channel index=2, name=virtual channel 2, pir=99999, cir=99, al=9, agc index=7
        application index=1, name=appGC-2, pir=8000000, cir=0, al=5, agc index=6
downstream Virtual-Link:
    virtual index=3, name=virtual link 3
        channel index=3, name=virtual channel 3, pir=99999, cir=99, al=9, agc index=15
        application index=1, name=appGC-3, pir=8000000, cir=0, al=5, agc index=12
        application index=2, name=appGC1-3, pir=8000000, cir=0, al=5, agc index=13
        application index=3, name=appGC2-3, pir=8000000, cir=0, al=5, agc index=14
```

This example shows the output of the **p3vlink --show-vlink-data** Subscriber Manager command:

```
p3vlink --show-vlink-data --vlink-name=device_Cmts0/0-downstream1

VLink Name: device_Cmts0/0-downstream1
VLink Id:    1
Direction:    downstream
SCE Name:     sce0
Device Name:  device
PIR:     200000000


Channels related to VLink
<name>-L, index <index>, PIR <value>, CIR <value>
<name>-W, index <index>, PIR <value>, CIR <value>


Related upstream virtual links —Lists all upstream interface related to the same MAC layer
as the selected downstream interface.
device_Cmts0/0-upstream0
device_Cmts0/0-upstream1
device_Cmts0/0-upstream2
device_Cmts0/0-upstream3

Command terminated successfully
```

This example shows the output of the **p3vlink --show-device** Subscriber Manager command:

```
p3vlink --show-device -d CMTS1 --detail

Name:                      CMTS1
Host Name:                 Paris
IP:                        192.0.2.10
Type:                      Static
SCE Related:               sce0
Upstream factor:           95
Downstream factor:         95
Last success Query:        Thu Jun 19 17:54:48 IDT 2008
Last Query Attempt:        Thu Jun 19 17:54:48 IDT 2008
Last Query Status:         Completed
Sync state with SCE:       done
Sync state with CM:        done
Giaddr List:               127.0.0.1
Upstream Global Controllers:   None
Downstream Global Controllers: <GC Name>=<GC Value>,<GC Name>=<GC Value>…
isLogAll:                  true
Num of up interfaces:      6
Num of down interfaces:    2


VLink Information:
1) Name: CMTS1_Cmts0/0-upstream2, Vlink Id: 1, Direction UP, PIR 5000 kbps.
2) Name: CMTS1_Cmts0/0-downstream1, Vlink Id:1, Direction DOWN, PIR 10000 kbps
        Channel Name: <vlink Name>-W, index <value>, PIR <value> kpbs, CIR <value> kpbs
        Channel Name: <vlink Name>-L<channel index>, index <value>, PIR <value> kpbs, CIR
<value> kpbs
3) Name: CMTS1_Cmts0/0-upstream3, Vlink Id:2, Direction UP, PIR 10000 kbps.
4) Name: CMTS1_Cmts1/0-downstream1, Vlink Id:2, Direction DOWN, PIR 20000 kbps.
5) Name: CMTS1_Cmts0/0-upstream1, Vlink Id:3, Direction UP, PIR 10000 kbps.
6) Name: CMTS1_Cmts1/0-upstream2, Vlink Id:4, Direction UP, PIR 20000 kbps.
7) Name: CMTS1_Cmts1/0-upstream3, Vlink Id:5, Direction UP, PIR 20000 kbps.
8) Name: CMTS1_Cmts1/0-upstream1, Vlink Id:6, Direction UP, PIR 20000 kbps.

Command terminated successfully
```

To enforce the correct policy on a specific subscriber:

a. Monitor all CMTS device interfaces by using the Subscriber Manager **p3vlink --show-device -d** *NAME* [**--detail**] command.

b. Verify that in the output of the CLU Sync state with Cisco SCE is Done.

If Sync state with Cisco SCE is Not Done:

– View the connection state between the Subscriber Manager and the Cisco SCE by using the Subscriber Manager CLU **p3net --show -n** *SCE_NAME*.

– Synchronize the Cisco SCE with the CMTS device configuration by using the Subscriber Manager CLU **p3vlink --resync -n** *SCE_NAME*.

Step 3   Verify that the VLM-CMTS data is synchronized.

Compare the virtual link names from the Subscriber Manager CLU **p3subs --show -s** *<sub MAC>* output with the CMTS configuration to verify that the subscriber is assigned to the correct CMTS and CMTS interface.

> ✎
> **Note**   The virtual link name structure is <CTMS_NAME>_<INTERFACE_DESCRIPTION> and is obtained from the configuration file and the SNMP ifTable data.

Ensure that the PIR value is the same as the CMTS interface speed (as taken from the SNMP ifTable data) by comparing the virtual link PIR values from the Subscriber Manager CLU **p3vlink --show-vlink-data --vlink-name** *<UpVlinkId/DownVlinkId Name>* with the CMTS configuration.

To ensure that the PIR value is the same as the CMTS interface speed:

a. Use **p3vlink --show-device -d** *<DEVICE_NAME>* to verify that:

– The monitor period is not 0.

– The last query completed successfully. Check the user log for reasons for failure.

b. Use **p3vlink --start-query -d** *<DEVICE_NAME>* to force a start query on a specific CMTS device.

Verifying if the Distribution of Subscribers to the Virtual Link is Correct

Step 1   Obtain the VLM name for a specific interface by using the **p3subs --show -s** *<sub MAC>* command, or build the interface name as <CTMS_NAME>_<INTERFACE_DESCRIPTION>.

Step 2   Retrieve the list of subscribers related to a specific interface and compare it with the CMTS data using the **p3vlink --show-subs --vlink-name**= *<UpVlinkId/DownVlinkId Name>* command:

```
p3vlink --show-subs --vlink-name test1_Cmts0/0-upstream2
Subscribers related to device: test1 vlink-id: 5, giaddr: 10.78.233.149, direction UP
010101010101
1 subscriber was found
Command terminated successfully
```

Inaccurate, Unavailable, or Missing Reports Information for a Specific CMTS Interface

The Cisco Insight can generate per interface consumption reports that can be used to monitor the solution. The VLM updates the reporter with the interface ID to name data and the Cisco SCE sends the raw data with the interface ID (virtual link).

A problem can stem from the VLM update or from the Cisco SCE RDRs.

Two possible solutions include:

- Verifying if the Cisco SCE sends virtual link update RDRs (VLUR) to the Collection Manager. For information, see the *Cisco SCE8000 10GBE Software Configuration Guide* or the *Cisco SCE8000 GBE Software Configuration Guide*.

- Verifying if the VLM updates the Collection Manager.

Verifying if the VLM Updates the Collection Manager

Step 1   Verify the connectivity between the Subscriber Manager and the Collection Manager.

View the configured network elements and verify that the Collection Manager exists by using the Subscriber Manager CLU **p3net --show-all --detail** command.

View the Subscriber Manager-Collection Manager connection properties and state by using the **p3net --show -n** *CM_NAME* command, and then verify that the Cisco SCE list property value contains the Cisco SCE to which the CMTS is connected.

To fix the communication problems confirm that the Subscriber Manager configuration file contains the relevant Collection Manager information:

- – Check that a Collection Manager Section exists and points to the Cisco SCE section.
- – Validate the Collection Manager IP and port.
- – Check that the Cisco SCE is related to the Collection Manager.

See the "Information About Communication Failures" section in the "Subscriber Manager Overview" chapter of *Cisco Service Control Management Suite Subscriber Manager User Guide*.

Step 2   Verify that the VLM and Collection Manager data is synchronized.

Verify that the synchronization state with Collection Manager is set to done using the CLU **p3vlink --show-device -d** *<CMTS_NAME>* command. To view a list of configured virtual links, use the Collection Manager CLU **update_vlinks.sh --sce=***<SCE_IP>* **--show** command.

To fix this problem:

a.   Force the VLM and the Collection Manager to synchronize by using the **p3vlink --resync -n** *<CM_NAME>* command.

b.   For manual configuration, see *Cisco Service Control Management Suite Collection Manager User Guide* to add virtual links by using the **update_vlinks.sh --sce=***<SCE_IP>* **--file=vlinks.csv** command.

This example shows the output of the **p3net --show -n** command:

```
>p3net --show -n cm0

Network Element Information:
============================
Name:                 cm0
Host:                 10.56.197.231
Ip:                   10.56.197.231
Port:                 14375
Status:               Connection ready
Type:                 Collection Manager
SCE List:             sce0
Synchronization Status: Not-done(100% failures)
Redundancy Status:    Standalone
Quarantine Status:    ok
Command terminated successfully
```

This example shows the output of the **p3vlink --show-device -d** command:

```
>p3vlink --show-device -d test1

Device Name:                test1
Host Name:                  singleSimpleDevices
IP:                         10.78.233.149
Type:                       Static
SCE Related:                sce1
Upstream factor:            95
Downstream factor:          95
Last success Query:         Fri Feb 19 14:29:11 IST 2010
Last Query Attempt:         Fri Feb 19 14:29:11 IST 2010
Last Query Status:          Completed
Sync state with SCE:        Not-done
Sync state with CM:         N/A
Giaddr List:                10.78.233.149;
Upstream Global Controllers:   None
Downstream Global Controllers: None
isLogAll:                   true
Num of up interfaces:       8
Num of down interfaces:     2

Command terminated successfully
```

This example shows the output of the **update_vlinks.sh** script:

```
./update_vlinks.sh --sce=10.56.197.232 --show
.
.
.
TIME_STAMP|              SE_IP|         VLINK_ID|    VLINK_DIRECTION|
VLINK_NAME|
---------+-----------------+-----------------+----------------+--------------------
--+
.
.
.
2008-12-17|    10.56.197.232|              10|               0|
dev0_9_if19-upstream0|
2008-12-17|    10.56.197.232|              10|               1|
dev0_9_if19-down|
.
.
.
```

Cisco SCE is Congested, but Connected CMTSs are not Congested

If the virtual link assignment is incorrect or false subscriber login operations are not handled by the correct virtual link controller, virtual links can become congested. To resolve this issue, you must confirm that there are no subscribers associated with the virtual link and also verify that the distribution of subscribers to the virtual link is as expected.

To verify that the distribution of subscribers to the virtual link is as expected, see the "Verifying if the Distribution of Subscribers to the Virtual Link is Correct" section on page 6-4.

Verifying if no Subscriber is Associated with the Default Virtual Link

Step 1   Use the Cisco SCE **show interface LineCard 0 subscriber property** <*upVlinkId\downVlinkId*> **equals 0** command to ensure that there are no subscribers associated with the default virtual link.

Subscribers in the Cisco SCE can have a virtual link ID set to 0 in several cases:

- If the giaddr list is learned automatically, a few subscribers may have this policy if they performed the first login from this giaddr. In this case, compare the results with the Subscriber Manager database.

- If a specific interface or CMTS is removed from the VLM, at some point all the subscribers associated with this interface or CMTS are set to use the default virtual link.

- No match exists in the DHCP Sniffer LEG mapping table and the LEG is configured to log in a subscriber with the default virtual link.

- If the interfaces are shut down and followed by a device query. In this case, all subscribers or cable modems associated to the interfaces that are shut down are set to use the default vlink ID. These subscribers or cable modems are added to the primary queue of the SNMP BG process to identify the new vlink associations. After the primary or retry queue completes its query, the subscribers get new vlink associations.

- If a CMTS is removed from the Subscriber Manager and followed by a device query. In this case, all subscribers or cable modems associated to the removed CMTS are set to use the default vlink ID. As the CMTS is already removed, no SNMP BG query will be performed for these subscribers.

- If a CMTS is moved from one Cisco SCE to another Cisco SCE. In this case, all subscribers or cable modems that are associated to the interfaces of the CMTS are set to use the default vlink ID. As the CMTS is already moved to another Cisco SCE, no SNMP BG query will be performed for these subscribers. After the IPDR message is received, these subscribers will be added to the primary queue of the SNMP BG process.

The following example shows the output of the
show interface LineCard 0 subscriber property upVlinkId equals 0 command:

```
SCE2000#>show interface LineCard 0 subscriber property upVlinkId equals 0
N/A
000004650001
000004650002
000004650003
000004650004
000004650005
000004650006
000004650007
000004650008
000004650009
00000465000A
00000465006F
000004650070
000004650071
000004650072
000004650073
000004650074
000004650075
000004650076
000004650077
000004650078
0000046500DD
0000046500DE
0000046500DF
```

This example shows the output of the **p3dhcpsniff --show-policy --policy=upVlinkId --detail** command:

```
>p3dhcpsniff --show-policy --policy=upVlinkId --detail

Policy Name: upVlinkId
======================
separator:_
use default: false
default value: 0
allow no package: true
concat option:giaddr,
concat option:82:1,
concat option type: integer,binary
log success: true
log default success: false
Number of mappings: 400

5.101.254.100_00010000=9
5.101.254.100_00010003=10
5.101.254.100_80010000=9
5.101.254.100_80010003=10
5.101.254.101_00010000=9
5.101.254.101_00010003=10
```

```
5.101.254.101_80010000=9
5.101.254.101_80010003=10
5.101.254.102_00010000=9
5.101.254.102_00010003=10
5.101.254.102_80010000=9
5.101.254.102_80010003=10
5.101.254.103_00010000=9
5.101.254.103_00010003=10
5.101.254.103_80010000=9
5.101.254.103_80010003=10
5.101.254.104_00010000=9
5.101.254.104_00010003=10
5.101.254.104_80010000=9
5.101.254.104_80010003=10
5.101.254.105_00010000=9
5.101.254.105_00010003=10
5.101.254.105_80010000=9
5.101.254.105_80010003=10
5.101.254.106_00010000=9
5.101.254.106_00010003=10
5.101.254.106_80010000=9
```

User log Messages

The messages that are written to the userlog are categorized based on their severity as:

These are the preconditions of the messages:

- None—Messages are sent irrespective of the value set in the config file.
- General.log_all—Messages are sent only if the log_all flag in the general section of the vlink.cfg file is set to true.
- Device.log_all—Messages are sent only if the log_all flag in the device section is set to true.

User log Error Messages

Table 6-1 lists the error messages that can be written to the userlog.

Table 6-1   User log Error Messages

Message	Description	Precondition
Device {0} Error: Speed value {1} cannot be translated to int number.	The SNMP interface provides a non-integer value for the if speed.	None
Device {2}: Cannot create query factory class {0} from jar {1}: Error {3}	Cannot instantiate the class related to the device and responsible for the query operation.	None
Failed to send vlink message to Cisco SCE {0}	An error occurred when trying to update the Cisco SCE with Vlinks. The error is specified in the umlog.	None

Table 6-1   User log Error Messages (continued)

Message	Description	Precondition
Failed to update CM {0} with configuration related to SCE {1}	An error occurred when trying to update the Collection Manager. The error message is specified in the umlog.	None
Clearing {0} vlink information because of the following error:\n System detected reduction in max valid vlink index in SCE <sceName>, valid vlink index was '<maxVlinkIdInDb>' and it was decreased to <maxValidVlinkIndexInSce>	The VLM deleted all vlinks related to a specific Cisco SCE, because the vlink max valid index was reduced.	None
System detected reduction in max valid vlink index in SCE {0} valid vlink index was '{1} ' and it was decreased to {2}	The VLM detected that the Cisco SCE max valid vlink index was reduced.	None
Failed to allocate virtual link index for interface {0} because of lack of vlink {upstream/downstream} resources in SE {name}	Cisco SCE free vlink indexes are no longer available; abort the vlink creation.	None
SCE {0}, Failed to set pir {1}, to vlink {2}, with vlink id {3}	The Cisco SCE was unable to set the PIR value on the GC. This can occur if the PIR value exceeds the MAX PIR value in the Cisco SCE.	None
Failed to set Host Name <name> to device <DeviceName_A> since it is already occupied by device < DeviceName_B>.	Host name (MIB .1.3.6.1.2.1.1.5.0) duplication, verify that DeviceName_A has different Host Name, remove DeviceName_A, and add it again.	None
SNMP SysName {0} is illegal value for static device {1}, expecting to get {2} value.	Found unexpected sysName for static device query failure. IP related to static device cannot be moved to other device, IP returns an unexpected sysName value (null/different than current), query operation fails. Work Around: Set the sysName related to the IP to the expected one and start query on the device by using **p3vlink –start-query** CLU command. If the device IP changes, update the configuration file, load config and restart the query on the device by using the **p3vlink –start-query** CLU command.	None
Failed to communicate with device {0}, using its giaddr list {1}, number of retries={2}, timeout between retries={3} ms	Device is not responsive to the VLM using its giaddr list. Check physical connection to the device.	None
Failure in Init process; error in LEG synchronization: {0}	The VLM has a failure in the boot, vlink mapping table is not created properly, and needs to provide a support file.	None
Failure in Init process; failed to synchronize LEG with all mappings on {0} minutes	The VLM has a failure in the boot, vlink mapping table is not created properly, and needs to provide a support file.	None

User log Warning Messages

Table 6-2 lists the warning messages that can be written to the userlog.

Table 6-2   User log Warning Messages

Message	Description	Precondition
VLM does not have valid RPC connection to Cisco SCE {0}, aborting VLink updates in SCE.	This message is sent when the VLM tries to update the Cisco SCE with vlink information but the RPC connection is missing.	None
Starting up VLM Solution	—	None
VLM Solution is stopped, going to clear all vlink information.	—	None
System detected change in max valid vlink index in SCE '{0} ', valid vlink index is increased from {1} to {2}	The VLM detected that the Cisco SCE max valid vlink index was increased.	None
giaddr value duplication; both devices {0} and {1} are having the same ip definition {2}.	The same IP Address is assigned to two different devices. The VLM assigns the IP to the latest device.	None
PIR size of {0} kbps is more than SCE {1} max bw size, setting vlink {2} with max sce PIR value: {3}	The device interface bandwidth is higher than the maximum bandwidth of the Cisco SCE, the VLM sets the MAX Cisco SCE bandwidth value instead.	none
SCE {0} does not support vlink functionality, aborting VLink updates in SCE	VLM tries to send message to Cisco SCE, RPC connection is available PQI is installed but VLM is disabled. To recover from the failure, download the policy that enables vlink support and perform VLM synchronization on the Cisco SCE.	None
VLM did not find any installed application in Cisco SCE {0}	VLM tries to send message to Cisco SCE, RPC connection is available but PQI is missing in the Cisco SCE. To recover from the failure, install PQI and download the policy that supports vlink. Perform the VLM synchronization by using the **p3vlink –resynch operation/**.	None
Connection interrupts to SCE {0} while trying to download VLM data.	VLM tries to send message to Cisco SCE, RPC connection is not available. Perform Cisco Subscriber Manager-Cisco SCE disconnection methodology.	None
Failed to set Host Name {0} to device {1} since it is occupied by device {2}	Failed to set hostname to a nonexisting device. If the device is a static device, send the support file to the tech support. If the device is dynamic, check if the device was previously deleted by the CLU command or by dynamic giaddr removal procedure.	None

Table 6-2   *User log Warning Messages (continued)*

Message	Description	Precondition
Failed to create CommunityTarget to IP <IP Address>	If VLM is unable to create an SNMP session to the IP address, send the support file to Cisco support.	None
Failed to read sysName related to ip:port {0}, , number of retries={1}, timeout between retries={2} ms	VLM failed to get the sys name MIB value related to IP Address. Validate that sysName value is set.	None
There are no giaddr related to device {0}, VLM is going to remove it from the system	VLM removes the dynamic device that does not have any giaddr related to it.	None
VLM is disabled or not supported in SCE {0}	Ensure that relevant PQI is installed in the Cisco SCE. Ensure that the policy with vlink enabled is set in the Cisco SCE.	None
IP {0} Collision detected between Device {1} to the Device {2}, Deleting device {3} and moving its IP data to {4}.	—	None
Collision detected between Device {0} to the Device {1}, assigning IP {2} to device {3}.	—	None
IP {0} found in device {1} collide with main ip address related to Static Device {2}, operation aborted.	—	None

User log Information Messages

Table 6-3 lists the information messages that can be written to the userlog.

Table 6-3   *User log Information Messages*

Message	Description	Precondition
Device {0} was added to VLM	—	None
SCE {0} was added to VLM	—	None
SCE {0} was removed from VLM	—	None
<SCE Name> : Max valid vlink index is set to <value>	This value is read from the Cisco SCE. If the Cisco SCE is not available, the system uses the default value (1023).	General.log_all = true or Device.log_all = true
Add device to VLM {name} up factor={1} down factor={2} aliases={3}	Indicates that a new device was added to the VLM database. The umlog contains the giaddr information.	Device.log_all = true
Create vlink {name} with id {1}, on device {name}	Adds vlink to the VLM. The umlog contains the database internal data.	Device.log_all = true
delete vlink {name} with id {1}, direction-{2}, on device {name}	Removes vlink from the VLM. The umlog contains the database internal data.	Device.log_all = true

Table 6-3   User log Information Messages (continued)

Message	Description	Precondition
Delete device {name}	Deletes device from the repository database.	Device.log_all = true
VLM device to remove device {0} since it does not have any giaddr.	The VLM automatically removes the Device {0} because all its giaddr were being removed by the aging mechanism.	None
Virtual Link mappings are missing for subscriber <subscriber_name>, login operation is being delayed, LEG is querying for mappings related to giaddr <ip value>.	While processing DHCP RDR, SCE DHCP SNIFFER detects that Mappings to up/down vlink id are missing. The RDR message is stored in a queue, and the query operation is initiated.	logAll = true Or Print message every 100 occurrences
Virtual Link mappings are missing for subscriber <subscriber_name>, continue login operation with no mappings.	Perform login operation even if mappings are not found. The VLM query on the device is complete before the message is generated.	logAll = true Or Print message every 100 occurrences
Blocking operation for mac <mac id> since vlink policy is still not set for giaddr <IP value>	If the LEG detects that policy mappings are not synchronized with the device, the login operation is blocked. After the completion of device query, the login operations continue.	logAll = true Or Print message every 100 occurrences
Device {0} changed its IP to {1}	The dynamic device changes its IP when: • Current IP is not responsive. • **sysName** related to the IP is different from the one defined in the device.	None
Giaddr {0} which was related to device {1} found out to be related to device {2}, VLM starts query on this device	A giaddr which was related to device {1}, is currently related to another device, system tries to query this device.	None
Device {0} was removed	Indicates that a device was removed from the VLM.	None
VLM detected new dynamic device: Device {0} is related to SCE {1}	Creates a dynamic device.	None
Dynamic Device Creation feature is being enabled	The VLM detects configuration file with Dynamic Device Configuration feature enabled.	None
Dynamic Device Creation feature is being disabled.	The VLM detects configuration file with Dynamic Device Configuration feature disabled.	None
IP Collision between Static Device {0} to the Dynamic Device {1}, The Dynamic device is replaced by the Static device.	—	None