Configuring VDSL2 and ADSL2/2+ NIM for Cisco 4000 Series Integrated Service Routers

VDSL2 and ADSL2/2+ Cisco® 4000 Series Integrated Services Router Network Interface Modules (ISR NIMs) provide highly reliable WAN connections for remote sites. These interfaces offer cost-effective virtualized WAN connections in both point-to-point and point-to-multipoint designs. You can mix and match NIMs to tailor cost-effective solutions for common networking solutions for low- and high-density WAN aggregation.

Organization needs high speed digital data transmission to operate between their data equipment and central office, usually located at the telecom service provider premises. The Cisco multimode VDSL2 and ADSL1/2/2+ NIMs provide 1-port (2-pair) multimode VDSL2 and ADSL2+ WAN connectivity. This connectivity in combination with Cisco 4000 Series Integrated Service Routers, provides high-speed digital data transmission between customer premises equipment (CPE) and the central office.

This capability enables service providers and resellers to offer additional services, such as business-class security, voice, video, and data; differentiated classes of service (QoS), and managed network access over existing telephony infrastructure. These value-added features, along with the flexible manageability and reliability of Cisco IOS Software, provide the mission-critical networking features that businesses expect.

XDSL NIM Modules are supported from Cisco IOS XE Release 3.14.0S onwards on the Cisco® 4000 ISR series platforms.

For more information on DSLAM interoperability, refer to the Cisco Multimode VDSL2 and ADSL2/2 Network Interface Module Data Sheet.

Figure 1: NIM Annex A

Figure 2: NIM Annex M

Figure 3: NIM Annex B
## VDSL2 and ADSL2/2+ NIM Variants

Table 1: VDSL2 and ADSL2/2+ NIM Variants

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIM-VAB-A</td>
<td>1-port (2-pair) VDSL2/ADSL2+ NIM over POTS</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 over POTS Band Plans</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 profiles: 8a, 8b, 8c, 8d, 12a, 12b, 17a</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 bonding (of pair 0 and pair 1)</td>
</tr>
<tr>
<td></td>
<td>• Profile 30a (over pair 1)</td>
</tr>
<tr>
<td></td>
<td>• Vectoring</td>
</tr>
<tr>
<td></td>
<td>• ADSL1/2/2+ Annex A, ADSL2 Annex L, non-optimized ADSL2/2+ Annex M</td>
</tr>
<tr>
<td>NIM-VAB-M</td>
<td>1-port (2-pair) VDSL2/ADSL2+ NIM over POTS with Annex M</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 over POTS Band Plans</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 profiles: 8a, 8b, 8c, 8d, 12a, 12b, 17a</td>
</tr>
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<td></td>
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<td></td>
<td>• Profile 30a (over pair 1)</td>
</tr>
<tr>
<td></td>
<td>• Vectoring</td>
</tr>
<tr>
<td></td>
<td>• Optimized ADSL2/2+ Annex M</td>
</tr>
<tr>
<td></td>
<td>• ADSL/ADSL2/2+ Annex A</td>
</tr>
<tr>
<td>NIM-VA-B</td>
<td>1-port (1-pair) VDSL2/ADSL2+ NIM over ISDN</td>
</tr>
<tr>
<td></td>
<td>• ADSL1/2/2+ Annex B, non-optimized ADSL2/2+ Annex J</td>
</tr>
<tr>
<td></td>
<td>• VDSL2 over ISDN Band Plans (8a to 17a) with Vectoring</td>
</tr>
</tbody>
</table>
# DSL Feature Specifications

## Table 2: DSL Feature Specifications

| Multimode DSL (VDSL2 and ADSL2/2+) | • Broadcom chipset  
|                                     | • One RJ-14 VDSL2 interface  
|                                     | • Independent module firmware subpackage loading  
|                                     | • Dying gasp  
|                                     | • Support for double-ended line testing (DELT) diagnostics mode |

## Table 3: VDSL2 Feature Specifications

| VDSL2 | • ITU G.993.2 (VDSL2) and ITU G.993.5 (VDSL2)  
|       | • 997 and 998 band plans  
|       | • VDSL2 profiles: 8a, 8b, 8c, 8d, 12a, 12b, and 17a  
|       | • VDSL bonding, Profile 30a (NIM-VAB-A and NIM-VAB-M)  
|       | • Vectoring  
|       | • U0 band support (25 to 276 kHz)  
|       | • Ethernet packet transfer mode (PTM) based only on IEEE 802.3ah 64/65 octet encapsulation |

## Table 4: ADSL2/2+ Feature Specifications

| ADSL2/2+ | • ADSL over POTS with Annex A and Annex B ITU G. 992.1 (ADSL), G.992.3 (ADSL2), and G.992.5 (ADSL2+)  
|          | • ADSL over POTS with Annex M (extended upstream bandwidth) G.992.3 (ADSL2) and G.992.5 (ADSL2+)  
|          | • G.994.1 ITU G.hs  
|          | • Reach-extended ADSL2 (G.922.3) Annex L for increased performance on loop lengths greater than 16,000 feet from central office  
|          | • T1.413 ANSI ADSL DMT issue 2 compliance  
|          | • DSL Forum TR-067, and TR-100 conformity  
|          | • Impulse noise protection (INP) and extended INP  
|          | • Downstream power backoff (DPBO)  
|          | • Asynchronous transfer mode (ATM) only  
|          | • Maximum 8 PVCs per interface |
Configuring DSL

Cisco 4000 Series Integrated Services Routers (ISRs) support asymmetric digital subscriber line (ADSL) 1/2/2+ and very high speed digital subscriber line 2 (VDSL2) transmission modes, also called multimode.

DSL Configuration Restrictions

- ADSL mode is supported only on Pair 0.
- VDSL2 bonding and 30a profile is supported only on NIM-VAB-A and NIM-VAB-M.
- Whenever operating mode is changed, the line-mode configuration is removed from the router. It should be configured again when the operating mode is re-configured.

Configuring ADSL

Perform the below mentioned steps to configure DSL controller.

Configuring Auto Mode

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router&gt; enable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router# configure terminal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>controller VDSL slot/subslot/port</td>
<td>Enters configuration mode for the VDSL controller.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config-controller)# controller vds1 0/1/0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>operating mode auto</td>
<td>Configures the auto operating mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config-controller)# operating mode auto</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>end</td>
<td>Exits controller configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config-controller)# end</td>
<td></td>
</tr>
</tbody>
</table>
## Configuring ADSL1 and ADSL2/2+ Annex A and Annex M Mode

### Procedure

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: <code>enable</code></td>
<td></td>
</tr>
<tr>
<td><code>router&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: <code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><code>router# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td><code>controller VDSL slot/subslot/port</code></td>
<td>Enters configuration mode for the VDSL controller.</td>
</tr>
<tr>
<td>Example: <code>controller vdsl 0/1/0</code></td>
<td></td>
</tr>
<tr>
<td><code>router(config-controller)# controller vdsl 0/1/0</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>`operating mode {adsl1</td>
<td>adsl2 annex a</td>
</tr>
<tr>
<td>Example: <code>operating mode adsl2+ annex m</code></td>
<td></td>
</tr>
<tr>
<td><code>router(config-controller)# operating mode adsl2+ annex m</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td><code>end</code></td>
<td>Exits controller configuration mode.</td>
</tr>
<tr>
<td>Example: <code>end</code></td>
<td></td>
</tr>
<tr>
<td><code>router(config-controller)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

- **Step 4** operating mode: `{adsl1 | adsl2 annex a | annex m | adsl2+ annex a | annex m}`
  - **ADSL1**—Configures operation in ITU G.992.1 Annex A full-rate mode.
  - **ADSL2**—Configures operation in ADSL2 operating mode-ITU G.992.3 Annex A, Annex L, and Annex M. If an Annex operating mode is not chosen, Annex A, Annex L, and Annex M are enabled. The final mode is decided by negotiation with the DSL access multiplexer (DSLAM).
  - **ADSL2+**—Configures operation in ADSL2+ mode-ITU G.992.5 Annex A and Annex M. If an Annex A operating mode is not chosen, both Annex A and Annex M is enabled. The final mode is decided by negotiation with DSLAM.
  - **Annex A and M**—(Optional) If the annex option is not specified, both Annex A and Annex M are enabled. The final mode is decided by negotiation with the Digital Synchronous Line Access Multiplexer (DSLAM).
Configuring VDSL2

A single-wire pair enables you to configure profile 8a through 17a on line 0, and profile 8a through 30a on line 1. Very-high-bit-rate digital subscriber line 2 (VDSL2) bonding combines two copper wire pairs to increase the capacity or extend the copper network’s reach. For a customer, this means enhanced data rate and operation on longer loops.

Configuring a Single-Wire Pair on Line 0

Perform the following steps to configure single-wire pair on line 0:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>configure terminal</td>
<td>Enters global configuration mode when using the console port.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router#configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>controller VDSL slot/subslot/port</td>
<td>Enters controller configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router(config)# controller vdsl 0/1/0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>line-mode single-wire line line-number</td>
<td>Enables 8a through 17a profile and ADSL on line 0 in single-wire (nonbonding) mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router(config-controller)# line-mode single-wire line 0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>exit</td>
<td>Exits controller configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router(config-controller)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Configuring a Single-Wire Pair on Line 1

Perform the following steps to configure single-wire pair on line 1.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>configure terminal</td>
<td>Enters global configuration mode when using the console port.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router#configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>controller VDSL slot/subslot/port</td>
<td>Enters controller configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>router(config)# controller vdsl 0/1/0</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring Bonding in Auto Mode

You can configure bonding either in auto mode or VDSL2. The default configuration is auto.

Perform the following steps to configure bonding in **auto** mode:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>configure terminal</td>
<td>Enters global configuration mode when using the console port.</td>
</tr>
<tr>
<td>Example:</td>
<td>router#configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>controller VDSL slot/subslot/port</td>
<td>Enters controller configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config)# controller vdsl 0/1/0</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>operating mode mode</td>
<td>Specifies the operating mode. The operating mode is auto.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config)# operating mode auto</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>line-mode bonding</td>
<td>Enables bonding mode in CPE.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config-controller)# line-mode bonding</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>exit</td>
<td>Exits controller configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>router(config-controller)# exit</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring Bonding in VDSL2 Mode

Perform the following steps to configure bonding in VDSL2 mode.

| Step 3 | line-mode single-wire line line-number [profile 30a] |
| Example: | router(config-controller)# line-mode single-wire line 1 profile 30a |
| Purpose | Enables profile 8a through 30a profile on line 1 in single-wire (non-bonding) mode. If profile 30a is not specified, profiles 8a to 17a are enabled on that line. |

| Step 4 | exit |
| Example: | router(config-controller)# exit |
| Purpose | Exits the controller mode. |
### Procedure

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>router#configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode when using the console port.</td>
</tr>
</tbody>
</table>

| **Step 2** | **controller VDSL slot/subslot/port** |
| Example: | router(config)# controller vdsl 0/1/0 |
| | Enters controller configuration mode. |

| **Step 3** | **operating mode mode** |
| Example: | router(config)# operating mode vdsl2 |
| | Specifies the operating mode. The operating mode is VDSL2. |

| **Step 4** | **line-mode bonding** |
| Example: | router(config-controller)# line-mode bonding |
| | Enables bonding mode in CPE. |

| **Step 5** | **exit** |
| Example: | router(config-controller)# exit |
| | Exits the controller mode. |

### DSL Interface Configuration Examples

In Cisco IOS XE, ATM PVCs can be configured under ATM sub-interfaces only. PVC configuration is not allowed under the main ATM interface. You can configure 8 point to point sub-interfaces either with one PVC configured under each point to point sub-interface or single multi-point sub-interface.

You do not need to configure the `tx-ring-limit` command in the Cisco® 4000 Series Integrated Services Routers, if you are migrating from classic Cisco IOS® and using `tx-ring-limit` command to reduce the latency. Because the DSL NIM modules buffers have been fine tuned for the optimal performance and latency.

The following example shows how to configure ATM interface:

```plaintext
interface ATM0/1/0
no ip address
no atm oversubscribe
no atm enable-ilmi-trap
no shut

interface ATM0/1/0.1 point-to-point
ip address 71.71.71.1 255.255.255.0
no atm enable-ilmi-trap
pvc 1/77
vbr-rt 400 400
```

The following example shows how to configure Ethernet interface:

```plaintext
interface Ethernet0/1/0
```
If the trained mode is VDSL2 or VDSL2+, the TC mode should be in Packet Transfer Mode (PTM). In this case, the PTM Ethernet interface is in the up state. All other upper layer parameters such as PPP, IP, and so on should be configured under the Ethernet interface. If the trained mode is ADSL, ADSL2, or ADSL2+, the TC mode should be ATM and all the upper layer parameters should be configured under the ATM Permanent Virtual Circuit (PVC). If you change the operating mode between ADSL and VDSL, you need not to reboot the router in order to activate the corresponding Ethernet or ATM interfaces. In case of PTM mode, check with your ISP if they are expecting Dot1q tag configuration on the CPE. ISP should provide Dot1q tag value.

Router(config)#interface Ethernet0.835
Router(config-subif)#encapsulation dot1Q 835
Router(config-subif)#pppoe-client dial-pool-member 1

Features Supported in xDSL NIMs

ATM Conditional Debug Support

Most ATM debugging commands are implemented either at the system level or at the interface level. The ATM Conditional Debug Support feature allows debugging to be limited specifically to an ATM interface, to a virtual channel identifier (VCI), or to a virtual path identifier/virtual channel identifier (VPI/VCI) pair, through use of the debug condition interface command.

For more information on configuring ATM conditional debug support feature, see the ATM Conditional Debug Support document.

ATM OAM Loopback Mode Detection

The Loopback Mode Detection Through OAM feature allows you to enable automatic detection of when a peer ATM interface is in loopback mode. When loopback is detected on an interface where end-to-end F5 Operation, Administration, and Maintenance (OAM) is enabled, the impacted permanent virtual circuit (PVC) is moved to a DOWN state, and traffic is suspended. When the loopback condition in the peer ATM interface is removed, the PVC is moved back to an UP state.

For more information on configuring ATM OAM Loopback Mode Detection, see the Loopback Mode Detection through OAM document.

ATM Oversubscription for DSL

The ATM Oversubscription for DSL feature enables users to improve network utilization of otherwise underutilized shared networks by leveraging statistical multiplexing on ATM networks. Instead of supporting only unconditional reservation of network bandwidth to VBR PVCs, the Router offers PVC oversubscription to statistically guarantee bandwidth to VBR PVCs.

In Cisco IOS XE Release 3.14.0S or later, the ATM Oversubscription feature enables you to specify the amount of oversubscription (oversubscription factor) equal to twice the line rate. Following are the features of oversubscription:

- Oversubscription is allowed on VBR-rt and VBR-nrt.
- Under no oversubscription condition, PVCs can be configured up to line rate. For example, if the line rate is 1000 Kbps. The SCR or PCR of a VBR PVC cannot be more than 1000 Kbps if there are no other PVCs. If there is a CBR PVC with PCR of 500Kbps, then the maximum SCR or PCR allowed on the VBR PVC is 500 Kbps.
- When over-subscription is enabled, multiple VBR-rt or VBR-nrt PVCs are allowed to be configured even if the sum of their SCRs exceeds the actual bandwidth available over the physical line. Suppose oversubscription is enabled and over subscription
factor of 2 is set for a line rate of 1000k sum of SCR of VBR-rt and VBR-nrt can be less than or equal to 2000k, this is excluding CBR PVCs bandwidth.

• If the user configures VBR-rt or VBR-nrt more than the configured oversubscription factor then PVC will be configured for the bandwidth available. If there is no oversubscription bandwidth left then VC will be downgraded to UBR. For example for line rate of 1000k, with oversubscription factor 2: PVC1 is vbr-rt 400k 400k, PVC2 is vbr-nrt 1600k 1600k and PVC3 is vbr-rt 500k 500k. In this case the PVC1 and PVC2 will be configured to given pcr and scr, PVC3 will be downgraded to UBR class.

• If there is no bandwidth left, then some PVCs may be downgraded to UBR class.

• PCR & SCR of VBR PVC can never exceed the line rate even if there is enough available bandwidth for the configured PCR and SCR.

Oversubscription of the ATM interfaces is enabled by default and is subject to infinite oversubscription factor which is not supported on DSL NIM. User must enable oversubscription factor.

The following configuration enables the oversubscription 2. The only oversubscription factor supported is 2.

```
Router(config)#interface atm 0/1/0
Router(config-if)#atm oversubscription factor 2
Router(config-if)#exit
```

To disable oversubscription of the interface, use the no atm oversubscribe command.

For example, the following configuration disables oversubscription of the ATM 0/1/0 interface:

```
Router(config)#interface atm 0/1/0
Router(config-if)#no atm oversubscribe
Router(config-if)#exit
```

**Example:**

Below is the example for the sum of pvc rates less than the line rate of 1561kbps.

```
Router#show atm pvc
  VCD / Peak Av/Min Burst
  Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
0/3/0.1 2     0  32 PVC SNAP CBR 300 UP
  (C) CBR 300
0/3/0.2 3     0  33 PVC SNAP CBR 100 UP
  (C) CBR 100
0/3/0.3 4     0  34 PVC SNAP VBR 400 200 10 UP
  (C) VBR 400 200 10
0/3/0.4 5     0  35 PVC SNAP VBR 600 300 10 UP
  (C) VBR 600 300 10
0/3/0.5 6     0  36 PVC SNAP VBR 300 150 10 UP
  (C) VBR 300 150 10
0/3/0.6 7     0  37 PVC SNAP VBR 700 450 10 UP
  (C) VBR 700 450 10
0/3/0.7 8     0  38 PVC SNAP UBR 1561 UP
  (C) UBR 0
0/3/0.8 1     0  39 PVC SNAP UBR 1000 UP
  (C) UBR 1000
```

When line rate gets downgraded to 294 kbps, CBR and VBR PVC rates gets adjusted dynamically as below.

```
Router#show atm pvc
  VCD / Peak Av/Min Burst
```
### ATM Routed Bridge Encapsulation (RBE) Concept

ATM routed bridge encapsulation (RBE) is used to route IP over bridged RFC 1483 Ethernet traffic from a stub-bridged LAN.

For more information on configuring ATM RBE, see the Providing Connectivity Using ATM Routed Bridge Encapsulation over PVCs document.

### Default Route on a PPP Virtual Access Interface

If a Virtual-Template (VT) interface is configured to obtain its IP address by IPCP, the dynamically created Virtual-Access (VA) interface gets the IP address after PPP negotiation. Since the Virtual-access is created dynamically, we cannot configure mappings on the dynamic interface. Also, there is no way to configure a static route through the virtual-access interface; we need to insert a default route via the next-hop address for the virtual-access and this is achieved using "ppp ipcp route default".

For more information on the usage of the command, see the ppp ipcp default route command document.

### Dynamic Bandwidth Change for ATM PVCs

The ATM Dynamic Bandwidth for ATM PVCs over DSL feature provides the ability to configure Cisco IOS-XE software to automatically adjust PVC bandwidth in response to changes in the total available interface bandwidth. This feature eliminates the manual intervention every time DSL line rates change, and allows the available bandwidth to be used effectively at all times.

It is recommended to enable ATM Dynamic Bandwidth feature on ATM interfaces. For more information on enabling the ATM Dynamic Bandwidth feature, refer the section "Enabling ATM Dynamic Bandwidth".

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**Note**

1. When there is a change in line condition or DSL line flaps, ATM interface Bandwidth gets updated after line condition is stable. PVC Service Class bandwidth and Multilink Bundle bandwidth (if MLPPP is configured) gets adjusted dynamically. As a result, traffic flows according to the adjusted bundle bandwidth.

2. When "bandwidth x" is configured under dialer and there is a change in line condition or DSL line flaps, ATM interface Bandwidth gets updated after line condition is stable. PVC Service Class bandwidth gets adjusted dynamically, but Multilink Bundle bandwidth (if MLPPP is configured) does not get updated dynamically because of fixed dialer bandwidth configuration. Because of this, throughput might not be achieved as expected. It is recommended not to configure "bandwidth x" under dialer interface for MLP ATM configurations to be in sync with ATM interface/Service Class bandwidth.
Restrictions for Implementing ATM Dynamic Bandwidth

- This feature is supported only for ATM permanent virtual circuits (PVCs).
- The algorithm used to implement this feature is applied only when dynamic changes to ATM interface occur. It is applied at VC creation on Router bootup as well.
- If the ATM Dynamic Bandwidth feature is enabled/disabled after a change in total bandwidth, feature would not work until line toggles.

Enabling ATM Dynamic Bandwidth

By default ATM dynamic bandwidth feature is enabled. If ATM dynamic bandwidth is disabled, perform the below steps to enable the feature:

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int atm0/1/0
Router(config-if)#atm bandwidth dynamic
Router(config-if)#end
Router#

Sample configuration:

!  
interface ATM0/1/0
no ip address
load-interval 30
no atm enable-ilmi-trap
!

Show atm pvc output with atm dynamic bandwidth enabled.

Example 1:

Router#show atm pvc
VCD / Peak Av/Min Burst
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
0/1/0.1 1 8 37 PVC MUX UBR 1045 UP   
(C) UBR 0
Router#

Example 2:

Router#show atm pvc
VCD / Peak Av/Min Burst
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
0/3/0.1 2 0 32 PVC SNAP CBR 294 UP   
(C) CBR 300

Note: (C) is the configured rates.

In example 2, CBR PVC was configured with PCR as 300 kbps. Due to line rate change, PCR rate has dynamically changed to 294 kbps.
**Disabling ATM Dynamic Bandwidth**

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.

```
Router(config)#int atm0/1/0
Router(config-if)#no atm bandwidth dynamic
Router(config-if)#end
Router#
```

```
Router#sh run int atm0/1/0
Building configuration...

Current configuration : 110 bytes
!
interface ATM0/1/0
    no ip address
    load-interval 30
    no atm bandwidth dynamic
    no atm enable-ilmi-trap
end
```

```
Router#
```

Show atm pvc output with atm dynamic bandwidth feature disabled:

```
Router#show atm pvc | sec 0/1/0
0/1/0.1 1 8 37 PVC MUX UBR 1045 UP
Router#
```

**How the ATM Dynamic Bandwidth Feature Works**

When the total available bandwidth on a DSL interface changes, all of the PVCs configured under the ATM sub-interface(s) are re-created.

If necessary and applicable for a particular PVC based on its service class, new values are applied for the following parameters when PVCs are re-created:

- **PCR**—peak cell rate
- **SCR**—sustainable cell rate

The following steps are performed by the Cisco IOS-XE software to determine what value should be assigned to a parameter when a PVC is re-created in response to a change in total available bandwidth:

- A value is calculated for the parameter. The calculation takes into account the configured value for the parameter, the active value for the parameter (if it is different from the configured value), and the change in total available bandwidth.

- The calculated value is compared to the configured value of the parameter and to the maximum available cell rate, and a new value is determined. The new value is applied when the PVC is re-created.

The following sections describe how the new parameter values are determined when a PVC is re-created for supported QoS classes:

**CBR PVCs**

When the total available bandwidth changes, PVCs configured with CBR service class are recreated as follows:

- If the configured PCR value is less than the calculated PCR value, the PVC is recreated with the configured PCR value.
- If the configured PCR value is greater than the calculated PCR value, the PVC is recreated with the calculated value with no change in class.
• If there is no bandwidth left for the CBR PVC, then CBR PVCs will be downgraded to UBR class with a PCR value equal to the maximum available rate.

**VBR PVCs**

When the total available bandwidth changes, PVCs configured with VBR service class are re-created as follows:

• If the configured PCR value is less than the calculated PCR value, the PVC is recreated with the configured PCR value.

• If the configured PCR value is greater than the calculated PCR value, the PVC is recreated with a new PCR value. The new PCR value will be the lower of the following values:
  - The calculated PCR value
  - The maximum available cell rate

• If the configured SCR value is less than the calculated PCR value, the PVC is re-created with the configured SCR value.

• If the configured SCR value is greater than the calculated PCR value, the PVC is recreated with a new SCR value. The new SCR value will be the lower of the following values:
  - The calculated PCR value
  - The maximum available cell rate

**UBR PVCs**

When the total available bandwidth changes, PVCs configured with UBR service class are re-created as follows:

• If the PCR configuration is set to the default, the PVC is re-created with a PCR value equal to the new line rate.

• If the configured PCR value is less than the calculated PCR value, the PVC is re-created with the configured PCR value.

• If the configured PCR value is greater than the calculated PCR value, the PVC is recreated with a new PCR value. The new PCR value will be the lower of the following values:
  - The calculated PCR value
  - New line rate

**Example:**

Below is the example for the sum of pvc rates less than the line rate of 1561kbps.

```
Router# show atm pvc
VCD / Peak Av/Min Burst
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
0/3/0.1 2 0 32 PVC SNAP CBR 300 UP  
  (C) CBR 300
0/3/0.2 3 0 33 PVC SNAP CBR 100 UP  
  (C) CBR 100
0/3/0.3 4 0 34 PVC SNAP VBR 400 200 10 UP  
  (C) VBR 400 200 10
0/3/0.4 5 0 35 PVC SNAP VBR 600 300 10 UP  
  (C) VBR 600 300 10
0/3/0.5 6 0 36 PVC SNAP VBR 300 150 10 UP  
  (C) VBR 300 150 10
0/3/0.6 7 0 37 PVC SNAP VBR 700 450 10 UP  
```
When line rate gets downgraded to 687kbps, CBR and VBR PVC rates gets adjusted dynamically as below.

```
Router# show atm pvc
VCD / Peak Av/Min Burst
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
0/3/0.1 2  0 32 PVC SNAP CBR 300 UP
            (C) CBR 300
0/3/0.2 3  0 33 PVC SNAP CBR 100 UP
            (C) CBR 100
0/3/0.3 4  0 34 PVC SNAP VBR 287 200 10 UP
            (C) VBR 400 200 10
0/3/0.4 5  0 35 PVC SNAP VBR 87 87 1 UP
            (C) VBR 600 300 10
0/3/0.5 6  0 36 PVC SNAP UBR 687 UP
            (C) VBR 300 150 10
0/3/0.6 7  0 37 PVC SNAP UBR 687 UP
            (C) VBR 700 450 10
0/3/0.7 8  0 38 PVC SNAP UBR 687 UP
            (C) UBR 0
0/3/0.8 1  0 39 PVC SNAP UBR 1000 UP
            (C) UBR 1000
```

**Firmware Update on xDSL NIMs**

You can update the firmware using the following methods:

- PHY Firmware Update
- Update Using Package

**PHY Firmware Update**

This section describes the PHY firmware updates to ADSL/VDSL controller on Cisco ADSL/VDSL NIM and C1100 series Integrated services Router.

**Prerequisites**

The following prerequisites must be met before updating the firmware:

- The package file must be available on the router’s flash memory or the USB flash drive’s memory.
- Cisco IOS software Release XE Fuji 16.9.1 or later should be installed.

**Upgrading to a New Firmware Release**

You can upgrade to a new firmware release using one of the following procedures:
**Procedure**

<table>
<thead>
<tr>
<th><strong>Step</strong></th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Download the new firmware from the Cisco.com Software Center at: <a href="http://software.cisco.com/download/release.html?i=!y&amp;mdfid=284367038&amp;softwareid=284942912&amp;release=1.7.5.0_11175002&amp;os=UnixOrLinux.">http://software.cisco.com/download/release.html?i=!y&amp;mdfid=284367038&amp;softwareid=284942912&amp;release=1.7.5.0_11175002&amp;os=UnixOrLinux.</a></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Copy the firmware to a designated location, either in the router’s flash memory or a USB flash drive’s memory.</td>
<td><strong>Note</strong> If you are using a USB drive, insert the USB flash drive into the router.</td>
</tr>
</tbody>
</table>
| **Step 3** | Configure the router to load the new firmware from the designated location using the following command:                                                                                                         | **Example:** Router# configure terminal
Enter configuration commands, one per line. End with CTRL/Z.
Router(config)#controller vdsl 0/1/0
Router(config-controller)#firmware phy
filename filename to read firmware
Router(config-controller)#firmware phy filename
flash: Download fw filename
bootflash: Download fw filename
Router(config-controller)#firmware phy filename
bootflash: gs_39x3_gnu.pkg                                                                 |                                                                                                                                 |

**Determining the Firmware Version**

To determine the version of the firmware that is currently running, execute the following command and review the PHY source, PHY firmware files, PHY firmware version in show output:

Router#sh controller vdsl 0/1/0

Controller VDSL 0/1/0 is UP

Daemon Status:  UP

<table>
<thead>
<tr>
<th>XTU-R (DS)</th>
<th>XTU-C (US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chip Vendor ID:</td>
<td>'BDCM' 'BDCM'</td>
</tr>
<tr>
<td>Chip Vendor Specific:</td>
<td>0x0000 0xA3A3</td>
</tr>
<tr>
<td>Chip Vendor Country:</td>
<td>0xB500 0xB500</td>
</tr>
<tr>
<td>Modem Vendor ID:</td>
<td>'CSCO' 'BDCM'</td>
</tr>
<tr>
<td>Modem Vendor Specific:</td>
<td>0x4602 0x0000</td>
</tr>
<tr>
<td>Modem Vendor Country:</td>
<td>0xB500 0xB500</td>
</tr>
<tr>
<td>Serial Number Near:</td>
<td>FOC19028UML 4331/K9 16.9.20180</td>
</tr>
<tr>
<td>Serial Number Far:</td>
<td></td>
</tr>
<tr>
<td>Modem Version Near:</td>
<td>16.9.20180112:13360</td>
</tr>
<tr>
<td>Modem Version Far:</td>
<td>0xa3a3</td>
</tr>
</tbody>
</table>
Modem Status: TC Sync (Showtime!)
DSL Config Mode: AUTO
Trained Mode: G.992.5 (ADSL2+) Annex A
TC Mode: ATM
Selftest Result: 0x00
DELT configuration: disabled
DELT state: not running
Failed full inits: 0
Short inits: 0
Failed short inits: 0
Modem FW Version: 4.14L.04
Modem PHY Version: A2pv6F039x3.d26d
Modem PHY Source: bootflash:
Modem PHY FW Pkg: gs_39x3_gnu.pkg

Firmware Upgrade Using the Package

Before you begin
Boot the router in packages.conf mode with the Cisco IOS XE image (super package) to avoid rebooting the router later after upgrad ing or downgrading the firmware.

Download the firmware subpackages for the firmware upgrade from the Cisco software downloads site. To upgrade the firmware on a xDSL Network Interface Module (NIM), perform these steps. Step 1 to 4 represent how to boot the router with packages.conf file before proceeding with Firmware Upgrade. Steps 5-8 represent the procedure to upgrade firmware on the NIM module.

Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Copy Cisco IOS XE image into bootflash: mydir. <strong>Example:</strong> Router# mkdir bootflash:mydir</td>
<td>Creates a directory to save the expanded software image. You can use the same name as the image to name the directory.</td>
</tr>
<tr>
<td>Step 2</td>
<td>request platform software package expand file bootflash:/mydir/&lt;IOS-XE image to expand super package. <strong>Example:</strong> Router# request platform software package expand file bootflash:/mydir/1sr0460-universalk9.03.14.00.5.155-1.1-std.SPA.bin</td>
<td>Expands the platform software package to super package.</td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Step 3</td>
<td>Set bootmarker to load router with <code>packages.conf</code>.&lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Router(config)# no boot system&lt;br&gt;Router(config)# config-register 0x2102&lt;br&gt;Router(config)# boot system&lt;br&gt;bootflash:mydir/packages.conf&lt;br&gt;Router(config)# exit&lt;br&gt;Router# write memory&lt;br&gt;Building configuration...&lt;br&gt;[OK]&lt;br&gt;Router# reload</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>Once router boots and if there is an issue, verify if it is the correct firmware <code>&lt;Embedded with IOS&gt;</code>.&lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;router# show platform software subslot x/y module firmware</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>copy NIM firmware subpackage to the folder <code>bootflash:mydir/</code>. &lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Router#copy&lt;br&gt;bootflash:isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg&lt;br&gt;bootflash:mydir/</td>
<td>Copies the NIM firmware subpackage into <code>bootflash:mydir/</code>.</td>
</tr>
<tr>
<td>Step 6</td>
<td>request platform software package install <code>rp 0 file bootflash:/mydir/&lt;firmware subpackage&gt;</code>.&lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Router#request platform software package install&lt;br&gt;rp 0 file&lt;br&gt;bootflash:mydir/isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg</td>
<td>Installs the software package.</td>
</tr>
<tr>
<td>Step 7</td>
<td><code>hw-module subslot x/y reload</code> to boot the module with the new firmware. &lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Router#hw-module subslot 0/2 reload</td>
<td>Reloads the hardware module subslot and boots the module with the new firmware.</td>
</tr>
<tr>
<td>Step 8</td>
<td><code>show platform software subslot x/y module firmware</code> to verify that the module is booted up with the new firmware. &lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Router# show platform software subslot 0/2 module firmware</td>
<td>Displays the version of the newly installed firmware.</td>
</tr>
<tr>
<td>Step 9</td>
<td>If new firmware is correctly displayed, repeat Step3 to make sure you see new firmware all the time.</td>
<td></td>
</tr>
</tbody>
</table>
Examples

The following example shows how to perform firmware upgrade in a router module:

Router#mkdir bootflash:mydir
Create directory filename [mydir]?
Created dir bootflash:/mydir

Copy in progress...

425288648 bytes copied in 44.826 secs (9487544 bytes/sec)

Router#dir bootflash:mydir
Directory of bootflash:/mydir/
632738 -rw- 425288648 Dec 12 2014 09:16:42 +00:00
isr4400-universalk9.03.14.00.S.155-1.S-std.SPA.bin
7451738112 bytes total (474025984 bytes free)

Router#request platform software package

Verifying parameters
Validating package type
Copying package files
SUCCESS: Finished expanding all-in-one software package.

Router#reload
Proceed with reload? [confirm]

*Dec 12 09:26:09.874: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload Command
*Dec 12 09:26:25.156 R0/0: %PMAN-5-EXITACTION: Process manager is exiting: process exit with reload chassis code

Initializing Hardware ...

System integrity status: 00000610
Rom image verified correctly
System Bootstrap, Version 15.3(3r)S1, RELEASE SOFTWARE
Copyright (c) 1994-2013 by cisco Systems, Inc.

Current image running: Boot ROM0

Last reset cause: LocalSoft
Cisco ISR4451-X/K9 platform with 4194304 Kbytes of main memory

rommon 1 boot bootflash:mydir/packages.conf

File size is 0x000028f1
Located mydir/packages.conf
Image size
10481 inode num 632741, bks cnt 3 blk size 8*512

#
File size is 0x150ae3cc
Image size 353035212 inode num 356929, bks cnt 86191 blk size 8*512
Boot image size = 353035212 (0x150ae3cc) bytes

Package header rev 1 structure detected
Calculating SHA-1 hash...done
validate_package: SHA-1 hash:
calculated 8e966678:8afb08f4:8a8bb8f:fe591121:8bddf4b3
expected 8e966678:8afb08f4:8a8bb8f:fe591121:8bddf4b3

RSA Signed RELEASE Image Signature Verification Successful.
Package Load Test Latency : 3799 msec
Image validated
Dec 12 09:28:50.338 R0/0: %FLASH_CHECK-3-DISK_QUOTA: Flash disk quota exceeded
[free space is 61864 kB] - Please clean up files on bootflash.

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San Jose, California 95134-1706

Cisco IOS Software, ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 15.5(1)S,
RELEASE SOFTWARE (fc5)
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If you require further assistance please contact us by sending email to export@cisco.com.

cisco ISR4451-X/K9 (2RU) processor with 1681388K/6147K bytes of memory.
Processor board ID FTX1736AJUT
2 Ethernet interfaces
4 Gigabit Ethernet interfaces
2 ATM interfaces
32768K bytes of non-volatile configuration memory.
4194304 bytes of physical memory.
7393215K bytes of flash memory at bootflash:

Press RETURN to get started!

*Dec 12 09:28:58.922: %IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL:
Module name = esg Next reboot level = appxk9 and License = appxk9
*Dec 12 09:28:58.943: %IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL:
Module name = esg Next reboot level = ipbasek9 and License = ipbasek9
*Dec 12 09:28:58.981: %ISR_THROUGHPUT-6-LEVEL: Throughput level has been set to 1000000 kbps
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface Lsmpi0, changed state to up
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface EOBC0, changed state to up
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface GigabitEthernet0, changed state to down
*Dec 12 09:29:14.142: %LINK-3-UPDOWN: Interface LIIN0, changed state to up
*Dec 12 09:28:51.438: %CMRP-3-PFU_MISSING: cmand: The platform does not detect a power supply in slot 1
*Dec 12 09:29:01.256: %CMLIB-6-THROUGHPUT_VALUE: cmand: Throughput license found, throughput set to 1000000 kbps
*Dec 12 09:29:03.223: %CPPHA-7-START: cpp_ha: CPP 0 preparing ucode
*Dec 12 09:29:11.645: %CPPHA-7-READY: cpp_ha: CPP 0 loading and initialization complete
*Dec 12 09:29:11.711: %IOSXE-6-PLATFORM: CPP_PFILTER_EA_EVENT__API_CALL__REGISTER
*Dec 12 09:29:16.330: %IOSXE_MGMTVRF-6-CREATE_SUCCESS_INFO: Management vrf Mgmt-intf created with ID 1, ipv4 table-id 0x1, ipv6 table-id 0x1E000001
*Dec 12 09:29:16.330: %LINEPROTO-5-UPDOWN: Line protocol on Interface Lsmpi0, changed state to up
*Dec 12 09:29:16.330: %LINEPROTO-5-UPDOWN: Line protocol on Interface EOBC0, changed state to up
*Dec 12 09:29:16.330: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0, changed state to down
*Dec 12 09:29:16.330: %LINEPROTO-5-UPDOWN: Line protocol on Interface LIIN0, changed state to up
*Dec 12 09:29:17.521: %SYS-5-LOG_CONFIG_CHANGE: Buffer logging disabled
*Dec 12 09:29:18.867: %SYS-5-CONFIG_I: Configured from memory by console
*Dec 12 09:29:18.870: %IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/0, interfaces disabled
*Dec 12 09:29:18.870: %IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/1, interfaces disabled
*Dec 12 09:29:18.871: %IOSXE_OIR-6-REMSPA: SPA removed from subslot 0/2, interfaces disabled
*Dec 12 09:29:18.873: %SPA_OIR-6-OFFLINECARD: SPA (ISR4451-X-4x1GE) offline in subslot 0/0
*Dec 12 09:29:18.874: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VA-B) offline in subslot 0/1
*Dec 12 09:29:18.874: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
*Dec 12 09:29:18.876: %IOSXE_OIR-6-INSSPA: Card (fp) inserted in slot F0
*Dec 12 09:29:18.876: %IOSXE_OIR-6-ONLINECARD: Card (fp) online in slot F0
*Dec 12 09:29:18.882: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/0
Cisco IOS Software, ISR Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 15.5(1)S,
RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
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Dec 12 09:29:18.884: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/1
Dec 12 09:29:18.884: %IOSXE_OIR-6-INSSPA: SPA inserted in subslot 0/2
Dec 12 09:29:18.935: %SYS-5-RESTART: System restarted --

Router>
Router>en
Password:
Router#show controller vdsl 0/2/0
Controller VDSL 0/2/0 is UP

Daemon Status: UP

XTU-R (DS) XTU-C (US)
Chip Vendor ID: 'BDCM' 'BDCM'
Chip Vendor Specific: 0x0000 0xA41B
Chip Vendor Country: 0xB500 0xB500
Modem Vendor ID: 'CSCO'
Modem Vendor Specific: 0x4602 0x0000
Modem Vendor Country: 0xB500 0x0000
Serial Number Near: FOC18426DQ8 4451-X/K15.5(1)S
Serial Number Far:
Modem Version Near: 15.5(1)S
Modem Version Far: 0xa41b

Modem Status(L1): TC Sync (Showtime!)
DSL Config Mode: VDSL2
Trained Mode(L1): G.993.2 (VDSL2) Profile 30a

TC Mode: PTM
Selftest Result: 0x00
DELT configuration: disabled
DELT state: not running

Failed full inits: 0
Short inits: 0
Failed short inits: 0

Modem FW Version: 4.14L.04
Modem PHY Version: A2pv6F039h.d240_rc1

Line 1:

XTU-R (DS)  XTU-C (US)
Trellis: ON ON
SRA: disabled disabled
SRA count: 0 0
Bit swap: enabled enabled
Bit swap count: 9 0
Profile 30a: enabled
Line Attenuation: 3.5 dB 0.0 dB
Signal Attenuation: 0.0 dB 0.0 dB
Noise Margin: 30.9 dB 12.4 dB
Attainable Rate: 200000 kbits/s 121186 kbits/s
Actual Power: 13.3 dBm 7.2 dBm
Per Band Status: D1 D2 D3 U0 U1 U2 U3
Line Attenuation(db): 0.9 1.5 5.5 N/A 0.1 0.9 3.8
Signal Attenuation(db): 0.8 1.5 5.5 N/A 0.0 0.2 3.2
Noise Margin(db): 31.1 31.0 30.9 N/A 12.3 12.4 12.5
Total FECC: 0 0
Total ES: 0 0
Total SES: 0 0
Total LOSS: 0 0
Total UAS: 51 51
Total LPRS: 0 0
Total LOFS: 0 0
Total LOLS: 0 0

DS Channel1  DS Channel0  US Channel1  US Channel0
Speed (kbps): NA 100014 NA 100014
SRA Previous Speed: NA 0 NA 0
Previous Speed: NA 0 NA 0
Reed-Solomon EC: NA 0 NA 0
CRC Errors: NA 0 NA 0
Header Errors: NA 0 NA 0
Interleave (ms): NA 9.00 NA 0.00
Actual INP: NA 4.00 NA 0.00

Training Log: Stopped
Training Log Filename: flash:vdsllog.bin

Router#
Router#
Router#copy bootflash:isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg bootflash:mydir/
Destination filename [mydir/isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg]?
Copy in progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

Router#request platform software package install rp 0 file bootflash:mydir/isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
--- Starting local lock acquisition on R0 ---
Finished local lock acquisition on R0

--- Starting file path checking ---
Finished file path checking

--- Starting image file verification ---
Checking image file names
Locating image files and validating name syntax
  Found isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
Verifying image file locations
Inspecting image file types
Processing image file constraints
Creating candidate provisioning file
Finished image file verification

--- Starting candidate package set construction ---
Verifying existing software set
Processing candidate provisioning file
Constructing working set for candidate package set
Constructing working set for running package set
Checking command output
Constructing merge of running and candidate packages
Checking if resulting candidate package set would be complete
Finished candidate package set construction

--- Starting ISSU compatibility verification ---
Verifying image type compatibility
Checking IPC compatibility with running software
Checking candidate package set infrastructure compatibility
Checking infrastructure compatibility with running software
Checking package specific compatibility
Finished ISSU compatibility verification

--- Starting impact testing ---
Checking operational impact of change
Finished impact testing

--- Starting list of software package changes ---
Old files list:
  Removed isr4400-firmware_nim_xdsl.03.14.00.S.155-1.8-std.SPA.pkg
New files list:
  Added isr4400-firmware_nim_xdsl.2014-11-17_11.05_39n.SSA.pkg
Finished list of software package changes

--- Starting commit of software changes ---
Updating provisioning rollback files
Creating pending provisioning file
Committing provisioning file
Finished commit of software changes

--- Starting analysis of software changes ---
Finished analysis of software changes
--- Starting update running software ---
Blocking peer synchronization of operating information
Creating the command set placeholder directory
Finding latest command set
Finding latest command shortlist lookup file
Finding latest command shortlist file
Assembling CLI output libraries
Assembling CLI input libraries
Skipping soft links for firmware upgrade
Skipping soft links for firmware upgrade
Assembling Dynamic configuration files
Applying interim IPC and database definitions
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
rsync: getaddrinfo: cc2-0 873: Name or service not known rsync error:
error in socket IO (code 10) at /auto/mcpbuilds19/release/03.14.00.S/BLD-V03_14_00_S_FC5/contrib/rsync/clientserver.c(104) [sender=2.6.9]
Replacing running software
Replacing CLI software
Restarting software
Applying final IPC and database definitions
Generating software version information
Notifying running software of updates
Unblocking peer synchronization of operating information
Unmounting old packages
Cleaning temporary installation files
Finished update running software
SUCCESS: Finished installing software.
Router#
Router#show platform software subslot 0/2 module firmware
Avg Load info
-------------------------------------------
1.83 1.78 1.44 3/45 607

Kernel distribution info
-------------------------------------------
Linux version 3.4.11-rt19 (sapanwar@blr-atg-001) (gcc version 4.6.2
(Buildroot 2011.11) ) #3 SMP PREEMPT Fri Nov 7 09:26:19 IST 2014

Module firmware versions
-------------------------------------------
Modem Fw Version: 4.14L.04
Modem Phy Version: A2pv6F039h.d24o_rc1

Boot Loader: Secondry
-------------------------------------------
Version: 1.1

Modem Up time
-------------------------------------------
0D 0H 25M 38S

Router#
Router#hw-module subslot 0/2 reload
Proceed with reload of module? [confirm]

Router#
*Dec 12 09:55:59.645: %IOSXE_OIR-6-SOFT_RELOADSPA: SPA(NIM-VAB-A) reloaded on subslot 0/2
*Dec 12 09:55:59.646: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
*Dec 12 09:55:59.647: %CONTROLLER-5-UPDOWN: Controller VDSL 0/2/0, changed state to down
*Dec 12 09:57:22.514: new extended attributes received from iomd(slot 0 bay 2 board 0)
*Dec 12 09:57:22.515: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2
*Dec 12 09:57:22.515: %SPA_OIR-6-OFFLINECARD: SPA (NIM-VAB-A) offline in subslot 0/2

Router#
*Dec 12 09:58:35.471: %SPA_OIR-6-ONLINECARD: SPA (NIM-VAB-A) online in subslot 0/2
*Dec 12 09:58:37.470: %LINK-3-UPDOWN: Interface Ethernet0/2/0, changed state to down
*Dec 12 09:58:37.470: %LINK-3-UPDOWN: Interface ATM0/2/0, changed state to down

Router#

Router#show platform software subslot 0/2 module firmware
Avg Load info
-------------------------------------------
0.84 0.23 0.08 1/45 598
Kernel distribution info
-------------------------------------------
Linux version 3.4.11-rt19 (sapanwar@blr-atg-001) (gcc version 4.6.2 (Buildroot 2011.11) ) #6 SMP PREEMPT Mon Nov 17 10:51:41 IST 2014
Module firmware versions
-------------------------------------------
Modem Fw Version: 4.14L.04
Modem Phy Version: A2pv6F039n.d24o_rc1
Boot Loader: Secondry
-------------------------------------------
Version: 1.1
Modem Up time
-------------------------------------------
0D 0H 0M 42S
Router#

For more information, refer Installing a Firmware Subpackage.

**IP to ATM CoS, Per-VC WFQ and CBWFQ QoS: PPPoE QoS Markings of .1P Bits in S (AOL)**

IP to ATM CoS support for a single ATM VC allows network managers to use existing features, such as committed access rate (CAR) or policy-based routing (PBR), to classify and mark different IP traffic by modifying the IP Precedence field in the IP version 4 (IPv4) packet header. Subsequently, Weighted Random Early Detection (WRED) or distributed WRED (DWRED) can be configured on a per-VC basis so that the IP traffic is subject to different drop probabilities (and therefore priorities) as IP traffic coming into a router competes for bandwidth on a particular VC.

For more information, see the Configuring IP to ATM CoS document.

**Low Latency Queueing**

Low Latency Queueing (LLQ) allows delay-sensitive data such as voice to be dequeued and sent first (before packets in other queues are dequeued), giving delay-sensitive data preferential treatment over other traffic. The `priority` command is used to allow
delay-sensitive data to be dequeued and sent first. LLQ enables use of a single priority queue within which individual classes of traffic can be placed. For more details on configuring LLQ, see the following documents:

Low Latency Queueing with Priority Percentage Support
Configuring Low Latency Queueing

**Modular QoS CLI (MQC) Unconditional Packet Discard**

The Modular QoS CLI (MQC) Unconditional Packet Discard feature allows customers to classify traffic matching certain criteria and then configure the system to unconditionally discard any packets matching that criteria. The Modular QoS CLI (MQC) Unconditional Packet Discard feature is configured using the Modular Quality of Service Command-Line Interface (MQC) feature. Packets are unconditionally discarded by using the new `drop` command within the MQC.

For more information on configuring Modular QOS CLI unconditional packet discard feature, see the Modular QoS CLI Unconditional Packet Discard document.

**MQC Policy Map Support on Configured VC Range ATM**

The Modular Quality of Service Command Line Interface (MQC) Policy Map support on Configured VC Range ATM feature extends the functionality for policy maps on a single ATM VC to the ATM VC range.

For more information on configuring MQC Policy Map Support on Configured VC Range ATM, see the MQC Policy Map on Configured VC Range ATM document.

**Multilink PPP (MLPPP) bundling**

This feature describes how to configure Multilink PPP over broadband interfaces. Configuring Multilink PPP over broadband includes configuring Multilink PPP over ATM (MLPoA), Multilink PPP over Ethernet (MLPoE), Multilink PPP over Ethernet over ATM (MLPoEoA), and so on.

For more information on Multilink PPP bundles and to configure Multilink PPP minimum links, Bundling and Multilink PPP support on multiple VC’s, see the following documents:

Configuring Multilink PPP Connections for Broadband and Serial Topologies
ATM Multilink PPP Support on Multiple VCs

**PPPoE Enhancement with RFC 4638**

The PPP over Ethernet Client feature provides PPP over Ethernet (PPPoE) client support on routers on customer premises.

For more information on configuring PPP over Ethernet feature, see the PPP over Ethernet Client document.

**PPPoEoA over ATM AAL5Mux**

The PPPoEoA over ATM AAL5MUX feature enables PPP over Ethernet (PPPoE) over ATM adaptation layer 5 (AAL5)-multiplexed permanent virtual circuits (PVCs), reducing logical link control (LLC) and Subnetwork Access Protocol (SNAP) encapsulation bandwidth usage and thereby improving bandwidth usage for the PVC.

For more information on configuring PPPoEoA over ATM AAL5MUX feature, see How to Configure PPPoEoA over ATM AAL5MUX at PPPoEoA over ATM AAL5Mux.
**PPP Over ATM (IETF-Compliant)**

PPP over ATM enables a high-capacity central site router with an ATM interface to terminate multiple remote PPP connections. PPP over ATM provides security validation per user, IP address pooling, and service selection capability.

For more information on configuring PPP over ATM for different encapsulation types, see the following documents:

- Providing Protocol Support for Broadband Access Aggregation of PPP over ATM Sessions
- Configuring PPP over ATM with NAT

**PPPoE Specification Conformance with PADT Message**

The PPP over Ethernet Client feature provides PPP over Ethernet (PPPoE) client support on routers on customer premises.

For more information on configuring PPP over Ethernet feature, see the [PPP over Ethernet Client](#) document.

**QoS on Dialer**

QoS on dialer interfaces feature provides support for Point-to-Point Protocol over Ethernet (PPPoE) and Point-to-Point Protocol over Asynchronous Transfer Mode (PPPoA) configurations on dialer interfaces. The feature provides support for Modular QoS CLI (MQC)-based queuing and shaping that supports per-customer quality of service (QoS). For more details on configuring QoS on dialer, see the [Shaping on Dialer Interfaces](#) document.

**QoS: PPPoE QoS Markings of .1P Bits**

The 802.1P CoS Bit Set for PPP and PPPoE Control Frames feature provides the ability to set user priority bits in the IEEE 802.1Q tagged frame to allow traffic prioritization. This capability enables a way to provide best effort quality of service (QoS) or class of service (CoS) at layer 2 without requiring reservation setup.

For more information on configuring PPPoE QoS Markings of 802.1P bits feature, see the [802.1P CoS Bit Set for PPP and PPPoE Control Frames](#) document.

**RBE Client Side Encapsulation with QoS**

The RBE client side encapsulation with QoS feature provides secure connectivity to an ATM bridged network in which previously a broadband access server would not forward Address Resolution Protocol (ARP) requests or perform proxy ARP, and would respond to ARPs for its own IP address only. This feature combines RBE with QoS policy-based routing to provide security to the entire network. RBE was developed to address known issues with RFC1483 bridging such as broadcast storms and security.

For more information on configuring ATM RBE with QoS, see the following documents:

- RBE Client Side Encapsulation with QoS and the Command References
- RBE Client Side Encapsulation with QoS

**VC Bundling**

APP License is required to support this feature on this module in Cisco IOS XE.

```
Router(config)#license boot level appxk9
```

ATM VC bundle management allows you to define an ATM VC bundle and add VCs to it. You can configure multiple Permanent Virtual Circuits (PVC) that have different QoS characteristics between two end devices. Each VC of a bundle has its own ATM traffic class and ATM traffic parameters. You can apply attributes and characteristics to discrete VC bundle members, or you can apply them collectively at the bundle level.
For more details on configuring VC Bundling, see the Configuring ATM document.

**Show and Debug Commands**

Verifies that the configuration is set properly.

```
Router#show controller vdsl 0/1/0
Controller VDSL 0/1/0 is UP

Daemon Status: UP

XTU-R and XTU-C shows local (Cisco Router) and remote (DSLAM) DSL related details like chipset vendor, Vendor ID, and so on.

XTU-R (DS) XTU-C (US)
Chip Vendor ID: 'BDCM' 'BDCM'
Chip Vendor Specific: 0x0000 0x9186
Chip Vendor Country: 0xB500 0xB500
Modem Vendor ID: 'CSCO' '
Modem Vendor Specific: 0x4602 0x0000
Modem Vendor Country: 0xB500 0x0000
Serial Number Near: FOC18086ML0 15.5(201409
Serial Number Far: Modem Version Near: 15.5(20140908:060834
Modem Version Far: 0x9186

Below shows the configured DSL operating mode, trained mode and TC mode:

Modem Status: TC Sync (Showtime!)
DSL Config Mode: AUTO
Trained Mode: G.993.2 (VDSL2) Profile 17a

TC Mode: PTM
Selftest Result: 0x00
DELT configuration: disabled
DELT state: not running

Failed full inits: 0
Short inits: 0
Failed short inits: 0

Modem FW Version: 4.14L.04
Modem PHY Version: A2pv6F039h.d24o_rc1

Line 0:

XTU-R (DS) XTU-C (US)
Trellis: ON OFF
SRA: disabled disabled
SRA count: 0 0
Bit swap: enabled enabled
Bit swap count: 0 0
Line Attenuation: 2.0 dB 0.0 dB
Signal Attenuation: 0.0 dB 0.0 dB
Noise Margin: 31.1 dB 0.0 dB
Attainable Rate: 139871 kbits/s 20001 kbits/s
Actual Power: 13.3 dBm - 6.7 dBm
Per Band Status: D1 D2 D3 U0 U1 U2 U3
Line Attenuation(dB): 2.1 2.3 1.9 N/A 0.0 0.0 N/A
Signal Attenuation(dB): 2.1 2.3 1.8 N/A 0.0 0.0 N/A
Noise Margin(dB): 32.3 30.6 30.5 N/A 0.0 0.0 N/A
```
DSL trained speed related information:

DS Channel1  DS Channel0  US Channel1  US Channel0
Speed (kbps):  49998  20001
SRA Previous Speed:  0  0  0  0
Previous Speed:  49998  20001
Reed-Solomon EC:  0  0  0  0
CRC Errors:  0  0  0  0
Header Errors:  0  0  0  0
Interleave (ms):  12.00  0.00  0.00  0.00
Actual INF:  0.00  5.01  0.00  0.00

Training Log: Stopped
Training Log Filename: flash:vdsllog.bin

Router# show interface atm 0/2/0
ATM0/2/0 is up, line protocol is up
Hardware is NIM-VAB-A, address is 30f7.0d55.402e (bia 30f7.0d55.402e)
MTU 1800 bytes, sub MTU 1800, BW 2679 Kbit/sec, DLY 100 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ATM, loopback not set
Keepalive not supported
Encapsulation(s): AAL5
8 maximum active VCs, 0 current VCCs
ATM Dynamic Bandwidth Enabled.
VC Auto Creation Disabled.
VC idle disconnect time: 300 seconds
4 carrier transitions
Last input never, output never, output hang never
Last clearing of "show interface" counters never
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  0 packets input, 128789 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)
  0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  0 packets output, 0 bytes, 0 underruns
  0 output errors, 0 collisions, 1 interface resets
  0 unknown protocol drops
  0 output buffer failures, 0 output buffers swapped out

Router# show interface ethernet 0/1/0
Ethernet0/1/0 is up, line protocol is up
Hardware is NIM-VAB-A, address is 30f7.0d55.4026 (bia 30f7.0d55.4026)
MTU 1500 bytes, BW 20001 Kbit/sec, DLY 400 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive not supported
Full Duplex, 1000Mbps, media type is Internal
output flow-control is unsupported, input flow-control is unsupported
ARP type: ARPA, ARP Timeout 04:00:00
Last input never, output 00:00:27, output hang never
Last clearing of “show interface” counters never
Input queue: 0/375/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
0 packets input, 0 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
0 watchdog, 0 multicast, 0 pause input
21 packets output, 9184 bytes, 0 underruns
0 output errors, 0 collisions, 1 interface resets
0 unknown protocol drops
0 babbles, 0 late collision, 0 deferred
0 lost carrier, 0 no carrier, 0 pause output
0 output buffer failures, 0 output buffers swapped out

Router# show atm vc
Codes: DN - DOWN, IN - INACTIVE

<table>
<thead>
<tr>
<th>VCD / Interface Name</th>
<th>VPI</th>
<th>VCI</th>
<th>Type</th>
<th>Encaps</th>
<th>SC</th>
<th>Kbps</th>
<th>Kbps</th>
<th>Cells</th>
<th>St</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/2/0.1</td>
<td>7</td>
<td>0</td>
<td>PVC</td>
<td>SNAP</td>
<td>UBR</td>
<td>2679</td>
<td>UP</td>
<td>(C)</td>
<td>UBR 0</td>
</tr>
<tr>
<td>0/2/0.2</td>
<td>8</td>
<td>0</td>
<td>PVC</td>
<td>SNAP</td>
<td>UBR</td>
<td>2679</td>
<td>UP</td>
<td>(C)</td>
<td>UBR 0</td>
</tr>
</tbody>
</table>

Module Specific Show Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show platform software subslot slot/subslot module firmware</td>
<td>Displays firmware version, CFE version, build label of both module (base board).</td>
</tr>
<tr>
<td>show platform software subslot slot/subslot module status</td>
<td>Displays CPU utilization, memory utilization, firmware status, and so on.</td>
</tr>
<tr>
<td>show platform hardware subslot slot/subslot module device help</td>
<td>Displays device information specific to the module (for example, Phy, Non-Interface Registers).</td>
</tr>
<tr>
<td>show platform hardware subslot slot/subslot module host-if status</td>
<td>Displays configuration and status for the host interface port(s) (that is, ports connected to the backplane switch) of baseboard.</td>
</tr>
<tr>
<td>show platform hardware subslot slot/subslot module host-if statistics</td>
<td>Displays link statistics for the host interface port(s) (that is, ports connected to the backplane switch).</td>
</tr>
<tr>
<td>show platform hardware subslot slot/subslot module interface interface name status</td>
<td>Displays status, configuration and IID for specified user-visible interface.</td>
</tr>
<tr>
<td>show platform hardware subslot slot/subslot module interface interface name statistics</td>
<td>Displays link statistics including FC info for specified user-visible interface.</td>
</tr>
</tbody>
</table>

Router# show platform software subslot 0/3 module firmware
Avg Load info
-------------------------------------------
2.00 1.88 1.19 1/46 598

32
Kernel distribution info

Linux version 3.4.11-rt19 (pavrao@bgl-ads-1863) (gcc version 4.6.2 (Buildroot 2011.11) ) #3 SMP PREEMPT Tue Jun 27 18:47:55 IST 2017

Module firmware versions

Modem Fw Version: 4.14L.04
Modem Phy Version: A2pv6F039t.d26d

Boot Loader: Secondary

Version: 1.1

Modem Up time

0D 0H 13M 47S

Router# show platform software subslot 0/3 module status

Process and Memory

Mem: 43020K used, 76596K free, OK shrd, 3200K buff, 9668K cached
CPU: 0% usr 4% sys 0% nic 95% idle 0% io 0% irq 0% sirq
Load average: 2.00 1.90 1.24 1/46 602

<table>
<thead>
<tr>
<th>PID</th>
<th>PPID</th>
<th>USER</th>
<th>STAT</th>
<th>VSZ</th>
<th>%MEM</th>
<th>CPU</th>
<th>%CPU</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>518</td>
<td>322</td>
<td>admin</td>
<td>S</td>
<td>6092</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>ds1mgmt</td>
</tr>
<tr>
<td>538</td>
<td>537</td>
<td>admin</td>
<td>S</td>
<td>6092</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>ds1mgmt</td>
</tr>
<tr>
<td>537</td>
<td>518</td>
<td>admin</td>
<td>S</td>
<td>6092</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
<td>ds1mgmt</td>
</tr>
<tr>
<td>516</td>
<td>322</td>
<td>admin</td>
<td>S</td>
<td>4056</td>
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<td>1%</td>
<td>0%</td>
<td>tr64c -m 0</td>
</tr>
<tr>
<td>323</td>
<td>322</td>
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<td>S</td>
<td>3948</td>
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<td>1%</td>
<td>0%</td>
<td>ask</td>
</tr>
<tr>
<td>521</td>
<td>519</td>
<td>admin</td>
<td>S</td>
<td>3932</td>
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<td>1%</td>
<td>0%</td>
<td>consoled</td>
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<td>522</td>
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<td>3596</td>
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<td>1%</td>
<td>0%</td>
<td>/bin/smd</td>
</tr>
<tr>
<td>312</td>
<td>311</td>
<td>admin</td>
<td>S</td>
<td>2976</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>/bin/swmdk</td>
</tr>
<tr>
<td>310</td>
<td>311</td>
<td>admin</td>
<td>S</td>
<td>2976</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>/bin/swmdk</td>
</tr>
<tr>
<td>313</td>
<td>312</td>
<td>admin</td>
<td>S</td>
<td>2976</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>/bin/swmdk</td>
</tr>
<tr>
<td>311</td>
<td>310</td>
<td>admin</td>
<td>S</td>
<td>2976</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>/bin/swmdk</td>
</tr>
<tr>
<td>602</td>
<td>601</td>
<td>admin</td>
<td>R</td>
<td>1680</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>/usr/bin/top -b -n 1 -d 30</td>
</tr>
<tr>
<td>519</td>
<td>1</td>
<td>admin</td>
<td>S</td>
<td>1676</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>init</td>
</tr>
<tr>
<td>363</td>
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<td>admin</td>
<td>S</td>
<td>1552</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
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</tr>
<tr>
<td>517</td>
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<td>S</td>
<td>1480</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>ds1diagd</td>
</tr>
<tr>
<td>326</td>
<td>322</td>
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<td>S</td>
<td>1432</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>dnproxy</td>
</tr>
<tr>
<td>511</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[ds10]</td>
</tr>
<tr>
<td>241</td>
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<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[bcmsw_rx]</td>
</tr>
<tr>
<td>145</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[mdblock0]</td>
</tr>
<tr>
<td>260</td>
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<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[bcmsw_timer]</td>
</tr>
<tr>
<td>206</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[bcmFlwStatsTask]</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[kworker/u:0]</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[ksotftirgd/1]</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[kworker/0:1]</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[kworker/1:0]</td>
</tr>
<tr>
<td>156</td>
<td>2</td>
<td>admin</td>
<td>SW&lt;</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[linkwatch]</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[bdi-default]</td>
</tr>
<tr>
<td>69</td>
<td>2</td>
<td>admin</td>
<td>DW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[skbFreeTask]</td>
</tr>
<tr>
<td>87</td>
<td>2</td>
<td>admin</td>
<td>SWN</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[kswapd0]</td>
</tr>
<tr>
<td>88</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[fcntlMark]</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[migration/1]</td>
</tr>
<tr>
<td>152</td>
<td>2</td>
<td>admin</td>
<td>SW</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[kworker/1:1]</td>
</tr>
<tr>
<td>329</td>
<td>2</td>
<td>admin</td>
<td>DW</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[Avs65_Task]</td>
</tr>
<tr>
<td>160</td>
<td>2</td>
<td>admin</td>
<td>SW&lt;</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>[deferwq]</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>admin</td>
<td>SW&lt;</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>[khelper]</td>
</tr>
</tbody>
</table>
Processors utilization
--------------------------------------
Linux 3.4.11-rt19 ((none)) 01/01/70 _mips_ (2 CPU)

00:14:47 CPU %usr %nice %sys %iowait %irq %soft %steal %guest %idle
00:14:47 all 0.13 0.00 1.42 0.00 0.00 0.17 0.00 0.00 98.28
00:14:47 0 0.13 0.00 1.52 0.00 0.00 0.28 0.00 0.00 98.07
00:14:47 1 0.13 0.00 1.32 0.00 0.00 0.06 0.00 0.00 98.49

Interrupts
--------------------------------------
--------------------------------------
CPU0 CPU1
0: 8608  9201 BCM63xx IPI
7: 881960 881466 BCM63xx timer
9: 0 0 BCM63xx_no_unmask brcm_9
10: 1780 0 BCM63xx_no_unmask brcm_10
13: 0 717 BCM63xx_no_unmask serial
21: 0 0 BCM63xx_no_unmask brcm_21
22: 0 0 BCM63xx_no_unmask brcm_22
31: 33832 0 BCM63xx_no_unmask dsl
34: 0 0 BCM63xx_no_unmask brcm_34
35: 0 0 BCM63xx_no_unmask brcm_35
39: 0 0 BCM63xx_no_unmask brcm_39
89: 0 0 BCM63xx_no_unmask brcm_89
91: 0 0 BCM63xx_no_unmask brcm_91
ERR: 0

System status
--------------------------------------
cpu 237 0 2521 174333 0 0 305 0 0 0
cpu0 118 0 1350 86981 0 0 249 0 0 0
cpu1 118 0 1170 87352 0 0 55 0 0 0
intr 1817730 17926 0 0 0 0 0 0 0 0 0
ctxt 616258
btime 0
processes 609
procs_running 1
procs_blocked 0
softirq 2174222 0 1762914 3274 270 0 0 32104 349576 0 26084

KLM Module status
--------------------------------------
iptable_mangle 1168 0 - Live 0xc0371000
iptables_filter 848 0 - Live 0xc036a000
ip_tables 11528 2 iptable_mangle,iptable_filter, Live 0xc0361000
xt_multiport 1446 0 - Live 0xc0357000
xt_mark 813 0 - Live 0xc0350000
xt_mac 739 0 - Live 0xc034a000
xt_DSCP 1819 0 - Live 0xc0344000
xt_dscp 1187 0 - Live 0xc033d000
pwrmgtd 8147 0 - Live 0xc0336000 (P)
bcmvlan 90718 0 - Live 0xc0312000 (P)
p8021ag 5891 0 - Live 0xc02e8000 (P)
bcmrl 6338 0 - Live 0xc02df000 (P)
cictMSkmod 306764 0 - Live 0xc0288000 (P)
bcm_enet 199999 1 pwrmgtd, Live 0xc01ec000
adsldd 458747 0 - Live 0xc0120000 (P)
bcmxtmcfg 75415 1 adsldd, Live 0xc009b000 (P)
pktflow 85993 2 bcmrl,bcm_enet, Live 0xc0067000 (P)
bcm_hpm 9827 0 [permanent], Live 0xc0045000 (P)
bcm_ingqos 8159 0 - Live 0xc003a000 (P)
chipinfo 1325 0 - Live 0xc0031000 (P)

System Memory status

--------------------------------------
MemTotal: 119616 kB
MemFree: 76496 kB
Buffers: 3220 kB
Cached: 9732 kB
SwapCached: 0 kB
Active: 5300 kB
Inactive: 9572 kB
Active(anon): 1924 kB
Inactive(anon): 0 kB
Active(file): 3376 kB
Inactive(file): 9572 kB
Unevictable: 0 kB
Mlocked: 0 kB
SwapTotal: 0 kB
SwapFree: 0 kB
Dirty: 0 kB
Writeback: 0 kB
AnonPages: 1976 kB
Mapped: 2764 kB
Shmem: 0 kB
Slab: 26208 kB
Kernel Stack: 752 kB
Page Tables: 252 kB
NFS_Unstable: 0 kB
Bounce: 0 kB
WritebackTmp: 0 kB
CommitLimit: 59808 kB
Committed_AS: 4888 kB
VmallocTotal: 1032116 kB
VmallocUsed: 1544 kB
VmallocChunk: 1028200 kB

Router# show platform hardware subslot 0/3 module interface ethernet 0/3/0 statistics
Mode: PTM IID: 1

Queue Stats LP HP
Throttles 0 0
Enables 0 0
Throttles Ref 0 0
Enables Ref 55 55
Throttled 0 0
Tx Packets 14 0
Tx Bytes 6046 0
Tx Q Drops 0 0
Rx Packets 0 NA
Rx Bytes 0 NA
Rx Q Drops 0 NA
Max Q Depth 400 400
Q Depth 0 0
XON Q Depth 25 25
XOFF Q Depth 35 35

End of XDSL Interface Statistics

Router# show platform hardware subslot 0/3 module interface atm 0/3/0 statistics
Mode: ATM IID:3 PVC:8/37

---

Queue Stats LP HP
Throttles 0 0
Enables 0 0
Throttles Ref 0 0
Enables Ref 1543 1543
Throttled 0 0
Tx Packets 7306 0
Tx Bytes 277628 0
Tx Q Drops 0 0
Rx Packets 0 NA
Rx Bytes 0 NA
Rx Q Drops 0 NA
Max Q Depth 400 400
Q Depth 0 0
XON Q Depth 96 96
XOFF Q Depth 100 100

End of XDSL Interface Statistics

Router# show platform hardware subslot 0/3 module device help
help The current information
c Conn Conn mgr details
rp RP details
rgmii BCM switch port RGMII details
mips BCM switch port MIPS details
steering Steering driver details
dma BCM switch and xtm DMA details

Router#show platform hardware subslot 0/3 module device conn
Connection Manager Statistics
Total number of packets used by NGIO is: 1 (2 Kbytes)
Processing statistics, processed: 427
Queue depth: current: 0 max: 5
handler (ms): min/avg/max: 0/0/0
NGIO (ms): min/avg/max: 0/0/10
statistics per invocation: avg: 1 max: 6
Corrupted packet Overrun: errors 0
Corrupted packet Underrun errors: 0
packet out of memory errors: 0
local remote
   pkts in  pkts out  errors  pkts in  pkts out  errors
Control Point: 0: Last update was 280 ms ago
   SAP 7:  0  0  0  0  0
   SAP 6:  0  0  0  0  0
   SAP 5:  0  0  0  0  0
   SAP 4:  0  0  0  0  0
   SAP 3:  0  0  0  0  0
   SAP  2: 14 85  0 68 13 0
   SAP  1: 12 873  0 872 12 0
   SAP  0: 402 328  0 326 401 0
Total : 428 1286  0 1266 426 0
Heartbeats Local Remote
   State: HB_INACTIVE HB_ACTIVE
       in 184 28
       out 28 184
       acks in 28 183
       acks out 184 28
       lost 0 0
       resets 0 0
Grand Total: 428 1286  0 1266 426 0

Router#show platform hardware subslot 0/3 module device rp
Reliable Protocol Statistics
link 0 packets in 435
link 0 packets out 1346
link 0 acks in 1342
link 0 acks out 435
link 0 retries 2
link 0 timeouts 0
link 0 delete errors 0
link 0 errors 0
link 0 transmit errors 0
link 0 revision errors 0
link 0 duplicates 0
link 0 out of sequence 0
link 0 out of window 0
link 0 current queue depth 0
link 0 max queue depth 14
link 0 processed 435
link 0 delivered 435
link 0 minimum latency(ms) 0
link 0 maximum latency(ms) 120
link 0 average latency(ms) 3
Router#show platform hardware subslot 0/3 module device rgmii
RGMII Tx Stats
-----------------------------------------
1762802 tx_octets_lo, 0 tx_octets_hi
0 tx_drop_pkts, 273 tx_qos_pkts
11 tx_bcast_pkts, 272 tx_mcast_pkts
14152 tx_ucast_pkts, 0 tx_col
0 tx_single_col, 0 tx_multi_col
0 tx_defer, 0 tx_late_col
0 tx_excess_col, 0 tx_framein_disc
0 tx_pause_pkts, 102618 tx_qos_octets_lo
0 tx_qos_octets_hi
RGMII Rx Stats
-----------------------------------------
7103314 rx_octets_lo, 0 rx_octets_hi
0 rx_undersize_pkts, 0 rx_pause_pkts
0 rx_oversize_pkts, 0 rx_jabber
0 rx_align_err, 0 rx_fcs_err
7103314 rx_good_octets_lo, 0 rx_good_octets_hi
0 rx_drop_pkts, 14092 rx_ucast_pkts
0 rx_mcast_pkts, 2 rx_bcast_pkts
0 rx.fragments, 0 rx_excess_frame_disc
0 rx_symbol_err, 9 rx_qos_pkts
4055 rx_qos_octets_lo, 0 rx_qos_octets_hi

Router#show platform hardware subslot 0/3 module device dma
BCMSW DAM info
--------------------------------------
== dma controller registers ==
controller config: 00000003
ch: config:int stat:int mask
rx:00000001:00000000:00000007
00000000:00000007:00000000
== sram contents ==
ch: bd base: status:current bd content
rx:078ec000:0000000b:08402000:07b37060
tx:07ae2000:0000004a:003c6110:05e96002
== MIPS and MISC registers ==
CP0 cause: 00000000
CP0 status: 10008d01
XTM Rx DMA info
--------------------------------------
Ch 0, NumRxBds: 776, HeadIdx: 1, TailIdx: 1, AssignedBds: 776
DMA cfg: 0x00000001, intstat: 0x00000000, intmask: 0x00000007
Ch 1, NumRxBds: 16, HeadIdx: 1, TailIdx: 1, AssignedBds: 16
DMA cfg: 0x00000001, intstat: 0x00000000, intmask: 0x00000007
XTM Tx Bonding DMA info
--------------------------------------
No Bonding Information
XTM Tx DMA info
--------------------------------------
Ch 0, NumTxBds: 400, HeadIdx: 3, TailIdx: 3, FreeBds: 400
BD RingOffset: 0x00000003, Wordl: 0x01b60f3
Ch 1, NumTxBds: 400, HeadIdx: 0, TailIdx: 0, FreeBds: 400
BD RingOffset: 0x00000000, Wordl: 0x00000000
Router# show platform hardware subslot 0/3 module device mips
MIPS Tx Stats
-----------------------------------------
712517 tx_octets_lo, 0 tx_octets_hi
0 tx_drop_pkts, 11 tx_qos_pkts
2 tx_bcast_pkts, 0 tx_mcast_pkts
14161 tx_ucast_pkts, 0 tx_col
0 tx_single_col, 0 tx_multi_col
0 tx_defer, 0 tx_late_col
0 tx_excess_col, 0 tx_framein_disc
0 tx_pause_pkts, 4997 tx_qos_octets_lo
0 tx_qos_octets_hi

MIPS Rx Stats
-----------------------------------------
1780378 rx_octets_lo, 0 rx_octets_hi
0 rx_undersize_pkts, 0 rx_pause_pkts
0 rx_oversize_pkts, 0 rx_jabber
0 rx_align_err, 0 rx_fcs_err
1780378 rx_good_octets_lo, 0 rx_good_octets_hi
0 rx_drop_pkts, 14223 rx_ucast_pkts
272 rx_mcast_pkts, 12 rx_bcast_pkts
0 rx_fragments, 0 rx_excess_frame_disc
0 rx_symbol_err, 273 rx_qos_pkts
102618 rx_qos_octets_lo, 0 rx_qos_octets_hi

Router# show platform hardware subslot 0/3 module device steering
Steering drv Data path stats
Mode: PTM, IID:1
25 low_watermark, 35 high_watermark
0 FcDrops
----Egress path----
Tx Priority queue :0
11 RxPkts, 4711 RxBytes, 0 RxErrs, 0 RxDropped
0 TxDroppedPkts, 0 TxDroppedBytes
Tx Priority queue :1
0 RxPkts, 0 RxBytes, 0 TxPkts, 0 TxBytes
0 RxDroppedPkts, 0 RxDroppedBytes
0 TxDroppedPkts, 0 TxDroppedBytes
----Ingress path----
0 RxPkts, 0 RxBytes
0 RxDroppedPkts, 0 RxDroppedBytes
0 TxPkts, 0 TxBytes
0 TxDroppedPkts, 0 TxDroppedBytes
Steering drv Control path stats
1973 pkt2Linux, 225957 pktBytes2Linux
0 pktDrops, 0 pktCpDrops

Router# show platform hardware subslot 0/3 module host-if statistics
Data path counters
Mode: PTM IID : 1 Module Datapath Enabled

----- Egress path -----
Enet counters
14795 RxPkts, 7187018 RxBytes, 0 RxErrs, 0 RxDropped
Steering counters
Tx Priority queue :0
13 RxPkts, 5601 RxBytes, 0 RxDropped
13 TxPkts, 5601 TxBytes, 0 TxDropped
Tx Priority queue :1
0 RxPkts, 0 RxBytes, 0 RxDropped
0 TxPkts, 0 TxBytes, 0 TxDropped
NGIO Flow Control Mags
LP XON 51 XOFF 0, HP XON 51 XOFF 0, DroppedFCMags 0
Low Watermark 25 High Watermark 35

XTM counters
  5 TxPkts, 2225 TxBytes, 0 TxErrs, 0 TxDropped

----- Ingress path ----- 

XTM counters
  0 RxPkts, 0 RxBytes, 0 RxErrs, 0 RxDropped

Steering counters
  0 RxPkts, 0 RxBytes, 0 RxDroppedPkts
  0 TxPkts, 0 TxBytes, 0 TxDroppedPkts

Enet counters
  15162 TxPkts, 2119357 TxBytes, 0 TxErrs, 0 TxDropped

Steering drv Control path stats
  2531 pkt2Linux, 289693 pktBytes2Linux
  0 pktDrops, 0 pktCpDrops

Router# show platform hardware subslot 0/3 module host-if status
Host Module L2 info:
  CP_MAC: 30.f7.0d.55.40.ac
  FFP_DP_MAC: 30.f7.0d.55.40.a9
  FFP_FC_MAC: 30.f7.0d.55.40.a9
  Module_MAC: d0.72.dc.93.f5.4b
  CP VLAN ID: 2351
  FFP DP VLAN ID: 2350
  FFP HP1 VLAN ID: 2350
  FFP HP2 VLAN ID: 2350
  FC VLAN ID: 2350
  Max CP MTU : 2048

Router# show platform hardware subslot 0/3 module interface ethernet 0/3/0 status
  PTM Interface IID:1
  Channel Status:ENABLE

-------End of XDSL Interface Status---------

Other useful CLIs for debugging issues related to packet flow:

  • show platform hardware backplaneswitch-manager rp active ffp statistics
  • show platform hardware backplaneswitch-manager rp active subslot subslot GE0 statistics
  • Show platform hardware qfp act infra bqs queue out default interface interface name
  • show platform hardware qfp active interface if-name interface name statistics
  • show platform hardware qfp active interface if-name interface name statistics
  • show platform hardware qfp active statistics drop
  • show platform hardware qfp active interface statistics clear

Packet Flow Specific to ATM PVC Related Show and Debug Commands

Router# show platform software atm F0 pvc
  Forwarding Manager ATM PVC Information
  Interface VCD ID Ing-ID Eg-ID VC State CDM ID
  ATM0/1/0.1 1 0x1004010 0 0x1248 378

Router# show platform hardware qfp active infrastructure bqs interface-string ATM0/1/0.1.1.1004010 hierarchy
Interface: ATM0/1/0.1.1.1004010 QFP: 0.0 if_h: 33 Num Queues/Schedules: 5

Queue specifics:
Index 0 (Queue ID: 0x448, Name: ATM0/1/0.1.1.1004010)
PARQ Software Control Info:
(queue) queue id: 0x00000448, wred: 0xe79955d0, qlimit (pkts): 64
parent_sid: 0x91, debug_name: ATM0/1/0.1.1.1004010
sw_flags: 0x08000011, sw_state: 0x00000c01, port_uidb: 65503
orig_min: 0, min: 0
min_qos: 0, min_dflt: 0
orig_max: 0, max: 0
max_qos: 0, max_dflt: 0
share: 1
plevel: 0, priority: 65535
defer_obj_refcnt: 0
ifh: 33 queue_type 0 (NONE)
qm_obj: 0x00007f81b81c9fa0
subdevice_id: 0

Statistics:
tail drops (bytes): 0, (packets): 0
total enqs (bytes): 103686, (packets): 6098
queue_depth (pkts): 0

Schedule specifics:
Index 0 (SID: 0x91, Name: ATM0/1/0.1.1.1004010)
PARQ Software Control Info:
sid: 0x91, parent_sid: 0x90
evfc_fc_id: 0x5200, fc_sid: 0xfffff
obj_id: 0x24, parent_obj_id: 0x20, debug_name: ATM0/1/0.1.1.1004010
num_entries (active): 1, num_children (max): 1
presize_hint: 0
sw_flags: 0x0000042a, sw_state: 0x00000801
orig_min: 0, min: 0
min_qos: 0, min_dflt: 1045000
orig_max: 0, max: 1045000
max_qos: 0, max_dflt: 1045000
share: 1
plevel: 0, service_fragment: False, port_uidb: 65503
priority: 0, defer_obj_refcnt: 0
ifh: 33 queue_type 0 (NONE)
qm_obj: 0x00007f81b81ca0f0
subdevice_id: 0

REM Schedule Info:
Cnt1=0x0 (FC Enabled) Aggregate State=0x0 (XON XON XON)
HP2, priority level 1. Enforced State=XON (XON)
Bytes Left=2147483647, Paks Left=2147483647
Rvd Flow-On Mgs=0, Rvd Flow-Off Mgs=0
Rvd Refresh Mgs=370, Refresh xon_mismatch=0 xoff_mismatch=0
HP1, priority level 2. Enforced State=XON (XON XON)
Bytes Left=0, Paks Left=0
Rvd Flow-On Mgs=0, Rvd Flow-Off Mgs=0
Rvd Refresh Mgs=0, Refresh xon_mismatch=0 xoff_mismatch=0
LP, normal priority. Enforced State=XON (XON XON)
Bytes Left=2147483647, Paks Left=2147483647
Rvd Flow-On Mgs=0, Rvd Flow-Off Mgs=0
Rvd Refresh Mgs=370, Refresh xon_mismatch=0 xoff_mismatch=0

Schedule specifics:
Index 1 (SID: 0x90, Name: ATM0/1/0 UBR COS)
PARQ Software Control Info:
sid: 0x90, parent_sid: 0x7f
evfc_fc_id: 0xffff, fc_sid: 0xfffff
obj_id: 0x20, parent_obj_id: 0x1c, debug_name: ATM0/1/0 UBR COS
num_entries (active): 1, num_children (max): 1
Schedule specifics:

Index 2 (SID:0x7f, Name: ATM0/1/0)

PARQ Software Control Info:
sid: 0x7f, parent_sid: 0x7c
evfc_fc_id: 0x5100, fc_sid: 0xfffff
obj_id: 0x1c, parent_obj_id: 0x17, debug_name: ATM0/1/0
num_entries (active): 2, num_children (max): 2
presize_hint: 0
sw_flags: 0x0842002a, sw_state: 0x00000001
orig_min: 0, orig_max: 0
min_qos: 0, min_dflt: 1097000
max_qos: 0, max_dflt: 1097000
share: 1
plevel: 0, service_fragment: False, port_uidb: 65525
priority: 0, defer_obj_refcnt: 0
ifm_h: 28, qos_h: 0x00000000, parent_obj_h: 0x00000000
ifh 11 queue_type 0 (NONE)
qm_obj: 0x00007f81b81cb0b0
subdevice_id: 0

REM Schedule Info:
Cntl=0x0 (FC_Enabled) Aggregate State=0x0 (XON XON XON)
HP2, priority level 1. Enforced State=XON (XON)
Bytes Left=0, Paks Left=0
Rvd Flow-On Mags=0, Rvd Flow-Off Mags=0
Rvd Refresh Mags=0, Refresh xon_mismatch=0 xoff_mismatch=0
HP1, priority level 2. Enforced State=XON (XON XON)
Bytes Left=0, Paks Left=0
Rvd Flow-On Mags=0, Rvd Flow-Off Mags=0
Rvd Refresh Mags=0, Refresh xon_mismatch=0 xoff_mismatch=0
LP, normal priority. Enforced State=XON (XON XON)
Bytes Left=0, Paks Left=0
Rvd Flow-On Mags=0, Rvd Flow-Off Mags=0
Rvd Refresh Mags=0, Refresh xon_mismatch=0 xoff_mismatch=0

Schedule specifics:

Index 3 (SID:0x7c, Name: Licensed Shaper)

PARQ Software Control Info:
sid: 0x7c, parent_sid: 0x0
evfc_fc_id: 0xffff, fc_sid: 0xfffff
obj_id: 0x17, parent_obj_id: 0x0, debug_name: Licensed Shaper
num_entries (active): 5, num_children (max): 5
presize_hint: 2
sw_flags: 0x08520022, sw_state: 0x00000001
orig_min: 0, orig_max: 400000000
min_qos: 0, min_dflt: 400000000
max_qos: 0, max_dflt: 400000000
share: 1
plevel: 0, service_fragment: False, port_uidb: 0
priority: 0, defer_obj_refcnt: 0
ifm_h: 23, qos_h: 0x00000000, parent_obj_h: 0x00000000
ifh 0 queue_type 0 (NONE)  
qm_obj: 0x00007f81b81cbf20  
subdevice_id : 0

- show platform hardware qfp active interface platform ATM0/1/0.1.1004010 path
- show platform hardware qfp active interface if-name atm0/1/0.1 statistics

**Collecting DSL Training Logs**

Perform the following steps to collect the DSL training logs:

```
Router# debug vdsl controller 0/1/0 training log
VDSL Controller VDSL 0/1/0 - Training debugging is on
```

Perform the following steps to stop collecting the training logs:

```
Router# no debug vdsl controller 0/1/0 training log
[VDSL_DIAG_LOG] recvd 158991 bytes, written 158991 bytes
VDSL Controller VDSL 0/1/0 - Training debugging is off
Router#
```

By default training log is collected in the file, `flash:vdsllog.bin_slot-subslot`.

**Example:**

```
Router# sh controller vdsl 0/1/0
Controller VDSL 0/1/0 is UP
Daemon Status: UP

    XTU-R (DS) XTU-C (US)
Chip Vendor ID: 'BDCM' 'BDCM'
Chip Vendor Specific: 0x0000 0x544D
Chip Vendor Country: 0xB500 0xB500
Modem Vendor ID: 'CSCO' 'BDCM'
Modem Vendor Specific: 0x4602 0x544D
Modem Vendor Country: 0xB500 0xB500
Serial Number Near: FOC18426DR9 4351/K9 15.5(201412
Serial Number Far:
Modem Version Near: 15.5(20141202:161930
Modem Version Far: 0x544d

Modem Status: TC Sync (Showtime!)
DSL Config Mode: AUTO
Trained Mode: G.992.5 (ADSL2+) Annex A

TC Mode: ATM

Selftest Result: 0x00
DELT configuration: disabled
DELT state: not running

Failed full inits: 0
Short inits: 0
Failed short inits: 0

Modem FW Version: 4.14L.04
Modem PHY Version: A2pv6F039h.d24o_rc1

Line 0:
XTU-R (DS) XTU-C (US)

Trellis: ON ON
SRA: disabled disabled
SRA count: 0 0
Bit swap: enabled enabled
Bit swap count: 669 383
Line Attenuation: 3.5 dB 1.7 dB
Signal Attenuation: 3.1 dB 0.0 dB
Noise Margin: 9.4 dB 5.9 dB
Attainable Rate: 15912 kbits/s 1379 kbits/s
Actual Power: 18.0 dBm 12.2 dBm
Total FECC: 176 176
Total ES: 43 0
Total SES: 0 0
Total LOSS: 0 0
Total UAS: 50 50
Total LPRS: 0 0
Total LOFS: 0 0
Total LOLS: 0 0

DS Channel1 DS Channel0 US Channel1 US Channel0

Speed (kbps): NA 13073 NA 1045
SRA Previous Speed: NA 0 NA 0
Previous Speed: NA 0 NA 0
Total Cells: NA 147977783 NA 2179031143
User Cells: NA 388927 NA 6870
Reed-Solomon EC: NA 176 NA 176
CRC Errors: NA 47 NA 0
Header Errors: NA 335 NA 0
Interleave (ms): NA 1.99 NA 1.94
Actual INP: NA 0.15 NA 0.77

Training Log : Stopped
Training Log Filename : flash:vdsllog_0-1.bin

User can modify the file in which training logs be stored before starting the training log collection procedure by configuring training
log filename flash:user-filename.

Example:

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#controller vdsl 0/1/0

Router(config-controller)#training log filename flash:mytraininglog_file

Router(config-controller)#exit

Router#show controller vdsl 0/1/0
Controller VDSL 0/1/0 is UP
Daemon Status: UP
XTU-R (DS) XTU-C (US)
Chip Vendor ID: 'BDCM' 'BDCM'
Chip Vendor Specific: 0x0000 0x544D
Chip Vendor Country: 0xB500 0xB500
Modem Vendor ID: 'CSCO' 'BDCM'
Modem Vendor Specific: 0x4602 0x544D
Modem Vendor Country: 0xB500 0xB500
Serial Number Near: FOC18426DR9 4351/K9 15.5(201412
Serial Number Far:
Modem Version Near: 15.5(20141202:161930
Modem Version Far: 0x544d

Modem Status: TC Sync (Showtime!)
DSL Config Mode: AUTO
Trained Mode: G.992.5 (ADSL2+) Annex A

TC Mode: ATM
Selftest Result: 0x00
DELT configuration: disabled
DELT state: not running

Failed full inits: 0
Short inits: 0
Failed short inits: 0

Modem FW Version: 4.14L.04
Modem PHY Version: A2pv6F039h.d24o.rc1

Line 0:

    XTU-R (DS) XTU-C (US)
Trellis: ON ON
SRA: disabled disabled
SRA count: 0 0
Bit swap: enabled enabled
Bit swap count: 669 383
Line Attenuation: 3.5 dB 1.7 dB
Signal Attenuation: 3.1 dB 0.0 dB
Noise Margin: 8.8 dB 5.9 dB
Attainable Rate: 15464 kbits/s 1379 kbits/s
Actual Power: 18.0 dBm 12.2 dBm
Total FECC: 176 176
Total ES: 43 0
Total SES: 0 0
Total LOSS: 0 0
Total UAS: 50 50
Total LPRS: 0 0
Total LOFS: 0 0
Total LOLS: 0 0

    DS Channel1 DS Channel0 US Channel1 US Channel0
Speed (kbps): NA 13073 NA 1045
SRA Previous Speed: NA 0 NA 0
Previous Speed: NA 0 NA 0
Total Cells: NA 1484200375 NA 2179384795
User Cells: NA 388991 NA 6938
Reed-Solomon EC: NA 176 NA 176
CRC Errors: NA 47 NA 0
Header Errors: NA 335 NA 0
Interleave (ms): NA 1.99 NA 1.94
Actual INF: NA 0.15 NA 0.77

Training Log : Stopped
Training Log Filename : flash:mytraininglog_file

Sample Configurations

Sample MLPPP Configurations and Show Commands

! interface Ethernet0/3/0
no ip address
load-interval 30
no negotiation auto
pppoe enable
pppoe-client dial-pool-number 2
!
interface Dialer2
bandwidth 55000
ip address negotiated
encapsulation ppp
load-interval 30
dialer pool 1
dialer-group 1
ppp authentication chap
ppp chap hostname cisco
ppp multilink
ppp multilink endpoint string mlpp
!

Router# show pppoe session
1 client sessions
Uniq ID PPPoE RemMAC Port VT VA State
N/A 268 a44c.119d.d671 Et0/3/0 Di2 Vi2 UP
c067.af94.c2a8 UP

Router# show ppp multilink active
Virtual-Access3
Bundle name: cisco1/mlpp/cisco/mlpp
Remote Username: cisco1
Remote Endpoint Discriminator: [1] mlpp
Local Username: cisco
Local Endpoint Discriminator: [1] mlpp
Bundle up for 05:40:46, total bandwidth 89000, load 196/255
Receive buffer limit 24384 bytes, frag timeout 1000 ms
Bundle in Distributed
Dialer interface is Dialer1
0/0 fragments/bytes in reassembly list
0 lost fragments, 0 reordered
0/0 discarded fragments/bytes, 0 lost received
0xD received sequence, 0xC2AE3 sent sequence
Platform Specific Multilink PPP info
NOTE: internal keyword not applicable on this platform
Interleaving: Disabled, Fragmentation: Disabled
Member links: 2 (max 16, min not set)
Vi1, since 05:40:46, 206250 weight, 1496 frag size
Vi2, since 05:40:41, 127500 weight, 1496 frag size

Router# show platform hardware qfp active feature mlp client bundle Virtual-Access3
Bundle Interface: Virtual-Access3
Bundle State: Up
Platform Interface Handle: 35
QFP Interface Handle: 26
QFP Interface uIDB Handle: Rx 65510, Tx 65510
Shadow Base: 0x020E19D0, Size: 1160
Num Links: 2, Next Link: 2, Enabled Links Mask: 0x0003
Tx Channel: 0x32, Tx Queue ID: 0x451, Tx Flow Control SID: 0x9f
Max Frags: 0x0, Lost Fragment Timeout: 1000
Max Frag Size: 65535, Frag Delay: 30
RX Class Buffer Size: 24384
MRRU: 1524, Peer MRRU: 1524
Bundle Bandwidth: 89000 kbps
RX Classes: 1, TX Classes: 1
Bundle Flags: 0x00000011, RX DP Flags: 0x04, TX DP Flags: 0x20
Outstanding datapath proxy requests:
    Bundle Create: 0, Update: 0, Remove: 0
    Links Add: 0, Delete: 0

Member Link Interfaces:
    Interface: EVSI20
    Platform Interface Handle: 20
    QFP Interface Handle: 17
    QFP Interface uIDB Handle: Rx 65519, Tx 65519
    Shadow Base: 0x02075CA0, Size: 218
    TX Chan: 52, P1 Queue ID: 1107, P2 Queue ID: 0
    Link Bandwidth: 55000 kbps, Link Weight: 206250, Link Qlimit: 2286
    Link Optimal Frag Size: 1496, Max Frag Size: 65535
    Rewrite Len w/ PID: 2 Rewrite Len w/o PID: 0
    Rewrite String: 00, 3d
    Outstanding datapath proxy requests:
    Links Add: 0, Update: 0, Delete: 0

    Interface: EVSI21
    Platform Interface Handle: 21
    QFP Interface Handle: 18
    QFP Interface uIDB Handle: Rx 65518, Tx 65518
    Shadow Base: 0x01D48550, Size: 218
    TX Chan: 51, P1 Queue ID: 1109, P2 Queue ID: 0
    Link Bandwidth: 34000 kbps, Link Weight: 127500, Link Qlimit: 2286
    Link Optimal Frag Size: 1496, Max Frag Size: 65535
    Rewrite Len w/ PID: 2 Rewrite Len w/o PID: 0
    Rewrite String: 00, 3d
    Outstanding datapath proxy requests:
    Links Add: 0, Update: 0, Delete: 0

Router# show platform hardware qfp active feature mlp datapath bundle Virtual-Access3 detail
QFP: 0.0 - Bundle Rx Interface: Virtual-Access3, State: UP
    Rx Bundle uIDB: 65510
    Num Links: 2, Num Classes: 1, MRRU: 1524
    Defined Links: 0x0003, Enabled Links: 0x0003
    Config Flags: 0x04 (EVSI, MCMP: Disabled, Strict Seq Check: Enabled)
    Buffer Limit: 24384 bytes per class, Lost Frag Timeout: 1000 ms
    Stats Non-MLP Encapped Rx: 0 packets
      Meta Packet Drop: 0, Attn Sync Drop: 0
      No Buffer: 0, Invalid Class: 0
      Hit Buffer Limit: 0, Rx Pkt Exceeds MRRU: 0
    Lost Frag Timeout: 0
    Reassembly QID: 0x000003F8, Qlimit: 2000, Qdepth: 0
    Bundle SB: 0x33445150, SB Size: 144
    Rx Classes:
      Class: 0
        Expected Seq Number: 0x000000D, In Order/In Sync Links: 0x0003/0x0003
    Stats Rx Buffered: 0/0 fragments/bytes
      Rx Fragmented: 0 fragments
      Rx Unfragmented: 13 packets
      Rx Post Reassembly: 13 packets
      Rx Discarded: 0/0 fragments/bytes
      Rx NULL Frags: 0, Rx Lost: 0
      Rx Out of Order: 0, Rx Rcv'd Lost: 0
    Reorder/Reassembly Stats:
      Reassembly Packet: 0/0 fragments/bytes
      Staged Packets: 0 (S1-empty,S2-empty)
      Inflight Packets: 0
    Class SB: 0x33349D10, SB Size: 272
    Rx Member Links:
      Member Link Interface: EVSI20, State: UP
      Rx Link uIDB: 65519, Link ID: 0, Link Mask: 0x0001
      Config Flags: 0x01 (EVSI)
      Class Link Buffered Fragments
        0 0
Link SB: 0x33470430, SB Size: 32
Member Link Interface: EVSI21, State: UP
Rx Link uIDB: 65518, Link ID: 1, Link Mask: 0x0002
  Config Flags: 0x01 (EVSI)
  Class Link Buffered Fragments
    0 0
Link SB: 0x33470410, SB Size: 32
QPP: 0.0 - Bundle Tx Interface: Virtual-Access3, State: UP
Tx Bundle uIDB: 65510
  Num Links: 2, Num Classes: 1, Peer MRRU: 1524
  Member Links Defined: 0x0003 Enabled: 0x0003 Congested(HP/LP): 0x0000/0x0000
  Bundle Equal Cost Frag Size: 1496
  Config Flags: 0x20 (EVSI, MCMP: Disabled, MCMP Encap Seq: No,
  Interleave: Disabled, Fragmentation: Disabled
  NCP MLP Encaped: Yes, NCP Tx Link ID: 0)
  EVSI First Member Link Encap Type: 1, EVSI L2 Overhead: 20
  Bundle Flow Control SID: 0x9F, SID Update In Prog: No, Bundle Flags: 0x01
  Flow Control Timer: Stopped, Xoff Timer Tics: 0, Check Interval: 4572
  MLP FC: Xon, SW FC: Full-Xon, HW FC: Full-Xon
  HW FC Full Xoff Events: 6410, HW FC LP Xoff Events: 0
  Bundle Load Cycle ID (HP/LP): 0/2594, Next Tx Link ID (HP/LP): 0/1
  Link Link Queue Cycle ID Cycle Tx Bytes Queue Depth
  ID Weight Limit HP/LP HP/LP HP(agg)/LP
  0 206250 9 0/2594 0/98444 0/0
  1 127500 9 0/2594 0/98314 0/0
Stats Non-MLP Encapped Tx: 2 packets
  Non-MLP Priority Interleaved: 0 packets
  TX Drop: 0, TX ESS Packet Drop: 0
  Invalid Class: 0
  Bundle SB: 0x34F6C800, SB Size: 256
Tx Classes:
  Class: 0
    Next Send Seq Number: 0x976A97
    Stats Tx Pre Frag Packets: 127363735 packets
      Tx Fragmented: 0 fragments
      Tx Unfragmented: 127363735 packets
      Tx Frag Interleaved: 0 fragments
      Tx Unfrag Interleaved: 0 packets
    Class SB: 0x3334DD20, SB Size: 64
Tx Member Links:
  Member Link Interface: EVSI20, Parent: Ethernet0/1/0, State: UP
  Tx Link uIDB: 65519, Link ID: 0, Link Mask: 0x0001
    Config Flags: 0x01 (EVSI)
    EVSI Parent Encap Type: 1, EVSI L2 Overhead: 20
    Link Weight: 206250, Frag Size: 1496
    P1 Tx QID: 0x00000045, Qdepth: 0
    P2 Tx QID: 0x00000000, Qdepth: 0
    Default Tx QID: 0x000000452, Qdepth: 0
  L2 Rewrite String: 003D
    Rewrite length w/ PID: 2, Length w/o PID: 0
    Link SB: 0x34FAB0C0, SB Size: 144
Member Link Interface: EVSI21, Parent: Ethernet0/3/0, State: UP
  Tx Link uIDB: 65518, Link ID: 1, Link Mask: 0x0002
    Config Flags: 0x01 (EVSI)
    EVSI Parent Encap Type: 1, EVSI L2 Overhead: 20
    Link Weight: 127500, Frag Size: 1496
    P1 Tx QID: 0x000000455, Qdepth: 0
    P2 Tx QID: 0x000000000, Qdepth: 0
    Default Tx QID: 0x000000454, Qdepth: 0
  L2 Rewrite String: 003D
    Rewrite length w/ PID: 2, Length w/o PID: 0
    Link SB: 0x34FAB030, SB Size: 144
Sample PPPoA Configuration

interface ATM0/3/0.1 point-to-point
ip unnumbered Loopback0
no atm enable-ilmi-trap
pvc 71/200
encapsulation aal5mux ppp dialer
dialer pool-member 151
!
interface Dialer151
ip address negotiated
encapsulation ppp
load-interval 30
dialer pool 151
ppp chap hostname BBIP45687587@adslmax.bt.com
ppp chap password 0 cisco
!
dialer-list 1 protocol ip permit
!

Sample PPPoEoA Configuration

interface ATM0/3/0
no ip address
no atm enable-ilmi-trap

interface ATM0/3/0.10 point-to-point
no atm enable-ilmi-trap
cdp enable
pvc 22/62
encapsulation aal5mux pppoe-client
pppoe-client dial-pool-number 120
!
interface Dialer120
mtu 1492
ip address negotiated
ip nat outside
encapsulation ppp
load-interval 30
dialer pool 120
dialer-group 1
ppp mtu adaptive
ppp chap hostname test@cisco.com
ppp chap password 0 cisco
ppp ipcp address required
ppp link reorders
!
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