Configuring Bridged−Style PVCs on ATM Interfaces in the GSR and 7500 Series

Document ID: 10410

Contents

Introduction

Cisco IOS® Software Releases 12.0S and 11.2GS are designed in order to run on 7200 series, 7500 series, and Gigabit Switch Routers (GSRs) in Internet backbones. As such, these releases provide robust IP routing and enhanced IP services for the Internet Service Provider (ISP) community. They do not provide support for full bridging protocols such as transparent bridging or source route bridging, nor do they support integrated routing and bridging (IRB).

The purpose of the bridged−style permanent virtual circuits (BPVCs) feature is to allow ATM interfaces in Cisco high−end routers that run the S release to be used in an edge or aggregation role and connect to a Catalyst switch or to another remote device that supports bridged−format RFC 1483 PDUs only. This document provides a sample configuration for BPVCs.

BPVCs are supported by the 4xOC3 and 1xOC12 ATM line cards for the GSR and by the PA−A3−T3/E3/OC3 for the 7500 series. The GSR only runs the 11.2GS or 12.0S trains, and thus only supports BPVCs. The 7500 series runs Cisco IOS mainline and technology releases other than the S train, and thus supports IRB and route−bridge encapsulation in addition to BPVCs.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

The information in this document is based on the bridged−style PVCs. Bridged−style PVCs were introduced originally for the GSR 4xOC3 line cards in Cisco IOS Software Releases 11.2(15)GS2 and 12.0(5)S and,

more recently, on the 1xOC12 line card. ST images derived from the S code base also support this feature.

Bridged−style PVCs are now supported on the 7500 series platform that use a PA−A3 port adapter and Cisco IOS Software Release 12.0(16)S or later, Cisco bug ID CSCdt53995 (registered customers only) . Only the PA−A3−OC3, PA−A3−T3, and PA−A3−E3 support this feature. This feature is also supported in the PA−A3−OC12 as of Cisco IOS Software Release 12.0(19)S.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

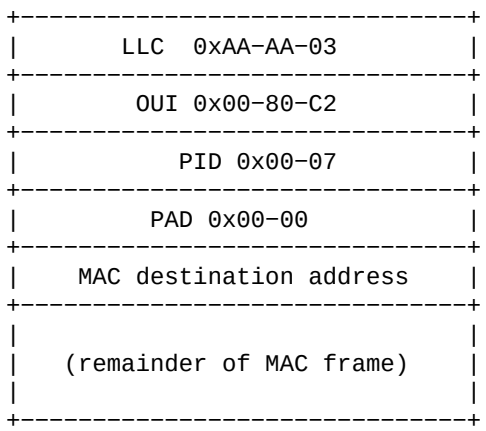
Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

How to Understand Bridged−Style PVCs

The bridged−style PVCs feature is also known as ATM half bridging,1483 Bridge−styled PVCs, and in the **show atm vc output** as 1483−half−bridged−encap. 1483 refers to RFC 1483, which defines how to encapsulate higher−layer protocol data units (PDUs), that includes bridged Ethernet frames, for transport over an ATM backbone. RFC 1483 defines bridged−format PDUs and routed−format PDUs, which are identified by unique values in the Logical Link Control/Subnetwork Access Protocol (LLC/SNAP) header. This diagram illustrates the bridged−format PDU.

Figure 1−1: Bridged−Format RFC 1483 Ethernet Frame



A BPVC accepts packets while it uses the bridged format. But, the packet is not run through the bridging code. Instead, the router assumes that it makes a routing decision on the packet.

An ATM interface configured with a BPVC handles packets that originate from the Ethernet LAN:

1. The LLC/SNAP header, specifically, the LLC, OUI, PID and PAD fields, are removed, and leaves only the Ethernet frame.
2. The destination MAC address in the Ethernet frame header is verified to match the MAC address of the ATM interface of the router.
3. If confirmed, the IP packet is routed based on the destination IP address. Non−routable packets are dropped.

A bridged−style interface handles packets destined to the Ethernet LAN:

1. The destination IP address of the packet is examined. The router consults the IP routing table and CEF forwarding information base (FIB) in order to determine the destination interface for the packet.
2. The router checks the ARP and adjacency tables for a destination MAC address in order to place in the Ethernet header.
3. If none is found, the router generates an ARP request for the destination IP address.
4. The ARP request is forwarded to the destination interface only.
5. The ARP reply is used in order to populate the CEF adjacency and ARP tables.
6. The router inserts the Ethernet MAC and ATM LLC/SNAP headers before the IP payload, and transmits the packet.

With packets that come from and are destined to the Ethernet user, the router runs each packet through the routing forwarding logic only. The packets do not require a layer−2 lookup. The **show bridge** command returns an invalid input message.

```
GSR#sh bridge
          ^
% Invalid input detected at '^' marker.
```

Note: An incoming packet is forwarded to the GSR route processor (RP) if the IP prefix of the packet matches on an entry in the FIB but not in the adjacency table. The incoming packet triggers the RP to transmit an ARP request. After the reception of the ARP reply, the RP FIB and RP ATM driver are responsible for the creation of adjacency and populating it down to all the linecards.

The Comparison of Bridged−Style PVCs and RBE

In addition to BPVCs, Cisco IOS supports a second protocol that accepts a bridged−format PDU, but makes only a routing decision. This protocol is route bridged encapsulation. Importantly, BPVCs and RBE differ in several key ways.

	RBE	**BPVCs**
Design Objective	Overcome the problems of broadcasts, possible spoofing of ARPs by a hostile user, and scalability with IRB and standard bridging when used in DSL applications. Originally developed for the 6400 Universal Access Concentrator	Enable the GSR to be used at the network edge with Catalyst ATM modules that support bridged−format PDUs only and are layer−2 only. Originally designed for the GSR
Subinterface Type	Point to point only	Multipoint only
Analyzes Destination MAC Address in Ethernet Header	No	Yes
Configuration Command	**atm route−bridge ip**	**atm pvc** *vcd vpi vci* **aal5snap bridge**
Supported	Ethernet v2 and 802.3	Ethernet v2 only

Ethernet Encapsulations		

Restrictions

Only Ethernet frames that use Ethernet v2 format are supported. IEEE 802.3 format is not supported. Any Ethernet frames received with a format other than v2 are dropped, and the ATM interface increments the input errors counter. In addition, the input errors counter increments when an ATM interface with Bridged PVCs receives a Spanning Tree Bridged Protocol Data Unit (BPDU). The rx_unknown_vc_paks counter in the **show controllers atm** output also increases.

- The subinterface must be multipoint since the ATM line card assumedly acts as the default gateway for many remote Ethernet users. Point to point subinterfaces are not supported.
- Each subinterface supports only one half−bridged PVC. Each such PVC can be viewed as a virtual Ethernet segment. Allowing two or more bridged−styled PVCs is equivalent to allowing identical IP addresses and IP prefixes over two or more Ethernet segments. But, non−bridged PVCs or SVCs also are allowed on the subinterface.
- Since the Cisco IOS S release does not support bridging, a single Ethernet MAC address can be used by more than one multipoint subinterfaces. Use the **mac−address** command on the ATM primary interface in order to customize the MAC address.

```
GSR−1#show interface atm 7/0ATM7/0 is up, line protocol is up
  Hardware is CM155 OC−3c ATM, address is 005f.9c22.8253 (bia 005f.9c22.8253)
```

- The router receives a packet with or without the original Ethernet frame check sequence. But, transmitted Ethernet frames do not include an Ethernet FCS since there is no hardware assistance for this calculation. The LLC/SNAP header indicates this with a protocol ID (PID) value of 0x0007.
- The ATM interface only routes, and does not bridge between two remote users reachable through BPVCs. The router does not maintain a bridging table, only ARP and CEF adjacency tables. You should consider this restriction when you design your ATM network, particularly with a hub and spoke topology. Each BPVC and multipoint subinterface should map to a single IP network.
- BPVCs originally were designed in order to allow GSR ATM line cards to receive bridged−format PDUs from a Catalyst 5000 ATM module in ATM edge applications. But, this feature allows GSR and now 7500 series ATM interfaces to exchange bridged−format PDUs with any layer−2 ATM device as long as that device ensures proper padding of received frames. Section 5.2 of RFC 2684 requires an ATM bridged interface to pad received Ethernet/802.3 frames, via incoming cells, to a minimum size that supports the MTU before it transmits the reassembled frames onto the Ethernet network. Cisco bug ID CSCdp82703 (registered customers only) implements such padding on the Catalyst 5000 ATM module.

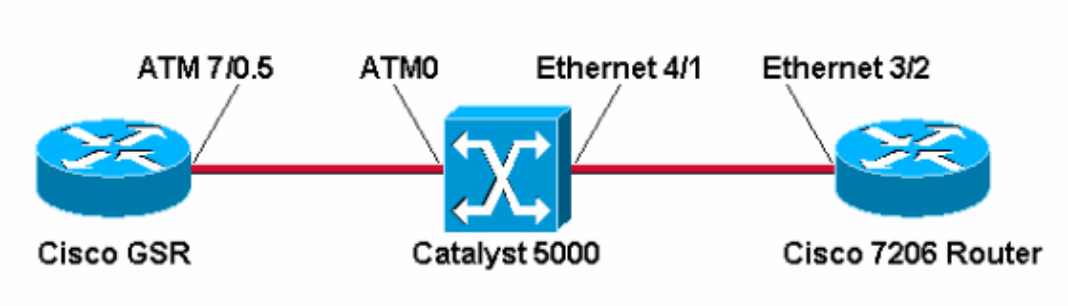
Configure

In this section, you are presented with the information in order to configure the features described in this document.

Note: Use the Command Lookup Tool (registered customers only) in order to find more information on the commands used in this document.

Network Diagram

This document uses this network setup:



Configurations

Complete these steps:

1. Create a multipoint subinterface.

```
GSR-1(config)#interface atm 7/0.5 multipoint
```

2. Create a PVC and assign the virtual circuit descriptor (VCD), virtual path identifier (VPI), and virtual channel identifier (VCI). Then choose aal5snap encapsulation.

```
GSR-1(config-subif)#atm pvc 5 0 50 ?
  aal5mux    AAL5+MUX Encapsulation
  aal5snap   AAL5+LLC/SNAP Encapsulation
```

3. Choose the bridge option for the PVC.

```
GSR-1(config-subif)#atm pvc 5 0 50 aal5snap ?
  <38-155000>    Peak rate(Kbps)
  bridge         1483 bridge-encapsulation enable
  inarp          Inverse ARP enable
  oam            OAM loopback enable
  random-detect  WRED enable
```

GSR ATM Interface

```
interface ATM7/0
 mtu 1500
 no ip address
 no ip directed-broadcast
 atm vc-per-vp 512
 atm maxvc 512
 atm clock INTERNAL
 !
!
interface ATM7/0.5 multipoint
 ip address 1.1.1.1 255.255.255.0
 no ip directed-broadcast
 atm pvc 5 0 50 aal5snap bridge
!
interface ATM7/0.6 multipoint
 ip address 2.2.2.2 255.255.255.0
 no ip directed-broadcast
 atm pvc 6 0 60 aal5snap bridge
```

Catalyst 5000 ATM Module

```
interface ATM0
 atm preferred phy A
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
!
interface ATM0.5 multipoint
```

```
 atm pvc 5 0 50 aal5snap
 atm bind pvc vlan 5 5
!
interface ATM0.6 multipoint
 atm pvc 6 0 60 aal5snap
 atm bind pvc vlan 6 6
```

7206 (Acting as an Ethernet Host)

```
interface Ethernet3/2
 ip address 1.1.1.2 255.255.255.0
 duplex full
```

By default, the GSR 4xOC3 ATM line card uses a maximum transmission unit (MTU) size of 4470 bytes. The Catalyst 5000 uses a default MTU of 1500 bytes.

```
GSR−1#show interface atm 7/0

ATM7/0 is up, line protocol is up
  Hardware is CM155 OC−3c ATM, address is 005f.9c22.8253 (bia 005f.9c22.8253)
  MTU 4470 bytes, sub MTU 4470, BW 155000 Kbit, DLY 80 usec, rely 196/255, load 1/25

ATM#show interface atm0

ATM0 is up, line protocol is up
  Hardware is Catalyst 5000 ATM
  MTU 1500 bytes, sub MTU 0, BW 156250 Kbit, DLY 80 usec, rely 255/255, load 1/255
```

Frames larger than 1500 bytes are transmitted by the BPVC, but are dropped by the receiving Catalyst ATM module interface. Therefore, you must use the **mtu** command under the main interface or the subinterface in order to change the MTU on the ATM router interface to 1500 to match the Catalyst.

```
GSR−1(config)#interface atm 7/0.5
GSR−1(config−subif)#mtu ?
  <64−18020>  MTU size in bytes
GSR−1(config−subif)#mtu 1500
GSR−1(config−subif)#end

GSR−1#show interface atm 7/0.5
ATM7/0.5 is up, line protocol is up
  Hardware is CM155 OC−3c ATM, address is 005f.9c22.8253 (bia 005f.9c22.8253)
  MTU 1500 bytes, BW 155000 Kbit, DLY 80 usec, rely 198/255, load 1/255
  Encapsulation ATM
  1486 packets input, 104020 bytes
  0 packets output,0 bytes
  0 OAM cells input, 0 OAM cells output
```

Verify

Use this section in order to confirm that your configuration works properly.

The Output Interpreter Tool (registered customers only) (OIT) supports certain **show** commands. Use the OIT to view an analysis of **show** command output.

- **show atm vc {vcd#}** Confirm that the the VC uses 1483−half−bridged−encap.

```
GSR#show atm vc 5

ATM7/0.5: VCD: 5, VPI: 0, VCI: 50
PeakRate: 155000, Average Rate: 155000
```

```
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 0 second(s)
InARP DISABLED, 1483-half-bridged-encap
InPkts: 11, OutPkts: 0, InBytes: 770, OutBytes: 0
InPRoc: 13, OutPRoc: 0, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
OAM cells received: 0
OAM cells sent: 0
Status: UP
```

- **show ip cef** and **show ip route**

```
GSR#show ip cef

1.1.1.21.1.1.2/32, version 98, connected, cached adjacency 1.1.1.2
0 packets, 0 bytes
  via 1.1.1.2, ATM7/0.5, 0 dependencies
    next hop 1.1.1.2, ATM7/0.5
    valid cached adjacency

GSR-1#show ip route 1.1.1.2

Routing entry for 1.1.1.0/24
  Known via "connected", distance 0, metric 0 (connected, via interface)
  Routing Descriptor Blocks:
  * directly connected, via ATM7/0.5
      Route metric is 0, traffic share count is 1
```

- **show ip cef adjacency atm**

```
GSR#show ip cef adjacency atm 7/0.5 1.1.1.2 detail

IP Distributed CEF with switching (Table Version 99)
  17 routes, 0 reresolve, 0 unresolved (0 old, 0 new)
  17 leaves, 11 nodes, 13616 bytes, 104 inserts, 87 invalidations
  0 load sharing elements, 0 bytes, 0 references
  universal per-destination load sharing algorithm, id 06E7A9DD
  2 CEF resets, 0 revisions of existing leaves
  0 in-place modifications
  refcounts:  4957 leaf, 4940 node
Adjacency Table has 2 adjacencies
  1 incomplete adjacency
1.1.1.2/32, version 98, connected, cached adjacency 1.1.1.2
0 packets, 0 bytes
  via 1.1.1.2, ATM7/0.5, 0 dependencies
    next hop 1.1.1.2, ATM7/0.5
    valid cached adjacency
```

- **show cam dynamic** on the Catalyst switch

```
Catalyst> (enable) show cam dynamic
* = Static Entry. + = Permanent Entry. # = System Entry.
      R = Router Entry. X = Port Security Entry
VLAN  Dest MAC/Route Des  Destination Ports or VCs / [Protocol Type]
----  ------------------  -----------------------------------------------------
5     00-30-7b-1e-90-56   4/1 [ALL]
5     00-5f-9c-22-82-53   3/1 VCD:5 VPI:0 VCI:50 Type: AAL5SNAP PVC [ALL]
Total Matching CAM Entries Displayed = 2
```

- **show arp** on the remote Ethernet host. Confirm the Ethernet encapsulation Type is ARPA, which is how Cisco IOS refers to Ethernet v2 format.

```
7206#show arp

Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  1.1.1.1                2   005f.9c22.8253  ARPA   Ethernet3/2
Internet  1.1.1.2                -   0030.7b1e.9056  ARPA   Ethernet3/2
```

Troubleshoot

Use this section in order to troubleshoot your configuration.

Troubleshooting Commands

Note: Refer to Important Information on Debug Commands before you use **debug** commands.

- **debug atm packet interface atm** Provides hexadecimal decode of the VPI/VCI, LLC/SNAP header, and packet payload. Confirm an OUI of 0x0080C2 and a Type of 0007.

```
GSR#debug atm packet interface atm 7/0.5
ATM packets debugging is on
Displaying packets on interface ATM7/0.5 only
GSR-1#ping 1.1.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/8 ms
059389: 6w3d: ATM7/0.5(O):
VCD:0x5 VPI:0x0 VCI:0x32 DM:0x100 SAP:AAAA CTL:03 OUI:0080C2 TYPE:0007 Length:0x80
059390: 6w3d: 0000 0030 7B1E 9056 005F 9C22 8253 0800 4500 0064 03FC 0000 FF01 B398
059391: 6w3d: 0101 0101 0102 0800 0BCA 21BB 0E5B 0000 0000 E85D 5A0C ABCD ABCD ABCD
059392: 6w3d: ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD
059393: 6w3d: ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD
059394: 6w3d:
059395: 6w3d: ATM7/0.5(I):
VCD:0x5 VPI:0x0 VCI:0x32 Type:0x0 SAP:AAAA CTL:03 OUI:0080C2 TYPE:0007 Length:0x80
059396: 6w3d: 0000 005F 9C22 8253 0030 7B1E 9056 0800 4500 0064 03FC 0000 FF01 B398
059397: 6w3d: 0102 0101 0101 0000 13CA 21BB 0E5B 0000 0000 E85D 5A0C ABCD ABCD ABCD
059398: 6w3d: ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD
059399: 6w3d: ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD ABCD
```

Related Information

- **ATM Technology Support Pages**
- **Technical Support & Documentation − Cisco Systems**

Updated: Oct 09, 2006 Document ID: 10410