

# Controlling Subscriber Bandwidth

The Dynamic Subscriber Bandwidth Selection (DBS) feature enables wholesale service providers to sell different classes of service to retail service providers by controlling bandwidth at the ATM virtual circuit (VC) level. ATM quality of service (QoS) parameters from the subscriber domain are applied to the ATM PVC on which a PPP over Ethernet (PPPoE) or PPP over ATM (PPPoA) session is established.


- Prerequisites for Controlling Subscriber Bandwidth, on page 1
- Restrictions for Controlling Subscriber Bandwidth, on page 1
- Information About Controlling Subscriber Bandwidth, on page 2
- How to Control Subscriber Bandwidth, on page 3
- Configuration Examples for Controlling Subscriber Bandwidth, on page 12
- Additional References, on page 13
- Feature Information for Controlling Subscriber Bandwidth, on page 15


## Prerequisites for Controlling Subscriber Bandwidth

A Cisco ASR 1000 series router must have the following shared port adapters (SPAs) installed to enable DBS:

- SPA-3XOC3-ATM-V2
- SPA-1XOC3-ATM-V2
- SPA-1XOC12-ATM-V2

## Restrictions for Controlling Subscriber Bandwidth

The DBS feature does not support the following:

- Switched virtual circuits (SVC)
- ATM port adapters installed in a Cisco ASR 1000 series router
- When changing QoS values dynamically on a VC, there can be some duration (in milliseconds) during which traffic on the VC is dropped.

# Information About Controlling Subscriber Bandwidth

## Traffic-Shaping Parameters

Using DBS you can set the ATM permanent virtual circuit (PVC) traffic-shaping parameters to be dynamically changed based on the RADIUS profile of a PPPoE or PPPoA user logging in on the PVC. If the user is the first user on a given PVC, the RADIUS profile values override the default values of the PVC. If users already exist on the PVC, the new value overrides the existing configuration only if it is higher than the existing value. If multiple PPPoE sessions are allowed on a subscriber VC, the highest peak cell rate (PCR) and sustainable cell rate (SCR) of all the sessions are selected as the PCR and SCR, respectively, of the VC.

You can apply DBS QoS parameters per user as well as per domain. If you apply DBS QoS parameters under a domain profile, all users in that profile are assigned the same DBS QoS parameters. These parameters are assigned to the RADIUS profile for that domain. You can also apply distinctive DBS QoS parameters via the RADIUS user profile.

Traffic-shaping parameters can be locally configured by Cisco IOS command-line interface (CLI) in VC-mode, VC-class, range mode, or PVC-in-range mode. These parameters have a lower priority and are overridden by the shaping parameters specified in the domain service profile. Traffic-shaping parameters that are CLI-configured at the VC class interface or subinterface level are treated as the default QoS parameters for the PVCs to which they apply. These parameters are overridden by the domain service profile QoS parameters of the domain the user is logged in to. If no VC class is configured, the default is the unspecified bit rate (UBR).

When a network access server (NAS) sends a domain authorization request and receives an affirmative response from the RADIUS server, this response may include a "QoS-management" string via vendor-specific attribute (VSA) 26 for QoS management in the NAS. The QoS management values are configured as part of the domain service profile attributes on the RADIUS server. These values contain PCR and SCR values for a particular user or domain. If the QoS specified for a domain or user cannot be applied on the PVC to which the session belongs, the session is not established.

Changing PVC traffic parameters because of new simultaneous PPPoE sessions on the PVC does not cause existing PPPoE sessions that are already established to disconnect. Changing domain service profile QoS parameters on the RADIUS server does not cause traffic parameters to automatically change for PVCs that have existing sessions.

When you enter the **dbs enable** or **no dbs enable** command to configure or unconfigure DBS, existing sessions are not disconnected. If you have a session that has been configured for DBS and you configure the **no dbs enable** command on a VC, additional sessions that are configured will display DBS-configured QoS values until the first new session is up. After the first session is brought up, the VC has default and locally configured values. If you configure the **dbs enable** command after multiple sessions are already up on the VC, all sessions on that VC have DBS QoS parameters.

## Benefits of Controlling Subscriber Bandwidth

DBS provides the following benefits:

- Wholesale service providers can provide different bandwidth options to their retail service provider customers, such as ISPs and enterprises.
- Subscribers can choose between enhanced and basic service, with a fixed billing plan for each service.

# How to Control Subscriber Bandwidth

## Configuring DBS Under a VC Class

Perform the following task to configure DBS under a VC class.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vc-class atm** *vc-class-name*
4. **dbs enable**

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **vc-class atm** *vc-class-name*<br>**Example:**<br>`Router(config)# vc-class atm class1` | Creates an ATM VC class and enters ATM VC class configuration mode.<br>• A VC class can be applied to an ATM interface, subinterface, or VC. |
| **Step 4** | **dbs enable**<br>**Example:**<br>`Router(config-vc-class)# dbs enable` | Applies DBS QoS parameters. |

## Configuring DBS on a PVC

Perform the following task to configure DBS for a PVC.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number* [**point-to-point** | **multipoint**]
4. **pvc** [*name*] *vpi /vci*
5. **dbs enable**
6. **protocol pppoe**

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **interface atm** *number* [**point-to-point** | **multipoint**]<br>**Example:**<br>`Router(config)# interface atm 5/0.1 multipoint` | Specifies an ATM interface or subinterface and enters interface configuration mode. |
| **Step 4** | **pvc** [*name*] *vpi /vci*<br>**Example:**<br>`Router(config-if)# pvc 2/101` | Specifies an ATM PVC and creates or assigns a name to an ATM PVC, and enters interface-ATM-VC configuration mode.<br>**Note**<br>The arguments *vpi* and *vci* cannot both be set to 0; if one is 0, the other cannot be 0. |
| **Step 5** | **dbs enable**<br>**Example:**<br>`Router(config-if-atm-vc)# dbs enable` | Applies DBS QoS parameters. |
| **Step 6** | **protocol pppoe**<br>**Example:**<br>`Router(config-if-atm-vc)# protocol pppoe` | Specifies PPPoE as the protocol of the ATM PVC. |

# Configuring DBS on a Range of PVCs

Perform this task to configure DBS for a range of PVCs.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number* [**point-to-point** | **multipoint**]
4. **range**[*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* /*end-vci*
5. **dbs enable**

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **interface atm** *number* [**point-to-point** | **multipoint**]<br>**Example:**<br>`Router(config)# interface atm 5/0.1 multipoint` | Specifies an ATM interface or subinterface and enters interface configuration mode. |
| **Step 4** | **range**[*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* /*end-vci*<br>**Example:**<br>`Router(config-subif)# range pvc 0/101 0/500 class-range pppoe` | Defines a range of ATM PVCs and enables PVC range configuration mode. |
| **Step 5** | **dbs enable**<br>**Example:**<br>`Router(config-if-atm-vc)# dbs enable` | Applies DBS QoS parameters. |

# Configuring DBS on a PVC Within a PVC Range

Perform this task to configure DBS for a specific PVC within a range of PVCs.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *number* [**point-to-point** | **multipoint**]
4. **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*
5. **in-range** [*pvc-name*] [[*vpi* /]*vci*]
6. **dbs enable**

## DETAILED STEPS

### Procedure

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **interface atm** *number* [**point-to-point** | **multipoint**]<br>**Example:**<br>`Router(config)# interface atm 5/0.1 multipoint` | Specifies an ATM interface or subinterface and enters interface configuration mode. |
| **Step 4** | **range** [*range-name*] **pvc** *start-vpi* / *start-vci end-vpi* / *end-vci*<br>**Example:**<br>`Router(config-subif)# range pvc 0/101 0/500 class-range pppoe` | Defines a range of ATM PVCs and enables PVC range configuration mode. |
| **Step 5** | **in-range** [*pvc-name*] [[*vpi* /]*vci*]<br>**Example:**<br>`Router(config-if-atm-range)# pvc-in-range pvc1 3/104` | Defines an individual PVC within a PVC range and enables PVC-in-range configuration mode. |
| **Step 6** | **dbs enable**<br>**Example:**<br>`Router(config-if-atm-range-pvc)# dbs enable` | Applies DBS QoS parameters. |

# Configuring the RADIUS Attributes for DBS

You can apply DBS QoS parameters per user as well as per domain. If you apply DBS QoS parameters under a domain profile, all users in that profile are assigned the same DBS QoS parameters. These parameters are assigned to the RADIUS profile for that domain. You can also apply distinctive DBS QoS parameters via the RADIUS user profile.

Configure the RADIUS attributes listed in this section in the user or domain profiles on the authentication, authorization, and accounting (AAA) server. The user or domain profile is downloaded from the AAA server as part of user authentication.

The QoS management string for DBS has the following syntax:

```
Cisco-Avpair = atm:peak-cell-rate=155000
Cisco-Avpair = atm:sustainable-cell-rate=155000
```

You must configure the PCR. Configuring the SCR is optional. If you configure only the PCR, the ATM service type is an unspecified bit rate (UBR). If you specify both the SCR and the PCR, the ATM service type is a variable bit rate nonreal-time (VBR-nrt) connection.

If the peak rate is greater than the maximum rate permitted on the ATM physical interface, the PCR applied on the ATM PVC is set to the maximum rate. If the specified PCR is less than the minimum rate, then the PCR applied on the ATM PVC is the minimum rate.

If the sustainable-cell-rate (in Kbps) applied exceeds the maximum for the interface, the session is rejected.

**Note** DBS cannot change service categories such as from UBR to VBR-nrt. For details, see the table in Configuring Dynamic Suscriber Services .

# Verifying DBS

**Note** The configuration examples in this section explain the PPPOE termination using a VPDN group.

### SUMMARY STEPS

1. Enter the **show atm pvc** *vpi* / *vci*command to view details about ATM PVCs or VCs:
2. Enter the **show atm pvc dbs**command to display information about ATM PVCs that have DBS QoS parameters applied:
3. Enter the **show running-config** command to verify that DBS QoS parameters have been applied. If you enter the **dbs enable** or the **no dbs enable**command, it appears in the output of the **show running-config command**. If you enter the **default dbs enable**command, it does not appear.

## DETAILED STEPS

### Procedure

**Step 1** Enter the **show atm pvc** *vpi* / *vci*command to view details about ATM PVCs or VCs:

**Example:**

```
Router# show atm pvc 0/75
ATM1/0.4:VCD:1, VPI:0, VCI:75
UBR, PeakRate:149760
AAL5-LLC/SNAP, etype:0x0, Flags:0xC20, VCmode:0x0
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC state:Not Managed
ILMI VC state:Not Managed
PA TxRingLimit:40 particles
PA Rx Limit:1600 particles
InARP frequency:15 minutes(s)
Transmit priority 4
InPkts:18, OutPkts:21, InBytes:1263, OutBytes:1476
InPRoc:18, OutPRoc:3
InFast:0, OutFast:0, InAS:0, OutAS:0
InPktDrops:0, OutPktDrops:0/0/0 (holdq/outputq/total)
CrcErrors:0, SarTimeOuts:0, OverSizedSDUs:0, LengthViolation:0,
CPIErrors:0
Out CLP=1 Pkts:0
OAM cells received:0
F5 InEndloop:0, F5 InSegloop:0, F5 InAIS:0, F5 InRDI:0
F4 InEndloop:0, F4 InSegloop:0, F4 InAIS:0, F4 InRDI:0
OAM cells sent:0
F5 OutEndloop:0, F5 OutSegloop:0, F5 OutRDI:0
F4 OutEndloop:0, F4 OutSegloop:0, F4 OutRDI:0
OAM cell drops:0
Status:UP
PPPOE enabled.
DBS enabled.
```

**Step 2** Enter the **show atm pvc dbs**command to display information about ATM PVCs that have DBS QoS parameters applied:

**Example:**

```
Router# show atm pvc dbs
            VCD /                                       Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells
Sts
1/0.7       3           0    75   PVC    MUX      VBR    2000    700   94
UP
```

**Step 3** Enter the **show running-config** command to verify that DBS QoS parameters have been applied. If you enter the **dbs enable** or the **no dbs enable**command, it appears in the output of the **show running-config command**. If you enter the **default dbs enable**command, it does not appear.

**Example:**

```
Router# show running-config
Building configuration...
Current configuration : 2902 bytes
```

```
!
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname host1
!
aaa new-model
!
!
aaa authentication ppp default group radius
aaa authorization network default group radius
aaa session-id common
!
username usera password 0 password0
username lac password 0 password1
username lns password 0 password2
username nrp1 password 0 password3
username user1 password 0 password4
username nrp1-3 password 0 password5
username xyz@abc.com password 0 password6
ip subnet-zero
!
!
ip host dirt 172.69.1.129
ip host boot 172.19.192.254
!
vpdn enable
!
vpdn-group lac
 request-dialin
  protocol l2f
  domain pepsi.com
 initiate-to ip 10.1.1.5
 local name lac
!
vpdn-group pppoe_terminate
 accept-dialin
  protocol pppoe
  virtual-template 1
 pppoe limit per-mac 2000
 pppoe limit per-vc 2000
!
!
!
!
!
!
!
!
!
vc-class atm pppoa
  encapsulation aal5mux ppp Virtual-Template2
  dbs enable
!
vc-class atm pppoe
  dbs enable
  protocol pppoe
!
interface Loopback1
 no ip address
!
```

```
interface FastEthernet0/0
 ip address 10.0.74.211 255.255.255.0
 duplex half
 no cdp enable
!
interface ATM1/0
 no ip address
 no ip route-cache
 no ip mroute-cache
 no atm ilmi-keepalive
 atm voice aal2 aggregate-svc upspeed-number 0
!
interface ATM1/0.4 point-to-point
 ip address 10.1.1.6 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 pvc 0/75
  dbs enable
  protocol pppoe
 !
!
interface ATM1/0.5 point-to-point
 ip address 10.1.1.6 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 pvc 0/85
 !
!
interface ATM1/0.7 point-to-point
 ip address 10.1.1.6 255.255.255.0
 no ip route-cache
 no ip mroute-cache
 pvc 0/95
  class-vc pppoa
  ubr 5000
 !
!
interface ATM1/0.10 point-to-point
 no ip route-cache
 no ip mroute-cache
 range pvc 0/101 0/500
  class-range pppoe
 !
  pvc-in-range 0/102
   no dbs enable
  !
!
interface Virtual-Template1
 ip unnumbered Loopback1
 ip mtu 1492
 no keepalive
 peer default ip address pool local_pool
 ppp authentication chap
!
interface Virtual-Template2
 ip address negotiated
 ip mtu 1492
 peer default ip address pool local_pool
 ppp authentication chap
!
interface Virtual-Template10
 ip address 192.168.11.1 255.255.255.0
 no keepalive
 peer default ip address pool p3
```

```
 ppp authentication chap
!
interface Virtual-Template11
 ip address negotiated
 no keepalive
 ppp chap hostname host1
 ppp chap password password1
!
ip local pool p3 192.168.0.0 192.170.12.250
ip local pool local_pool 150.10.3.1 150.10.10.250
ip default-gateway 10.0.74.1
ip classless
ip route 10.0.0.0 10.0.0.0 10.0.74.1
ip route 10.107.164.0 255.255.255.0 FastEthernet0/0
no ip http server
!
!
!
radius-server host 172.18.0.0 auth-port 1645 acct-port 1646
radius-server retransmit 3
radius-server key cisco
call rsvp-sync
!
!
mgcp profile default
!
!
gatekeeper
 shutdown
!
!
line con 0
line aux 0
line vty 5 15
!
!
end
```

# Monitoring DBS

Use the commands listed below to monitor DBS:

| Command | Purpose |
|---|---|
| **debug atm events** | Displays the normal set of ATM events when a session comes up or goes down. |
| **debug atm errors** | Displays protocol errors and error statistics associated with VCs. |
| **debug atm status** | Displays changes in the status of a VC when a session comes up or goes down or when the VC configuration is changed. |
| **debug ppp authentication** | Displays authentication protocol messages, including Challenge Authentication Protocol (CHAP) packet exchanges and Password Authentication Protocol (PAP) exchanges. |

| Command | Purpose |
|---|---|
| **debug ppp error** | Displays protocol errors and error statistics associated with PPP connection negotiation and operation. |
| **debug ppp negotiation** | Enables debugging of PPP negotiation process. |
| **debug radius** | Displays detailed debugging information associated with RADIUS. |
| **debug vpdn event** | Displays Layer 2 tunneling protocol (L2TP) errors and events that are a part of normal tunnel establishment or shutdown for VPDNs. |
| **debug vpdn l2x-errors** | Displays Layer 2 forwarding protocol (L2F ) and L2TP errors that prevent tunnel establishment or normal operation. |
| **debug vpdn 12x-events** | Displays L2F and L2TP events that are part of tunnel establishment or shutdown. |
| **debug vpdn pppoe-errors** | Displays PPPoE protocol errors that prevent a session from being established or errors that cause an established session to be closed. |
| **debug vpdn pppoe-events** | Displays PPPoE protocol messages about events that are part of normal session establishment or shutdown. |
| **show atm pvc** | Displays all ATM PVCs and traffic information. |
| **show atm pvc dbs** | Displays ATM PVCs that have DBS QoS parameters applied. |
| **show atm vc detailed** | Displays information about ATM PVCs and SVCs. |
| **show interfaces virtual-access** | Displays status, traffic data, and configuration information about a specified virtual access interface. |

# Configuration Examples for Controlling Subscriber Bandwidth

## Configuring DBS for a VC Class Example

In the following example, DBS QoS parameters have been applied to a VC called "cisco":

```
vc-class atm cisco
 dbs enable
```

## Configuring DBS for a PVC Example

In the following example, DBS QoS parameters have been applied on a PVC called "cisco":

```
interface atm0/0/0.5 point-to-point
 ip address 10.0.0.0 255.255.255.0
 pvc cisco 0/100
 dbs enable
 protocol pppoe
```

# Configuring DBS for a Range of PVCs Example

In the following example, DBS QoS parameters have been applied on a range of PVCs. The range is named "cisco range" and has a *start-vpi* of 0, a *start-vci* of 50, an *end-vpi*of 0, and an *end-vci* of 70:

```
interface atm0/0/0.1 multipoint
 ip address 10.0.0.0 255.255.255.0
 range cisco pvc 0/50 0/70
 dbs enable
```

# Configuring DBS for a PVC Within a PVC Range Example

In the following example, DBS parameters have been applied on PVC 60, which is part of the PVC range called "cisco":

```
interface atm0/0/0.1 multipoint
 range cisco pvc 0/50 0/70
 pvc-in-range 0/60
 dbs enable
```

# Configuring RADIUS Attributes Examples

The following example shows how to configure RADIUS attributes for a domain profile for DBS:

```
cisco.com  Password = "cisco", Service-Type = Outbound
     Service-Type = Outbound,
     Cisco-Avpair = "vpdn:tunnel-id=tunnel33",
     Cisco-Avpair = "vpdn:tunnel-type=l2tp",
     Cisco-Avpair = "vpdn:l2tp-tunnel-password=password2",
     Cisco-Avpair = "vpdn:ip-addresses=172.16.0.0",
     Cisco-Avpair = "atm:peak-cell-rate=155000",
     Cisco-Avpair = "atm:sustainable-cell-rate=155000"
```

The following example shows how to configure RADIUS attributes for a user profile for DBS:

```
user1@cisco.com Password = "userpassword1", Service-Type = Outbound
     Service-Type = Outbound,
     Cisco-Avpair = "atm:peak-cell-rate=155000",
     Cisco-Avpair = "atm:sustainable-cell-rate=155000"
```

# Additional References

### Related Documents

| Related Topic | Document Title |
|---|---|
| Cisco Subscriber Edge Services Manager | Cisco Subscriber Edge Services Manager |
| Access Point Name Manager | APN Manager Application Programming Guide |

| Related Topic | Document Title |
|---|---|
| RADIUS configuration | *"Configuring RADIUS" chapter of the Cisco IOS Security Configuration Guide* |
| RADIUS attributes | "RADIUS Attributes" appendix to the *Cisco IOS Security Configuration Guide* |
| Broadband access aggregation concepts | *"* Understanding Broadband Access Aggregation*" module* |
| Tasks for preparing for broadband access aggregation | *"* Preparing for Broadband Access Aggregation*" module* |
| Broadband access commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples | "Wide-Area Networking Commands" in the *Cisco IOS Wide-Area Networking Command Reference* |

### Standards

| Standards | Title |
|---|---|
| None | -- |

### MIBs

| MIBs | MIBs Link |
|---|---|
| None | To locate and download MIBs for selected platforms, Cisco IOS XE software releases, and feature sets, use Cisco MIB Locator found at the following URL:<br>http://www.cisco.com/go/mibs |

### RFCs

| RFCs | Title |
|---|---|
| None | -- |

### Technical Assistance

| Description | Link |
|---|---|
| The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.<br><br>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.<br><br>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. | http://www.cisco.com/cisco/web/support/index.html |

# Feature Information for Controlling Subscriber Bandwidth

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

***Table 1: Feature Information for Controlling Subscriber Bandwidth***

| Feature Name | Releases | Feature Configuration Information |
|---|---|---|
| Dynamic Subscriber Bandwidth Selection (DBS) | Cisco IOS XE Release 2.5 | This feature enables wholesale service providers to sell different classes of service to retail service providers by controlling bandwidth at the ATM virtual circuit (VC) level. ATM quality of service (QoS) parameters from the subscriber domain are applied to the ATM PVC on which a PPPoE or PPPoA session is established. |