

# Quality of Service for the NI-2 DSLAM

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## Introduction

This document explains the terms used in Asynchronous Transfer Mode (ATM) Quality of Service (QoS), their origins, and their meanings.

## Before You Begin

### Conventions

For more information on document conventions, see the Cisco Technical Tips Conventions.

### Prerequisites

Readers of this document should be knowledgeable of the following:

- How to configure a DSLAM.

### Components Used

This document is not restricted to specific software and hardware versions.

## Naming Conventions

The ATM Forum is now part of the International Telecommunication Union Telecommunication Standardization Sector (ITU-T). The following table shows the correlation between ATM Forum and ITU-T naming conventions.

ATM Forum TM4.0 ATM Service Category	ITU-T I.371 ATM Transfer	Typical use
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	Capability	
Constant Bit Rate (CBR)	Deterministic Bit Rate (DBR)	Real-time, QoS guarantees
Real-Time Variable Bit Rate (rt-VBR)	(for further study)	Statistical mux, real-time
Non-Real-Time Variable Bit Rate (nrt-VBR)	Statistical Bit Rate (SBR)	Statistical mux
Available Bit Rate (ABR)	ABR	Resource exploitation, feedback control
Unspecified Bit Rate (UBR)	(no equivalent)	Best effort, no guarantees
(no equivalent)	ATM Block Transfer (ABT)	Burst level feedback control

## Services

This section lists services and their capabilities.

### **CBR**

CBR is a category based on a constant (maximum) bandwidth allocation. In the ATM Forum it is called CBR and in ITU-T it's called DBR.

Typical applications are voice, video, and Circuit Emulation Services (CES).

### **Variable Bit Rate (VBR)**

VBR is a category based on a statistical (average) bandwidth allocation. VBR corresponds to the ATM Forum VBR and the ITU-T SBR. Two types exist: real-time (VBR-RT) and non real-time (VBR-NRT).

VBR-RT is intended for time-sensitive applications requiring tightly constrained delay and delay variation.

Typical applications are voice and video.

VBR-NRT is intended for bursty traffic characteristics and does not have tight constraints on delay and delay variation.

Typical applications are airline reservations, banking transactions, process monitoring, and Frame Relay internetworking.

### **ABR**

A category based on elastic bandwidth allocation, where the amount of reserved resources varies with time, depending on network availability. ABR is used by applications that can reduce or increase their information rates and by applications that have a vague requirement for throughput. The expression can be defined by maximum and minimum values rather than an average value like in the VBR.

Typical applications are Lane and TCP transfer.

## **UBR**

No explicit resource allocation is performed; neither bandwidth nor QoS objectives are specified.

Typical applications are image transfer, messaging, distribution.

## **Traffic Parameters**

Traffic parameters are a user's interpretation of the requirements for a given application and are set for each type of service. Following are the traffic parameters:

- Peak Cell Rate (PCR)
- Sustainable Cell Rate (SCR)
- Maximum Burst Size (MBS)
- Minimum Cell Rate (MCR)

The following table shows each type of service and its corresponding traffic parameters.

Type of Service	Parameters
CBR	PCR
VBR-RT	PCR, SCR, MBS
VBR-NRT	PCR, SCR, MBS
ABR	PCR, MCR+ behavior parameters
UBR	PCR

## **QoS Parameters**

### ***Cell Delay Variation (CDV)***

CDV can occur when cells from two or more ATM connections are multiplexed. Cells of a given ATM connection may be delayed while cells of another ATM connection are being serviced by the multiplexer. Similarly, some cells may be delayed while physical layer overhead or operation, administration, and maintenance (OAM) cells are inserted. Consequently, some randomness may affect the inter-arrival time between consecutive cells of a connection as monitored at the User-Network Interface (UNI). The upper bound on the clumping measure is the cell delay variation tolerance (CDVT).

### ***Maximum Cell Transfer Delay (Max CTD)***

Max CTD is the sum of the fixed delay component across the link or node and the maximum two-point objective across a link or node for the specified service category.

### ***Cell Loss Ratio (CLR)***

CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize the CLR, provided that the end-system adapts the traffic to the changing ATM layer transfer characteristics.

The CLR for a connection is defined as the ratio of *lost cells to total transmitted cells*.

## Provisioning and Maintaining Services

We need to allocate the resources first. This will be discussed during the negotiation with the Connection Admission Control (CAC).

CAC is defined as the set of actions taken by the network during the call setup or call re-negotiation phase to determine whether a connection request should be accepted or rejected, or whether a request for re-allocation can be accommodated.

The setup is monitored using Usage Parameter Control (UPC). UPC is the set of actions taken by the network to monitor and control traffic, in terms of traffic offered and validity of the ATM connection, at the end-system access. Its main purpose is to protect network resources from malicious and unintentional actions by detecting violations of negotiated parameters and taking appropriate actions.

The Generic Cell Rate Algorithm (GCRA) is used to define conformance with respect to the traffic contract of the connection. For each cell arrival, the GCRA determines whether the cell conforms to the traffic contract. The UPC function may implement the GCRA, or one or more equivalent algorithms to enforce conformance. The GCRA is defined with two parameters: the Increment (I) and the Limit (L).

## DSLAM-NI-2

### Advanced Services ATM Architecture

The Cisco 6160 internal design is based on a high-performance ATM switching architecture. This architecture includes more than one million cells of buffering, support for multiple ATM QoS levels, and a variety of ATM traffic management and shaping capabilities.

### Switched Virtual Circuits

Switched Virtual Circuits (SVCs) support for ITU-T and ATM Forum UNI 3.0, 3.1, and 4.0 SVCs provides end-user applications with real-time access to bandwidth and QoS. Support for Private Network Node Interface (PNNI) call routing and CAC is also included.

The Cisco 6260 supports the following subtending features:

- The capacity to run data as fast as the speed of its subtended link (an uplink cannot exceed OC-3 speed).
- Support for four arbitration priorities, one for each QoS level. The QoS service levels supported are:
  - ◆ CBR for rate-limited services that require guaranteed bandwidth and bounded delay.
  - ◆ VBR-RT for delay-sensitive voice and video services.
  - ◆ VBR-NRT for high-priority data services.
  - ◆ Unspecified bit rate (UBR) for low-priority data services.

## Configuring NI-2

For information about how to configure the NI-2, please see the Configuration Guide for Cisco DSLAMs with NI-2.

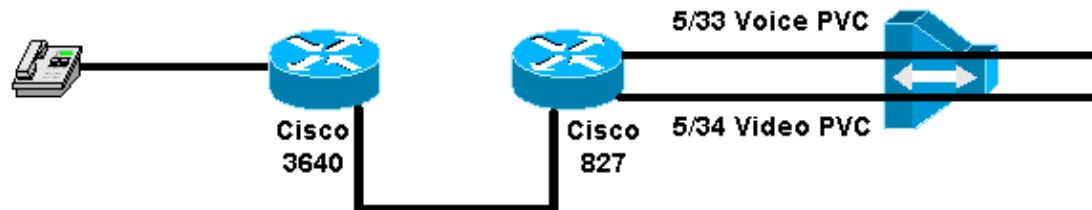
## Testing NI-2

### Topology

In this test we connected a Cisco 3640 with an FXS port to a Cisco 827 V4. The aim was to provide VBR-RT on the voice signals while a video was played (in real time) on another VC.

The training rate was set to 64/64 to cause the video to stop while a phone call was active.

The routers and DSLAM behaved as expected and we could see delays in the video display while the voice call was active.



### Configuration and show Command

#### User Side

When you allocate services on the user side, do it within the definition of the VC you are creating. Following is an example for the Cisco 827.

```
!  
interface ATM0.3 point-to-point  
ip address 172.16.20.2 255.255.255.0  
no ip directed-broadcast  
pvc 5/33  
vbr-rt 32 32 10  
encapsulation aal5snap
```

To verify that this is properly allocated, type the following command:

```
jigglypuff#show atm vc  
VCD / Peak Avg / Min Burst  
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells Sts  
0 10 0 16 PVC ILMI UBR 0 UP  
0 1 1 100 PVC SNAP UBR 640 UP  
0.3 2 5 33 PVC SNAP VBR 32 32 10 UP  
0.2 3 5 34 PVC MUX UBR 0 UP  
jigglypuff#
```

#### DSLAM Side

On the DSLAM we cannot allocate directly to a PVC; the cells are switched and the type of service is inserted in the **atm pvc** command by referring to an index.

An index is already built by default and can be seen by issuing the **show atm connection-traffic-table** command.

```
mewtwo#show atm connection-traffic-table  
  
Row Service-category pcr scr/mcr  
mbs cdvt
```

```

1 ubr 7113539 none none
2 cbr 424 none
3 vbr-rt 424 424 50 none
4 vbr-nrt 424 424 50 none
5 abr 424 0 none
6 ubr 424 none none
2147483644 vbr-rt 32 32 10 none
2147483645* ubr 0 none none
2147483646* ubr 1 none none
2147483647* ubr 7113539 none none

```

If you want a value different than the one provided in the table, you can provide your own. In this case, you might use this configuration:

```

conf t
config#atm connection-traffic-table-row index 63998
vbr-rt pcr 32 scr10 32 mbs 10 cdvt 1

```

The table is updated accordingly.

```

mewtwo#show atm connection-traffic-table
Row Service-category pcr scr/mcr mbs cdvt
1 ubr 7113539 none none
2 cbr 424 none
3 vbr-rt 424 424 50 none
4 vbr-nrt 424 424 50 none
5 abr 424 0 none
6 ubr 424 none none
63998 vbr-rt 32 32 10 1

2147483644 vbr-rt 32 32 10 none
2147483645* ubr 0 none none
2147483646* ubr 1 none none
2147483647* ubr 7113539 none none

```

After the table has been updated, you can assign it to the switched PVC.

```

interface ATM1/2
no ip address
dsl profile alain
no atm ilmi-keepalive
atm soft-vc 5 33 dest-address 47.0091.8100.0000.0010.073e.0b01.4000.0c80.0000.00
5 33 rx-cttr 63998 tx-cttr 63998
atm soft-vc 5 34 dest-address 47.0091.8100.0000.0050.736f.4c01.4000.0c83.0000.00
1 33 rx-cttr 1 tx-cttr 1
end

```

You can verify by using the following command:

```

mewtwo#show atm vc interface atM
1/2 5 33
Interface: ATM1/2, Type: dsl
VPI = 5 VCI = 33
Status: UP
Time-since-last-status-change: 01:37:50
Connection-type: SoftVC
Cast-type: point-to-point
Soft vc location: Source
Remote ATM address: 47.0091.8100.0000.0010.073e.0b01.4000.0c80.0000.00
Remote VPI: 5
Remote VCI: 33
Soft vc call state: Active
Number of soft vc re-try attempts: 0

```

```
First-retry-interval: 5000 milliseconds
Maximum-retry-interval: 60000 milliseconds
Aggregate admin weight: 10080
TIME STAMPS:
Current Slot:6
Outgoing Setup March 25 17:13:29.731
Incoming Connect March 25 17:13:29.751
Outgoing Release March 25 17:21:12.127
Incoming Rel comp March 25 17:21:12.127
Outgoing Setup March 25 17:21:25.259
Incoming Connect March 25 17:21:25.291
Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states: Not-applicable
Cross-connect-interface: ATM0/1,
```

Type: suni\_dual

```
Cross-connect-VPI = 0
Cross-connect-VCI = 49
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state: Not-applicable
Rx cells: 7004, Tx cells: 18298
Rx connection-traffic-table-index:
```

**63998**

```
Rx service-category: VBR-RT
(Realtime Variable Bit Rate)
Rx pcr-clp01: 32
Rx scr-clp01: 32
Rx mcr-clp01: none
Rx cdvt: 1
Rx mbs: 10
```

```
Tx connection-traffic-table-index:
63998
```

```
Tx service-category: VBR-RT (Realtime
(Variable Bit Rate)
Tx pcr-clp01: 32
Tx scr-clp01: 32
Tx mcr-clp01: none
Tx cdvt: 1
Tx mbs: 10
mewtwo#
```

## Other Commands

If the soft-VC or a later SVC fails to come up, maybe it's because the interface that it is crossing doesn't have the resources to provide the service.

```
mewtwo# show atm interface resource atm 1/2
Resource Management configuration:
Output queues:
Max sizes(derived): 256 cbr, 256 vbr-rt, 2048 vbr-nrt, 2048 ubr
EPD threshold: 128 cbr, 128 vbr-rt, 1024 vbr-nrt, 1024 ubr
Drop threshold: 128 cbr, 128 vbr-rt, 1024 vbr-nrt, 1024 ubr
Input queues:
Max sizes(explicit cfg): none cbr, none vbr-rt, none vbr-nrt, none ubr
Max sizes(installed): 1024 cbr, 1024 vbr-rt, 8192 vbr-nrt, 8192 ubr
Pacing: disabled 0 Kbps rate configured, 0 Kbps rate installed
Service Categories supported: cbr,vbr-rt,vbr-nrt,abr,ubr
Link Distance: 0 kilometers
Controlled Link sharing:
Max aggregate guaranteed services: none RX, none TX
```

```
Max bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
none abr RX, none abr TX, none ubr RX, none ubr TX
Min bandwidth: none cbr RX, none cbr TX, none vbr RX, none vbr TX,
none abr RX, none abr TX, none ubr RX, none ubr TX
Best effort connection limit: disabled 0 max connections
Max traffic parameters by service (rate in Kbps, tolerance in cell-times):
Peak-cell-rate RX: none cbr, none vbr, none abr, none ubr
Peak-cell-rate TX: none cbr, none vbr, none abr, none ubr
Sustained-cell-rate: none vbr RX, none vbr TX
Minimum-cell-rate RX: none abr, none ubr
Minimum-cell-rate TX: none abr, none ubr
CDVT RX: none cbr, none vbr, none abr, none ubr
CDVT TX: none cbr, none vbr, none abr, none ubr
MBS: none vbr RX, none vbr TX
Resource Management state:
Cell-counts: 0 cbr, 0 vbr-rt, 0 vbr-nrt, 0 ubr
Available bit rates (in Kbps):
852 cbr RX, 8192 cbr TX, 852 vbr RX, 8192 vbr TX,
852 abr RX, 8192 abr TX, 852 ubr RX, 8192 ubr TX
Allocated bit rates:
0 cbr RX, 0 cbr TX, 32 vbr RX, 32 vbr TX,
0 abr RX, 0 abr TX, 0 ubr RX, 0 ubr TX
Best effort connections: 1 pvcs, 0 svcs
mewtwo#
```

Accounting information of the different contract can be displayed as well.

```
mewtwo#show atm interface resource atm 1/2 accounting
RCAC result statistics (by request service category):
cbr:
0 satisfied, 0 no bandwidth, 0 delay
0 loss, 0 delay variation, 0 traffic parameter
vbr-rt:
2 satisfied, 0 unsupported combination, 0 no bandwidth
0 delay, 0 loss, 0 delay variation
0 traffic parameter
vbr-nrt:
1 satisfied, 0 unsupported combination, 0 no bandwidth
0 loss, 0 traffic parameter
abr:
0 satisfied, 0 traffic parameter, 0 best effort limit
ubr:
4 satisfied, 0 traffic parameter, 0 best effort limit
mewtwo#
```

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## Related Information

- [Configuring Resource Management on a DSLAM](#)
- [DSL and LRE Technical Support](#)
- [Dial Technology Support Pages](#)
- [Technical Support – Cisco Systems](#)

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