Understanding the CBR Service Category for ATM VCs

Contents

Introduction

Among the standards published by the ATM Forum for ATM technology is the [Traffic Management Specification Version 4.0](#) . This standard defines five service classes that describe the user traffic transmitted on a network and the quality of service that a network needs to provide for that traffic. The five service classes are:

- constant bit rate (CBR)
- [Variable bit rate non-real-time (VBR-nrt)](#)
- [Variable bit rate real-time (VBR-rt)](#)
- [Available bit rate (ABR)](#)
- unspecified bit rate ([UBR](#)) and [UBR+](#)

The purpose of this technical note is to:

- Define CBR
- Clarify the differences between CBR and circuit emulation service (CES)
- Clarify the differences between voice CBR and data CBR

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

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

Conventions

Refer to [Cisco Technical Tips Conventions](#) for more information on document conventions.

What Is Constant Bit Rate?

The CBR service class is designed for ATM virtual circuits (VCs) needing a static amount of bandwidth that is continuously available for the duration of the active connection. An ATM VC configured as CBR can send cells at peak cell rate (PCR) at any time and for any duration. It can also send cells at a rate less than the PCR or even emit no cells.

You define the required bandwidth in kbps by specifying a PCR. For example, the **cbr 64** command creates a CBR PVC with a PCR of 64 kbps.

Understanding CBR vs. CES

It is important to clarify the differences between CBR and CES. As described above, CBR defines an ATM class of user traffic. In contrast, CES defines a method of carrying traffic from non-ATM telephony devices over an ATM cloud. In fact, CES provides an interworking function (IWF) that allows the two protocols to communicate. To do so, Cisco ATM modules supporting CES or voice CBR (see below) provide two interface types:

- One or more CBR interfaces (typically physical T1s or E1s) - Connects to non-ATM, telephony devices, such as a private branch exchange (PBX) or time-division multiplexer (TDM). Identify the CBR port with the interface cbr command on the PA-A2 or **ces mod/port** on the NM-1A-OC3-1V.
- One ATM interface - Connects to ATM cloud. Identify the ATM port with the **interface atm** command.

With CES applications, the source router accepts standard T1 or E1 frames on the CBR port, converts these frames into ATM cells, and transmits the cells out the ATM interface through the ATM cloud. The destination router reassembles the ATM cells and sends them back through the interworking function to a CBR port.

The CES specification mandates the transmission of voice traffic on CBR VCs.

Understanding CES-CDV vs CDVT

The CBR service class is designed for real-time applications, particularly those involving voice and video, for which overall network delay is often critical. Delay introduced by the ATM network interconnecting two CES IWFs consists of the following two parameters:

- Cell transfer delay (CTD) -- Defines the largest expected cell delay between entrance into and

exit from the ATM network.

- Cell delay variation (CDV) -- Defines the jitter or variation in the delay that might be experienced by any particular cell.

The reassembly process on the receive side of the ATM network needs a buffer in which the reassembled cell stream is stored before it is transmitted out the T1 interface. In other words, CES hardware must have reassembly buffers large enough to accommodate the largest CDV present on a VC to prevent underflow and overflow, yet not so large as to induce excessive overall delay. On Cisco router interfaces supporting CES, select a value for CDV with the following commands depending on the interface hardware:

- PA-A2 - Use the **ces circuit {*circuit ID} {cdv 1-65535}*** command.
- NM-1A-OC3-1V - Use the **ces-cdv *time*** command.

Again, it is important to emphasize that this value should optimize the jitter versus absolute delay trade-off. Set the parameter to a small value if the end-to-end path will produce minimal CDV, and a large value if the connection will produce large CDV. Use the **show ces circuit interface cbr** command to verify the configured value and to monitor the measured value.

```
router# show ces circuit interface cbr 6/0 1

circuit: Name CBR6/0:1, Circuit-state ADMIN_UP / Interface CBR6/0, Circuit_id 1,
Port-Type T1, Port-State UP
Port Clocking network-derived, aal1 Clocking Method CESIWF_AAL1_CLOCK_Sync
Channel in use on this port: 1
Channels used by this circuit: 1
Cell-Rate: 171, Bit-Rate 64000
cas OFF, cell-header 0X3E80 (vci = 1000)
Configured CDV 2000 usecs, Measured CDV unavailable
ErrTolerance 8, idleCircuitdetect OFF, onHookIdleCode 0x0
state: VcActive, maxQueueDepth       128, startDequeueDepth       111
Partial Fill:      47, Structured Data Transfer 24
HardPVC
src: CBR6/0 vpi 0, vci 16
Dst: ATM6/0 vpi0, vci 1000
```

The amount of CDV that the reassembly process can accommodate can also be configured with the MIB entry atmfCESCdvRxT.

It is important to note the following three points about the above CDV value:

- This value is a receive-side value only. It does not affect the delay that may be introduced by the ATM router interface in supplying cells to the network. Ideally, an ATM router interface schedules cells of a given VC at an even inter-cell gap. This ideal time may be delayed or affected by OAM cells, cells carrying the physical layer framing, or cells from other VCs configured on the same interface and competing for the same cell timeslot.
- This value is very different from the cell delay variation tolerance (CDVT) parameter. CDVT is the tolerance a switch will allow when policing the PCR of a given VC. Traffic policing may be performed on cells generated by the CES IWF and transported by the ATM network. The CDVT parameter should take into account any cell delay variation caused by the reasons stated in the paragraph above. In the context of CES, CDVT is considered a network option and, per the CES recommendation, is currently not subject to standardization.
- The **show ces circuit interface cbr** command includes two values -- "maxQueueDepth" and "startQueueDepth." The "maxQueueDepth" value defines the play-out buffer size in cells. The

"startDequeueDepth" value defines how many cells the CES IWF stores before "playing the buffer out" and typically is set to half the play-out buffer size. Using an overly large buffer size can add a measurable amount of delay to the overall CTD.

The number of intervening switches, their queue management, and line speeds have a significant impact on the distribution of CDV that must be handled by the reassembly buffer in the destination IWF. There are currently no standards that define a boundary on CDV; however, some information on CDV and reassembly buffer sizes can be found in GR-1110-CORE and in the ATM Forum's Approved ATM Forum Specifications B-ICI 1.1 specification, section 5.1.2, which gives an approximation of how CDV accumulates across multiple nodes.

CBR for Voice vs. CBR for Data

ATM actually defines a protocol stack consisting of three layers. The ATM adaptation layer (AAL) supports the QoS needs of an ATM service class like CBR or VBR-nrt, and better enables an ATM network to carry different traffic types. AAL1 and AAL5 are the two most commonly used AAL types.

Cisco documentation differentiates between CBR for voice and CBR for data, depending on the AAL type supporting the CBR virtual connection. CBR for voice, which includes CES and voice over ATM applications, uses AAL1. A one-byte AAL1 header uses time stamps, sequence numbers and other bits to help the ATM network deal with ATM-layer defects like cell delay variation, cell mis-insertion, and cell loss. CBR for data uses AAL5, and the same interface typically does not support CBR for voice either. AAL5 adds an eight-byte trailer with a four-byte CRC for detecting errors in a protocol data unit (PDU).

Note that the AAL sublayer functions, which include segmentation and reassembly, are performed only at the user side of a user-network interface (UNI) between a router or Catalyst ATM module and an ATM switch.

CBR Interface Hardware

Cisco now offers several interface hardware modules and adapters that support the CBR service class. Initially, Cisco offered the PA-A2 port adapter for the 7200 router series. With Cisco IOS® Software Release 12.1(2)T, Cisco introduced NM-1A-OC3-1V and NM-1A-T3, both of which support CBR.

Interface Hardware	Supported Platform(s)	Data CBR	Voice CBR
PA-A2-4T1C-OC3SM, PA-A2-4T1C-T3ATM	7200	-	Yes
PA-A3 (see note below)	7200, 7500	Yes	-
PA-A6 (see note below)	7200, 7500	Yes	-
NM-1A-OC3-1V	3600	-	Yes
NM-1A-OC3	3600	Yes	-
NM-1A-T3	2600, 3600	Yes	-
AIM-ATM, AIM-ATM-	2600, 3600	Yes	-

VOICE 30			
WIC-1SHDSL*	1700, 2600 (not 2691), 3600	Yes	No
WIC-1ADSL*	1700, 2600, 3600, 2691, 3725, 3745	Yes	No
ADSL over ISDN* port	826 and 827	Yes	No
Multiflex Trunk (MFT)	MC3810	-	Yes

Note: Configuring a VBR-nrt PVC with the PCR and SCR set to the same value while lowering the transmit-priority of the VC provides equivalent real-time service class performance on the PA-A3 and PA-A6 for CBR for data. Cisco IOS release 12.2 introduced two new SAR priority levels to support proper prioritization for CBR and VBR-rt when competition for cell timeslots arises. It also introduced the ability to configure CBR and VBR-rt at the command line. For more information, see Understanding Router Support for ATM Real-Time Service Categories.

The AIM-ATM and AIM-ATM-VOICE 30 support CBR, VBR-nrt, VBR-rt, ABR, and UBR. Requests to transmit packets (or cells) are sent via open "channels". Use the **show controller atm** command to see the channel per VC. Channels may be configured with one of four priorities and one of three traffic classes (CBR, VBR, ABR). ATM Forum classes (CBR, VBR-rt, VBR-nrt, UBR, UBR+) may be configured by using combinations of channel priority and traffic class. CBR is assigned the highest priority level. The AIM does not support the **transmit-priority** command.

The built-in ADSL over ISDN (ADSLoISDN) port supports CBR.

Voice CBR on the NM-1A-OC3-1V

Configuring the NM-1A-OC3-1V for CBR voice services involves the following two steps:

1. Configure a VC with CES encapsulation on the ATM interface.
2. Configure the parameters of the CBR or VWIC ports.

To create a CBR PVC, add the CES keyword to the end of the PVC statement. This places you in interface-ces-vc configuration mode, from which you can optionally enter the receive-side CDV, or playout buffer size.

```
router# show ces circuit interface cbr 6/0 1

circuit: Name CBR6/0:1, Circuit-state ADMIN_UP / Interface CBR6/0, Circuit_id 1,
Port-Type T1, Port-State UP
Port Clocking network-derived, aal1 Clocking Method CESIWF_AAL1_CLOCK_Sync
Channel in use on this port: 1
Channels used by this circuit: 1
Cell-Rate: 171, Bit-Rate 64000
cas OFF, cell-header 0X3E80 (vci = 1000)
Configured CDV 2000 usecs, Measured CDV unavailable
ErrTolerance 8, idleCircuitdetect OFF, onHookIdleCode 0x0
state: VcActive, maxQueueDepth        128, startDequeueDepth        111
Partial Fill:        47, Structured Data Transfer 24
HardPVC
src: CBR6/0 vpi 0, vci 16
Dst: ATM6/0 vpi0, vci 1000
```

Command	Description

pvc [name] vpi/vci [ces]	Configures an ATM PVC with a VPI and VCI. Optionally specify CES encapsulation, which is equivalent to defining CBR class of service.
ces-cdv time	Optimizes the size of the playout buffer on the T1/E1 side. Time is the maximum tolerable jitter or difference in the cell arrival rate. Supported values range from one to 65,535 microseconds.
connect connection-name atm slot/port [name of PVC/SVC|vpi/vci] T1 slot/port TDM-group-number	Connects the CBR port to the ATM VC.
clock-select priority-no interface slot/port	

The NM-1A-OC3-1V comes with a voice processing deck (VPD) that plugs into into the base ATM network module. (At initial shipment, the VPD is not a field-upgradable option.) The VPD adds CBR for voice and AAL1 CES services to the Cisco 3600 series. The VPD accepts frames from up to four standard T1 and E1 ports, converts the frames into ATM cells, and then sends the cells across its cell interface to the ATM base card. This card, in turn, schedules these cells for transmission onto the physical wire.

A VWIC installed in the NM-1A-OC3-1V connects to the voice device and provides up to two T1 or E1 streams. Optionally, VWICs installed in another network module, such as a NM-1FE2W, provide additional T1 or E1 streams. It is important to note that this cross-connect capability from other NMs is available only with a 3660 having a TDM-enabled backplane and the multiservice interchange card, also called a MIX module (MIX-3660-64).

Cisco offers the following VWICs:

- VWIC-1MFT-T1=, VWIC-1MFT-E1=
- VWIC-2MFT-T1=, VWIC-2MFT-E1=
- VWIC-2MFT-T1-DI=, VWIC-2MFT-E1-DI=

Data CBR on the NM-1A-OC3 and NM-1A-T3

The NM-1A-OC3 and NM-1A-T3 support CBR for data using AAL5. To create a CBR PVC, use the cbr {rate} command and define a PCR.

```
interface ATM4/0.1 multipoint
  ip address 192.168.1.2 255.255.255.0
  pvc 1/50
    cbr 16000
```

Recall that CBR guarantees the PCR bandwidth to the VC as long as the VC is active. The **show atm interface atm** command displays the amount of bandwidth available after subtracting the reserved bandwidth specified in the CBR configuration statements. In the following example, an ATM OC-3 interface starts with 155 Mbps of bandwidth and reserves 16 Mbps for the CBR VC.

```
Router#show atm interface atm 4/0.1

 Interface ATM4/0.1:
 AAL enabled: AAL5 , Maximum VCs:1024, Current VCCs:5
 Maximum Transmit Channels:64
 Max. Datagram Size:4496
 PLIM Type:SONET - 155Mbps, TX clocking:LINE
 Cell-payload scrambling:OFF
 sts-stream scrambling:ON
 877 input, 120843834 output, 0 IN fast, 20 OUT fast
 Bandwidth distribution :CBR :16000 Avail bw = 139000
 Config. is ACTIVE
```

CBR on the MC3810

The multiflex trunk module (MFT) for the MC3810 provides one T1/E1 port with a built-in CSU/DSU. Using configuration commands, you can change the framing between T1 and E1 as well as change the supported layer-2 modes.

Use the **mode atm** command to change the mode type and create logical interface atm0. In ATM mode, the MFT supports data and video in AAL1 format and compressed voice or data in AAL5 format.

```
router(config)#controller {t1 | e1} 0
router(config-controller)#mode atm
```

After creating interface atm0, you can configure the ATM encapsulation type. The MFT supports five types of ATM encapsulation:

Encapsulation	ATM Service Class
aal1	CBR
aal5snap (without traffic-shaping parameters)	VBR-nrt
aal5snap (without traffic-shaping parameters)	UBR
aal5mux voice	VBR-rt
aal5muxframe-relay	VBR-nrt

To support ATM on the MFT, your MC3810 must be running a Voice over ATM image of Cisco IOS. Use the **show version** command to view the running image. A Voice over ATM image uses an "a" in the image name, such as **mc3810-a2i5s-mz** for "IP Plus VoATM no ISDN."

Related Information

- **Understanding the VBR-nrt Service Category and Traffic Shaping for ATM VCs**
- **Understanding the Variable Bit Rate Real Time (VBR-rt) Service Category for ATM VCs**
- **Understanding the Available Bit Rate (ABR) Service Category for ATM VCs**
- **Understanding the UBR Service Category for ATM VCs**
- **Understanding the UBR+ Service Category for ATM VCs**
- **Understanding Router Support for ATM Real-Time Service Categories**
- **Technical Support & Documentation - Cisco Systems**