

ATM Connections

This chapter describes how ATM connection services are established by adding ATM connections between ATM service interface ports in the network using ATM standard UNI 3.1 and Traffic Management 4.0. It describes BXM and ASI card operation and summarizes ATM connection parameter configuration

The chapter contains the following:

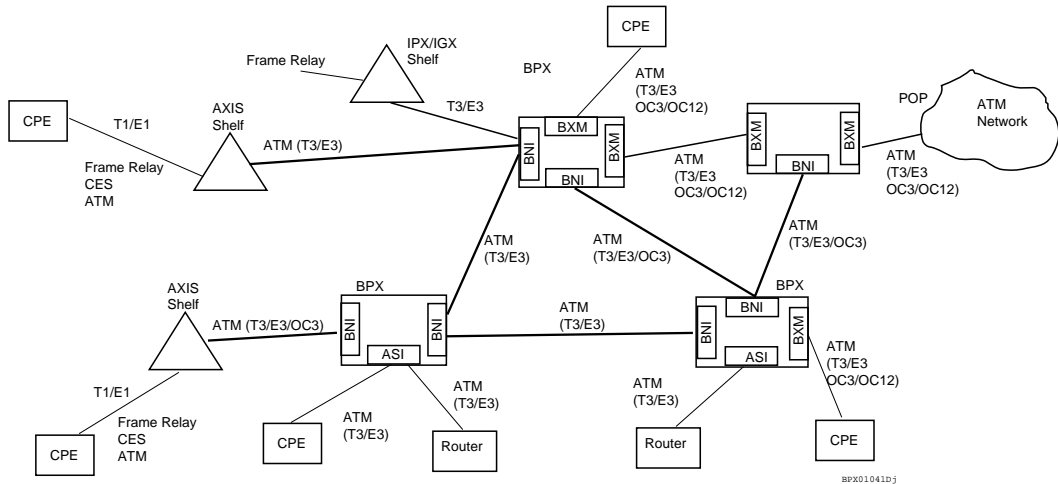
- ATM Connection Services
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- ATM Connection Requirements
- ATM Connection Configuration
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ATM Connection Services

ATM connection services are established by adding ATM connections between ATM service interface ports in the network. ATM connections can originate and terminate on the ASI (ATM Service Interface) cards, on BXM-T3/E3, BXM-155 (OC-3), and BXM-622 (OC-12) cards configured for port (service access) operation on the BPX, or on the AXIS shelf (using the AUSM card for the AXIS). Frame relay to ATM network interworking connections are supported between either BXM or ASI cards to the IPX, IGX, or AXIS. Frame relay to ATM service interworking connections are supported between either BXM or ASI cards to FRSM cards on the AXIS shelf.

Figure 10-1 is a depiction of ATM connections over a BPX network. It shows ATM connections via BXM-T3/E3, BXM-155, BXM-622, ASI-1, and ASI-155 cards, as well as over AXIS shelves. It also shows frame relay to ATM interworking connections over AXIS, IPX, and IGX shelves. For further information on the AXIS shelf, refer to the *AXIS Reference* document.

Figure 10-1 ATM Connections over a BPX Network



SVCs

When an Extended Services Processor (ESP) is co-located with a BPX Extended Services Node, ATM and Frame Relay Switched Virtual Circuits (SVCs) are supported in addition to Permanent Virtual Circuits (PVCs). For further information on ATM SVCs, refer to Chapter 10, SVCs, ATM and Frame Relay and to the *BPX Service Node Extended Processor Installation and Operation document*.

Traffic Management Overview

The ATM Forum Traffic Management 4.0 Specification defines five basic traffic classes:

- CBR (Constant Bit Rate)
- rt-VBR (Real-Time Variable Bit Rate)
- nrt-VBR (Non-Real Time Variable Bit Rate)
- UBR (Unspecified Bit Rate)
- ABR (Available Bit Rate)

Table 10-1 summarizes the major attributes of each of the traffic management classes:

Table 10-1 Standard ATM Traffic Classes

Attribute	CBR	rt-VBR	nrt-VBR	UBR	ABR
Traffic Parameters					
PCR & CDVT	x	x	x	x	x
SCR & MBS		x	x		
MCR					x
QoS Parameters					
Pk-to-Pk CDV	x	x			
Max CTD	x	x			
CLR	x	x	x		nw specific
Other Attributes					
Congestion Control Feedback					x

Traffic parameters are defined as:

- PCR (Peak Cell Rate in cells/sec): the maximum rate at which a connection can transmit
- CDVT (Cell Delay Variation Tolerance in usec): establishes the time scale over which the PCR is policed. This is set to allow for jitter (CDV) that is introduced for example, by upstream nodes.
- MBS (Maximum Burst Size in cells): is the maximum number of cells that may burst at the PCR but still be compliant. This is used to determine the BT (Burst Tolerance) which controls the time scale over which the SCR (Sustained Cell Rate) is policed.
- MCR (Minimum Cell Rate in cells per second): is the minimum cell rate contracted for delivery by the network.

QoS (Quality of Service) parameters are defined as:

- CDV (Cell Delay Variation): a measure of the cell jitter introduced by network elements
- Max CTD (Cell Transfer Delay): is the maximum delay incurred by a cell (including propagation and buffering delays).
- CLR (Cell Loss Ratio): is the percentage of transmitted cells that are lost.

Congestion Control Feedback:

- With ABR, provides a means to control flow based on congestion measurement.

ABR, Standard ATM Traffic Mgt 4.0

Standard ABR notes:

Standard ABR uses RM (Resource Management) cells to carry feedback information back to the connection's source from the connection's destination.

ABR sources periodically interleave RM cells into the data they are transmitting. These RM cells are called forward RM cells because they travel in the same direction as the data. At the destination these cells are turned around and sent back to the source as Backward RM cells.

The RM cells contain fields to increase or decrease the rate (the CI and NI fields) or set it at a particular value (the explicit rate ER field). The intervening switches may adjust these fields according to network conditions. When the source receives an RM cell it must adjust its rate in response to the setting of these fields.

VSVD Description

ABR sources and destinations are linked via bi-directional connections, and each connection termination point is both a source and a destination; a source for data that it is transmitting, and a destination for data that it is receiving. The forward direction is defined as from source to destination, and the backward direction is defined as from destination to source. Figure 10-2 shows the data cell flow in the forward direction from a source to its destination along with its associated control loop. The control loop consists of two RM cell flows, one in the forward direction (from source to destination) and the other in the backward direction (from destination to source).

The data cell flow in the backward direction from destination to source is not shown, nor are the associated RM cell flows. However, these flows are just the opposite of that shown in the diagram for forward data cell flows.

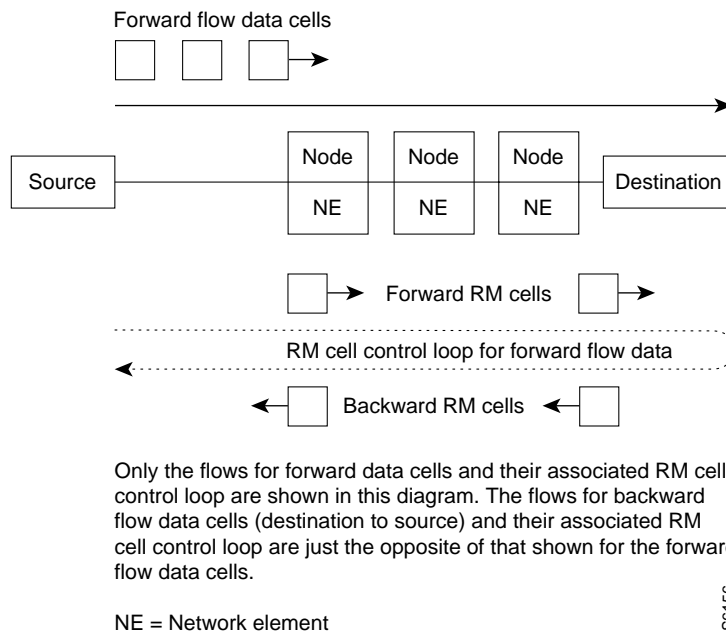
A source generates forward RM cells which are turned around by the destination and returned to the source as backward RM-cells. These backward RM-cells may carry feedback information from the network elements and/or the destination back to the source.

The parameter N_{rm} is defined as the maximum number of cells a source may send for each forward RM cell, i.e., one RM cell must be sent for every $N_{rm}-1$ data cells. Also, in the absence of $N_{rm}-1$ data cells, as an upper bound on the time between forward RM cells for an active source, an RM cell must be sent at least once every T_{rm} msec.

BXM Connections

The BXM-T3/E3, BXM-155, and BXM-622 cards support ATM Traffic Management 4.0. The BXM cards are designed to support all the following service classes: Constant Bit Rate (CBR), Variable Bit Rate (VBR), Available Bit Rate (ABR with VS/VD, ABR without VS/VD, and ABR using Foresight), and Unspecified Bit Rate (UBR). ABR with VS/VD supports explicit rate marking and Congestion Indication (CI) control.

Figure 10-2 ABR VSVD Flow Control Diagram



Only the flows for forward data cells and their associated RM cell control loop are shown in this diagram. The flows for backward flow data cells (destination to source) and their associated RM cell control loop are just the opposite of that shown for the forward flow data cells.

NE = Network element

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ForeSight Congestion Control

ForeSight may be used for congestion control across BPX/IGX/IPX switches for connections that have one or both end points terminating on ASI-T3/E3 or BXM cards. The ForeSight feature is a proprietary dynamic closed-loop, rate-based, congestion management feature that yields bandwidth savings compared to non-ForeSight equipped trunks when transmitting bursty data across cell-based networks. The BXM cards also support the VSVD congestion control mechanism as specified in the ATM Traffic Management 4.0 standards.

ATM Connection Requirements

There are two connection addressing modes supported. The user may enter a unique VPI/VCI address in which case the BPX functions as a virtual circuit switch. Or the user may enter only a VPI address in which case all circuits are switched to the same destination port and the BPX functions as a virtual path switch in this case. The full ATM address range for VPI and VCI is supported. Virtual Path Connections are identified by an * in the VCI field. Virtual Circuit Connections specify both the VPI and VCI fields.

The VPI and VCI fields have significance only to the local BPX, and are translated by tables in the BPX to route the connection. Connections are automatically routed by the AutoRoute feature once the connection endpoints are specified.

ATM connections can be added using either the StrataView Plus Connection Manager or a node's command line interface (CLI). Typically, the StrataView Plus Connection Manager is the preferred method as it has an easy to use GUI interface. The CLI may be the method of choice in some special cases or during initial node setup for local nodes.

When adding ATM connections, first the access port and access service lines connecting to the customer CPE need to be configured. Also, the trunks across the network need to be configured appropriately for the type of connection. Following that the **addcon** command may be used to add a connection, first specifying the service type and then the appropriate parameters for the connection.

For example, when configuring a BXM for CPE connections, the BXM is configured for port mode, a line is upped with the **upln** command and configured with the **cnfln** command. Then the associated port is configured with the **cnfport** command and upped with the **upport** command. Following this, the ATM connections are added via the **addcon** command with the syntax.

Connection Routing

ATM connections for a BXM or ASI card are identified as follows:

- slot number (in the BPX shelf where the BXM or ASI is located)
- port number (one of the ATM ports on the BXM or ASI)
- Virtual Path Identifier (VPI)
- Virtual Circuit Identifier (VCI) – (* for virtual path connections).

The slot and port are related to the BPX hardware. Virtual path connections (VPCs) are identified by a “*” for the VCI field. Virtual circuit connections (VCCs) are identified by both a VPI and VCI field.

Connections added to the network are automatically routed once the end points are specified. This AutoRoute feature is standard with all BPX, IGX, and IPX nodes. The network automatically detects trunk failures and routes connections around the failures.

Addcon Command Syntax

The following parameters are entered for BXM **addcon** command. Depending upon the connection type, the user is prompted for the appropriate parameters as shown in the following:

```
addcon local_addr node remote_addr traffic_type...extended parameters
```

Field	Value	Description
local/remote_addr	slot.port.vpi.vci	desired VCC or VPI connection identifier
node		slave end of connection
traffic_type		Type of traffic, chosen from CBR, VBR, ABR, and UBR
extended parameters		The traffic management and performance parameters associated with an ATM connection.

Note The range of VPIs and VCIs reserved for PVC traffic and SVC traffic is configurable using the **cnfport** command. While adding connections, the system checks the entered VPI/VPC against the range reserved for SVC traffic. If there is a conflict, the **addcon** command fails with the message “VPI/VCI on selected port is reserved at local/remote end”.

ATM Connection Configuration

The following figures and tables describe the parameters used to configure ATM connections:

- Table 10-2, Traffic Policing Definitions.
 - This table describes the policing options that may be selected for ATM connection types: CBR, UBR, and VBR. The policing options for ABR are the same as for VBR.
- Table 10-3, Connection Parameter Default Settings and Ranges
 - This table specifies the ATM connection parameter ranges and defaults. Not all the parameters are used for every connection type. When adding connections, you are prompted for the applicable parameters, as specified in the prompt sequence diagrams included in Figure 10-3 through Figure 10-10.
- Table 10-4, Connection Parameter Descriptions
 - This table defines the connection parameters listed in Table 10-3.

The following figures list the connection parameters in the same sequence as they are entered when a connection is added:

- Figure 10-3, CBR Connection Prompt Sequence
- Figure 10-4, VBR Connection Prompt Sequence
- Figure 10-5, ATFR Connection Prompt Sequence
- Figure 10-6, ABR Standard Connection Prompt Sequence

The following figure shows the VSVD network segment and external segment options available when ABR Standard or ABR ForeSight is selected. ForeSight congestion control is useful when both ends of a connection do not terminate on BXM cards. At present, FCES (Flow Control External Segment) as shown in Figure 10-7 is not available for ABR with ForeSight.

- Figure 10-7, Meaning of VSVD and Flow Connection External Segments

The following figures list the connection parameters in the same sequence as they are entered when a connection is added:

- Figure 10-8, ABR ForeSight Connection Prompt Sequence
- Figure 10-9, ATFST Connection Prompt Sequence
- Figure 10-10, UBR Connection Prompt Sequence

Table 10-2 Traffic Policing Definitions

Connection Type	ATM Forum TM spec. 4.0 conformance definition	PCR Flow (1st leaky bucket)	CLP tagging (for PCR flow)	SCR Flow (2nd leaky bucket)	CLP tagging (for SCR flow)
CBR	CBR.1 when policing set to 4 (PCR Policing only)	CLP(0+1)	no	off	n/a
CBR	When policing set to 5 (off)	off	n/a	off	n/a
UBR	UBR.1 when CLP setting = no	CLP(0+1)	no	off	n/a
UBR	UBR.2 when CLP setting = yes	CLP(0+1)	no	CLP(0)	yes
VBR, ABR, ATFR, ATFST	VBR.1 when policing set to 1	CLP(0+1)	no	CLP(0+1)	no
VBR, ABR, ATFR, ATFST	VBR.2 when policing set to 2	CLP(0+1)	no	CLP(0)	no
VBR, ABR, ATFR, ATFST	VBR.3 when policing set to 3	CLP(0+1)	no	CLP(0)	yes
VBR, ABR, ATFR, ATFST	when Policing set to 4	CLP(0+1)	no	off	n/a
VBR, ABR, ATFR, ATFST	when Policing set to 5 for off)	off	n/a	off	n/a

Note 1: - For UBR.2, SCR = 0

Note 2:

- CLP = Cell Lost Priority
- CLP(0) means cells that have CLP = 0
- CLP(1) means cells that have CLP = 1
- CLP(0+1) means both types of cells: CLP = 0 & CLP = 1
- CLP(0) has higher priority than CLP(1)
- CLP tagging means to change CLP = 0 to CLP = 1, where CLP= 1 cells have lower priority

Table 10-3 Connection Parameters with Default Settings and Ranges

PARAMETER WITH [DEFAULT SETTING]	BXM T3/E3, OC3 & OC12 RANGE	ASI T3/E3 RANGE	ASI-155 RANGE
PCR(0+1)[50/50]	50- T3/E3 cells/sec 50 - OC3 50 - OC12	T3: MCR – 96000 E3: MCR – 80000 Limited to MCR – 5333 cells/sec for ATFR connections.	OC3 (STM1): 0 – 353200
%Util[100/100] for UBR [1/1]	0 - 100%	1 - 100%	1 - 100%
MCR[50/50]	cells/sec 6 - T3/E3OC3/OC12	T3: 0 – 96000 cells/sec E3: 0 – 80000 cells/sec	N/A
FBTC (AAL5 Frame Base Traffic Control): for VBR [disable] for ABR/UBR [enable] for Path connection [disable]	enable/disable	enable/disable	enable/disable
CDVT(0+1): for CBR [10000/10000], others [250000/250000]	0 - 5,000,000 usec	T3/E3 1 – 250,000 usecs.	OC3/STM1: 0 – 10000 usecs.
VSVD[disable]	enable/disable	enable/disable	Select disable, as only ABR w/o VSVD is supported.
FCES (Flow Control External Segment) [disable]	enable/disable	enable/disable	N/A
Default Extended Parameters[enable]	enable/disable	enable/disable	N/A
CLP Setting[enable]	enable/disable	enable/disable	enable/disable
SCR [50/50]	cells/sec 50 - T3/E3OC3/OC12	T3: MCR – 96000:T3 E3: MCR – 80000: E3 Limited to MCR – 5333 cells/sec for ATFR connections.	OC3/STM1: 0 – 353200
MBS [1000/1000]	1 - 5,000,000cells	T3/E3: 1 – 24000 cells	OC3 (STM1): 10 – 1000 cells
Policing[3] For CBR: [4]	1 - VBR.1 2 - VBR.2 3 - VBR.3 4 - PCR policing only 5 - off	1 - VBR.1 2 - VBR.2 3 - VBR.3 4 - PCR policing only 5 - off	1 - VBR.1 2 - VBR.2 3 - VBR.3 4 - PCR policing only 5 - off

ATM Connection Configuration

PARAMETER WITH [DEFAULT SETTING]	BXM T3/E3, OC3 & OC12 RANGE	ASI T3/E3 RANGE	ASI-155 RANGE
ICR: max[MCR, PCR/10]	MCR - PCR cells/sec	MCR - PCR cells/sec	N/A
ADTF[1000]	62 - 8000 msec	1000 – 255000 msec.	N/A
Trm[100]	ABR std: 1 - 100 msec ABR (FST): 3 - 255 msec	20 – 250 msec.	N/A
VC QDepth [16000/16000] For ATFR/ATFST [1366/1366]	0 - 64140 cells	Applies to T3/E3 only ABR: 1 – 64000 cells ATFR: 1 – 1366 cells	ATFR: 1 – 1366 cells
CLP Hi [80/80]	0 - 100%	0 – 100%	N/A
CLP Lo/EPD [35/35]	0 - 100%	0 – 100%	N/A
EFCI [30/30] For ATFR/ATFST [100/100]	0 - 100%	0 – 100%	0 - 100%
RIF: For ForeSight: max[PCR/128, 10] For ABR STD[128]	If ForeSight, then in absolute (0 - PCR) If ABR then 2 ⁿ (1 - 32768)	If ForeSight, then in absolute (0 – PCR) If ABR, then 2 ⁿ (1 – 32768)	N/A
RDF: For ForeSight [93] For ABR STD [16]	If ForeSight, then % (0% - 100%) If ABR then 2 ⁿ (1 - 32768)	If ForeSight, then % (0% – 100%) If ABR, then 2 ⁿ (1 – 32768)	N/A
Nrm[32], BXM only	2 - 256 cells	N/A	N/A
FRTT[0], BXM only	0 - 16700 msec	N/A	N/A
TBE[1,048,320], BXM only	0 - 1,048,320 cells (different max range from TM spec. but limited by firmware for CRM(4095 only) where CRM=TBE/Nrm)	N/A	N/A
IBS[0/0]	0 - 24000 cells	T3/E3 ABR: 0 - 24000 cells ATFR: 1 - 107 cells	0 - 999 cells

Table 10-4 Connection Parameter Descriptions

Parameter	Description
PCR	Peak cell rate: The cell rate which the source may never exceed
%Util	% Utilization; bandwidth allocation for: VBR, CBR, UBR it's PCR*%Util, for ABR it's MCR*%Util
MCR	Minimum Cell Rate: A minimum cell rate committed for delivery by network
CDVT	Cell Delay Variation Tolerance: Controls time scale over which the PCR is policed
FBTC (AAL5 Frame Basic Traffic Control)	To enable the possibility of discarding the whole frame, not just one non-compliant cell. This is used to set the Early Packet Discard bit at every node along a connection.
ForeSight	Proprietary flow control feature
VSVD	Virtual Source Virtual Destination: (see Meaning of VSVD and Flow Control External Segments, Figure 10-7)
FCES (Flow Control External Segments)	(see Meaning of VSVD and Flow Control External Segments, Figure 10-7)
SCR	Sustainable Cell Rate: Long term limit on the rate a connection can sustain
MBS	Maximum Burst Size: Maximum number of cells which may burst at the PCR but still be compliant. Used to determine the Burst Tolerance (BT) which controls the time scale over which the SCR is policed
Policing	(see definitions of Traffic Policing, Table 10-2)
VC QDepth	VC Queue Depth
CLP Hi	Cell Loss Priority Hi threshold (% of VC QMax)
CLP Lo/EPD	Cell Loss Priority Low threshold (% of VC QMax)/Early Packet Discard. If AAL5 FBTC = yes, then for the BXM card this is the EPD threshold setting. For ASI cards, regardless of the FBTC setting, this is the CLP Lo setting.
EFCI	Explicit Forward Congestion Indication threshold (% of VC QMax)
ICR	Initial Cell Rate: The rate at which a source should send initially and after an idle period
ADTF (ATM Forum TM 4.0 term)	The Allowed-Cell-Rate Decrease Factor: Time permitted between sending RM-cells before the rate is decreased to ICR
Trm (ATM Forum TM 4.0 term)	An upper bound on the time between forward RM-cells for an active source, i.e., RM cell must be sent at least every Trm msec
RIF (ATM Forum TM 4.0 term)	Rate Increase Factor: Controls the amount by which the cell transmission rate may increase upon receipt of an RM cell

ATM Connection Configuration

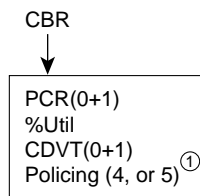
Parameter	Description
RDF (ATM Forum TM 4.0 term)	Rate Decrease Factor: Controls the amount by which the cell transmission rate may decrease upon receipt of an RM cell
Nrm (ATM Forum TM 4.0 term), BXM only.	Nrm Maximum number of cells a source may send for each forward RM cell, i.e. an RM cell must be sent for every Nrm-1 data cells
FRTT (ATM Forum TM 4.0 term), BXM only.	Fixed Round Trip Time: the sum of the fixed and propagation delays from the source to a destination and back
TBE (ATM Forum TM 4.0 term), BXM only.	Transient Buffer Exposure: The negotiated number of cells that the network would like to limit the source to sending during start-up periods, before the first RM-cell returns.
IBS	Initial Burst Size

CBR Connections

The **CBR** (constant bit rate) category is a fixed bandwidth class. CBR traffic is more time dependent, less tolerant of delay, and generally more deterministic in bandwidth requirements. CBR is used by connections that require a specific amount of bandwidth to be available continuously throughout the duration of a connection. Voice, circuit emulation, and high-resolution video are typical examples of traffic utilizing this type of connection. A CBR connection is allowed to transmit cells at the peak rate, below the peak rate, or not at all. CBR is characterized by peak cell rate (PCR).

The parameters for a CBR connection are shown in Figure 10-3 in the sequence in which they occur during the execution of the **addcon** command. The CBR policing definitions are summarized in Table 10-5.

Figure 10-3 CBR Connection Prompt Sequence



- ① For policing prompt:
 4 = PCR policing only
 5 = policing off

Note: BW allocation = (PCR)x(%Util) 80159

Table 10-5 CBR Policing Definitions

Connection Type	ATM Forum TM spec. 4.0 conformance definition	PCR Flow (1st leaky bucket)	CLP tagging (for PCR flow)	SCR Flow (2nd leaky bucket)	CLP tagging (for SCR flow)
CBR	CBR.1 when policing set to 4 (PCR Policing only)	CLP(0+1)	no	off	n/a
CBR	When policing set to 5 (off)	off	n/a	off	n/a

VBR and ATFR Connections

VBR Connections

VBR (variable bit rate) connections may be classified as rt-VBR or nrt-VBR connections.

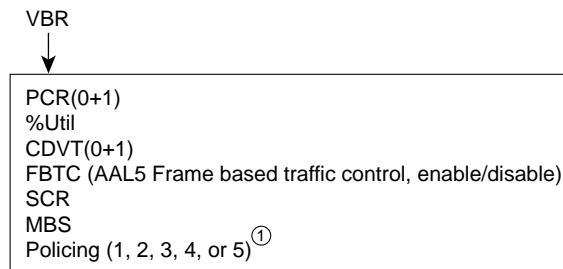
The rt-VBR (real-time variable bit rate) category is used for connections that transmit at a rate varying with time and that can be described as bursty, often requiring large amounts of bandwidth when active. The rt-VBR class is intended for applications that require tightly constrained delay and delay variation. An example of rt-VBR is video conferencing which requires real-time data transfer with bandwidth requirements that can vary in proportion to the dynamics of the video image at any given time. The rt-VBR category is characterized in terms of PCR, SCR (sustained cell rate), and MBS (maximum burst size).

The nrt-VBR (non-real time variable bit rate) category is used for connections that are bursty but are not constrained by delay and delay variation boundaries. For those cells in compliance with the traffic contract, a low cell loss is expected. Non-time critical data file transfers are an example of an nrt-VBR connection. A nrt-VBR connection is characterized by PCR, SCR, and MBS.

Configuring VBR connections. The characteristics of rt-VBR or nrt-VBR are supported by appropriately configuring the parameters of the VBR connection.

The parameters for a VBR connection are shown in Figure 10-4 in the sequence in which they occur during the execution of the **addcon** command. The VBR policing definitions are summarized in Table 10-6.

Figure 10-4 VBR Connection Prompt Sequence



- ① For policing prompt:
- 1 = VBR.1
 - 2 = VBR.2
 - 3 = VBR.3
 - 4 = PCR policing only
 - 5 = policing off

Note: BW allocation = (PCR)x(%Util)

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Table 10-6 VBR Policing Definitions

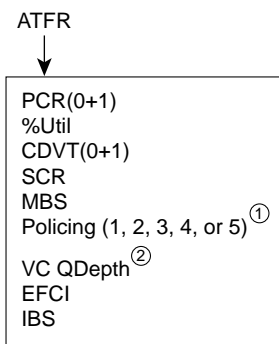
Connection Type	ATM Forum TM spec. 4.0 conformance definition	PCR Flow (1st leaky bucket)	CLP tagging (for PCR flow)	SCR Flow (2nd leaky bucket)	CLP tagging (for SCR flow)
VBR, ABR, ATFR, ATFST	VBR.1 when policing set to 1	CLP(0+1)	no	CLP(0+1)	no
VBR, ABR, ATFR, ATFST	VBR.2 when policing set to 2	CLP(0+1)	no	CLP(0)	no
VBR, ABR, ATFR, ATFST	VBR.3 when policing set to 3	CLP(0+1)	no	CLP(0)	yes
VBR, ABR, ATFR, ATFST	when Policing set to 4	CLP(0+1)	no	off	n/a
VBR, ABR, ATFR, ATFST	when Policing set to 5 for off)	off	n/a	off	n/a

ATFR Connections

An **ATFR** (ATM to Frame Relay) connection is a frame relay to ATM connection and is configured as a VBR connection, with a number of the ATM and frame relay connection parameters being mapped between each side of the connection.

The parameters for an ATFR connection are shown in Figure 10-5 in the sequence in which they occur during the execution of the **addcon** command.

Figure 10-5 ATFR Connection Prompt Sequence



- ① For policing prompt:
 - 1 = VBR.1
 - 2 = VBR.2
 - 3 = VBR.3
 - 4 = PCR policing only
 - 5 = policing off

- ② VC QDepth maps to VC Queue Max for frame relay
EFCI maps to ECN for frame relay
IBS maps to Cmax for frame relay

Note: FBTC (Frame based traffic control - AAL5, same as FGCRA) is automatically set to yes.

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Release 8.4 ABR Notes

The term ABR is used to specify one of the following:

- ABR standard without VSVD (This is ABR standard without congestion flow control.)
 - Supported by BXM, ASI-T3 (& ASI-E3), and ASI OC3 cards.
- ABR standard with VSVD. (This is ABR standard with congestion flow control as specified by the ATM Traffic Management, Version 4.0)
 - Also, referred to as ABR.1
 - Supported only by BXM cards
 - Feature must be ordered.
- ABR with ForeSight congestion control
 - Also, referred to as ABR.FST
 - Supported by BXM and ASI-T3 (& ASI-E3) cards
 - Feature must be ordered.

ABR and ATFST Connections

ABR Connections

The **ABR** (available bit rate) category utilizes a congestion flow control mechanism to control congestion during busy periods and to take advantage of available bandwidth during less busy periods. The congestion flow control mechanism provides feedback to control the connections flow rate through the network in response to network bandwidth availability. The ABR service is not restricted by bounding delay or delay variation and is not intended to support real-time connections. ABR is characterized by: PCR and MCR.

Policing for ABR connections is the same as for VBR connections which are summarized in Table 10-6.

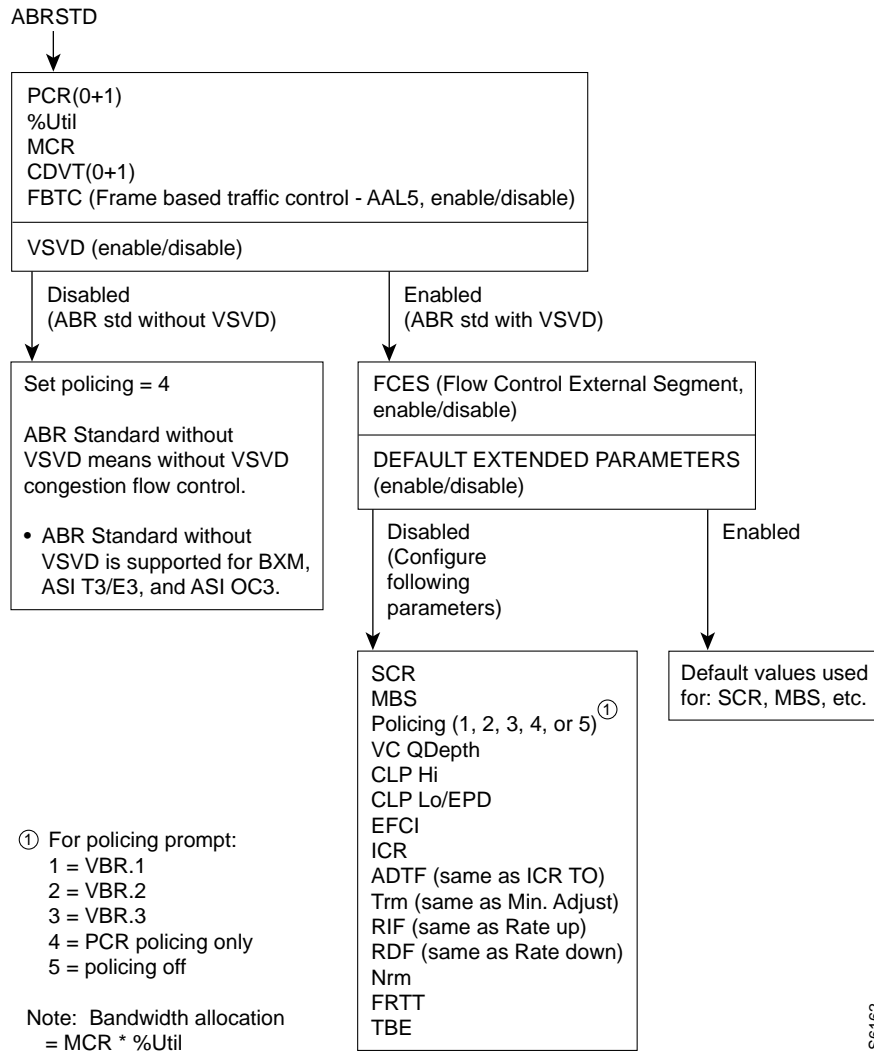
The ABR connections are configured as either ABR Standard (**ABRSTD**) connections or as ABR ForeSight (**ABRFST**) connections.

The parameters for an ABRSTD connection are shown in Figure 10-6 in the sequence in which they occur during the execution of the **addcon** command.

The ABRSTD connection supports all the features of ATM Standards Traffic Management 4.0 including VSVD congestion flow control.

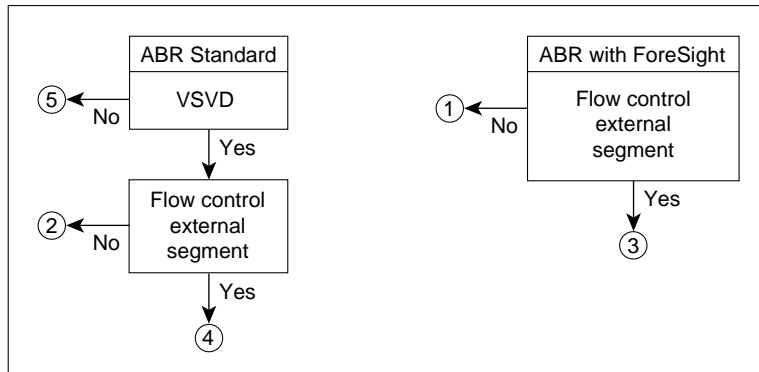
VSVD and flow control with external segments are shown in Figure 10-7.

Figure 10-6 ABR Standard Connection Prompt Sequence

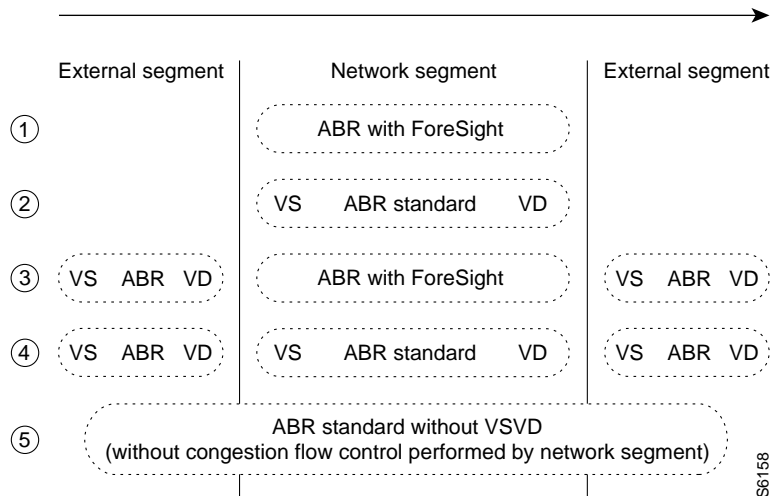


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Figure 10-7 Meaning of VSVD and Flow Control External Segments



VS and VD shown below are for traffic flowing in direction of arrow. For the other direction of traffic, VS and VD are in the opposite direction.

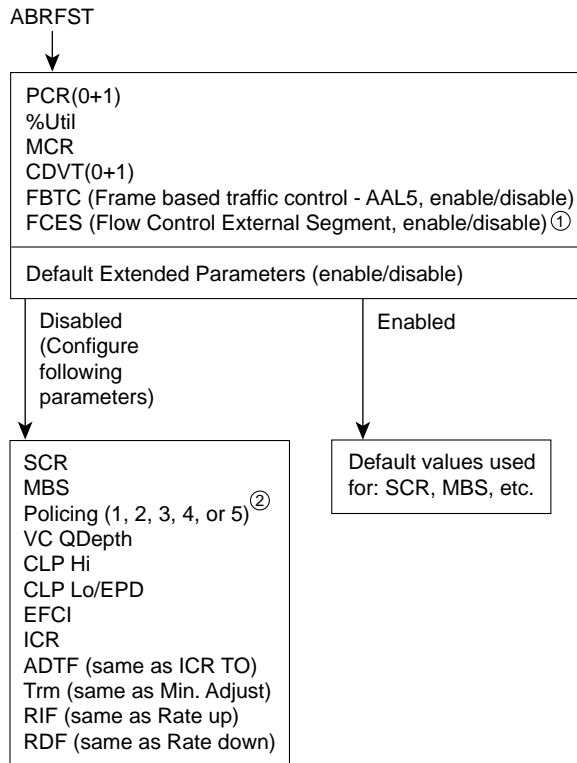


ATFST Connections

The **ABRFST** connection uses the propriety ForeSight congestion control and is useful when configuring connections on which both ends do not terminate on BXM cards.

The parameters for an ABRFST connection are shown in Figure 10-8 in the sequence in which they occur during the execution of the **addcon** command.

Figure 10-8 ABR ForeSight Connection Prompt Sequence



① At present, FCES is not available for ABR with ForeSight

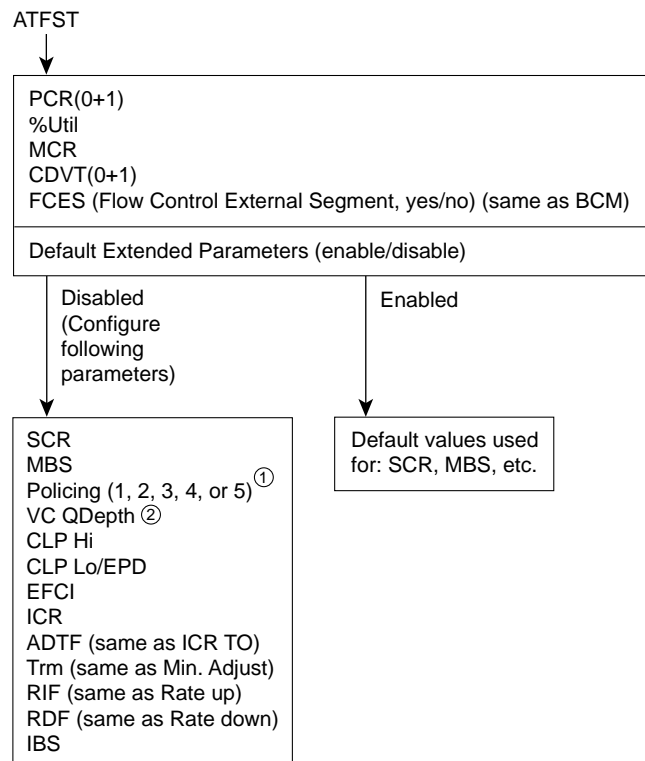
② For policing prompt:
 1 = VBR.1
 2 = VBR.2
 3 = VBR.3
 4 = PCR policing only
 5 = policing off

Note: Bandwidth allocation
 = (MCR)x(%Util)

An **ATFST** connection is a frame relay to ATM connection that is configured as an ABR connection with ForeSight. ForeSight congestion control is automatically enabled when connection type ATFST is selected. A number of the ATM and frame relay connection parameters are mapped between each side of the connection.

The parameters for an ATFST connection are shown in Figure 10-9 in the sequence in which they occur during the execution of the **addcon** command.

Figure 10-9 ATFST Connection Prompt Sequence



- ① For policing prompt:
 - 1 = VBR.1
 - 2 = VBR.2
 - 3 = VBR.3
 - 4 = PCR policing only
 - 5 = policing off

- ② VC QDepth maps to VC Queue max for frame relay.
EFCI maps to ECN for frame relay.
IBS maps to C max for frame relay.

Note: FBTC (Frame based traffic control - AAL5, same as FGCR) is automatically set to yes.

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UBR Connections

The unspecified bit rate (**UBR**) connection service is similar to the ABR connection service for bursty data. However, UBR traffic is delivered only when there is spare bandwidth in the network. This is enforced by setting the CLP bit on UBR traffic when it enters a port.

Therefore, traffic is served out to the network only when no other traffic is waiting to be served first. The UBR traffic does not affect the trunk loading calculations performed by the switch software.

The parameters for a UBR connection are shown in Figure 10-10 in the sequence in which they occur during the execution of the **addcon** command.

The UBR policing definitions are summarized in Table 10-7.

Figure 10-10 UBR Connection Prompt Sequence

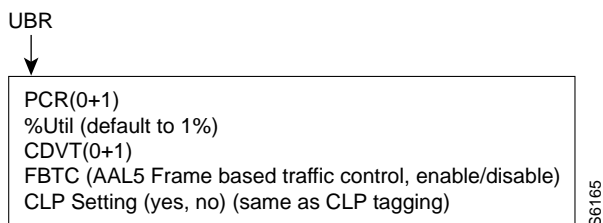


Table 10-7 UBR Policing Definitions

Connection Type	ATM Forum TM spec. 4.0 conformance definition	PCR Flow (1st leaky bucket)	CLP tagging (for PCR flow)	SCR Flow (2nd leaky bucket)	CLP tagging (for SCR flow)
UBR	UBR.1 when CLP setting = no	CLP(0+1)	no	off	n/a
UBR	UBR.2 when CLP setting = yes	CLP(0+1)	no	CLP(0)	yes

Traffic Policing Examples

Traffic Policing, also known as Usage Parameter Control (UPC), is implemented using either an ATM Forum single or dual-leaky bucket algorithm. The buckets represent a GCRA (Generic Cell Rate Algorithm) defined by two parameters:

- Rate (where I , expected arrival interval is defined as $1/\text{Rate}$)
- Deviation (L)

If the cells are clumped too closely together, they are non-compliant and are tagged or discarded as applicable. If other cells arrive on time or after their expected arrival time, they are compliant, but there is no accrued credit.

Dual-Leaky Bucket (An Analogy)

A GCRA viewpoint is as follows:

- For a stream of cells in an ATM connection, the cell compliance is based on the theoretical arrival time (TAT).
- The next TAT should be the time of arrival of the last compliant cell plus the expected arrival interval (I) where $I = 1/\text{rate}$.
- If the next cell arrives before the new TAT, it must arrive no earlier than new TAT - CDVT to be compliant.
- If the next cell arrives after the new TAT, it is compliant, but there is no accrued credit.

CBR Traffic Policing Examples

CBR traffic is expected to be at a constant bit rate, have low jitter, and is configured for a constant rate equal to Peak Cell Rate (PCR). The connection is expected to be always at peak rate.

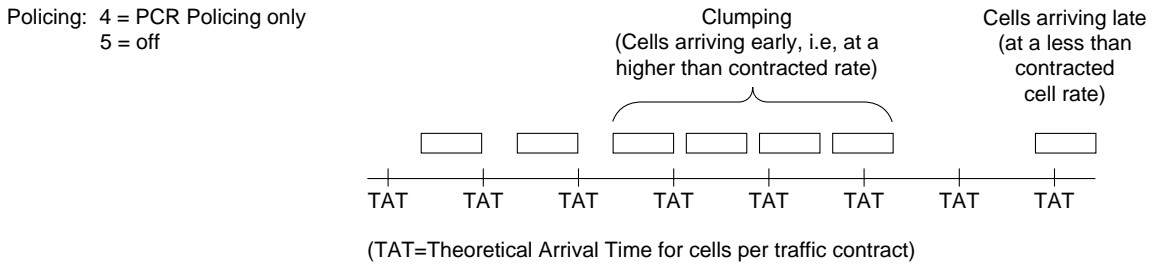
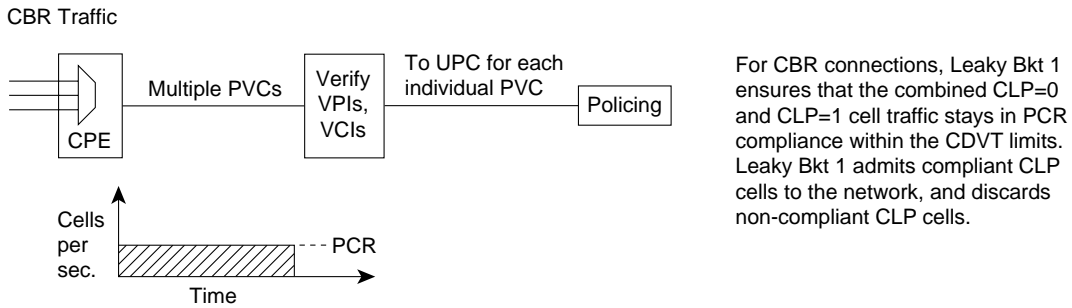
When a connection is added, a VPI.VCI address is assigned, and the UPC parameters are configured for the connection. For each cell in an ATM stream seeking admission to the network, the VPI.VCI addresses are verified and each cell is checked for compliance with the UPC parameters. The CBR cells are not enqueued, but are processed by the policing function and then sent to the network unless discarded.

For CBR, traffic policing is based on:

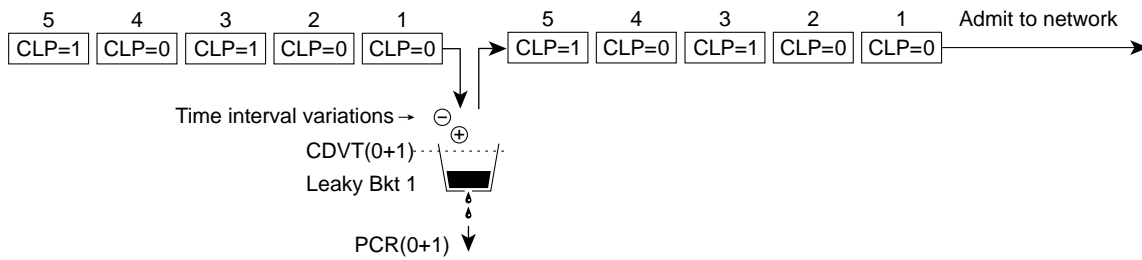
- Bucket 1
 - PCR(0+1), Peak Cell Rate
 - CDVT(0+1), Cell Delay Variation

The CBR connection may be configured with policing selected as either 4 or 5. With policing set to 5, there is no policing. With policing set to 4, there is single leaky bucket PCR policing as shown in Figure 10-11. The single leaky bucket polices the PCR compliance of all cells seeking admission to the network, both those with $CLP = 0$ and those with $CLP = 1$. Cells seeking admission to the network with CLP set equal to 1 may have either encountered congestion along the user's network or may have lower importance to the user and have been designated as eligible for discard in the case congestion is encountered. If the bucket depth CDVT (0+1) limit is exceeded, it discards all cells seeking admission. It does not tag cells. If leaky bucket 1 is not full, all cells ($CLP = 0$ and $CLP = 1$) are admitted to the network.

Figure 10-11 CBR Connection, UPC Overview



Example: Policing = 4



Discards incoming CLP(0+1) cells if Bkt 1 depth > CDVT(0+1). Does not tag cells.
If Bkt 1 depth < CDVT(0+1), passes CLP=0 and CLP=1 cells on to network.

Note: The notation 0, 1, and 0+1 refers to the types of cell being specified: cells with CLP set to 0, CLP set to 1, or both types of cells, respectively. For example, CLP(0), CLP(1), and CLP(0+1).

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Figure 10-12 shows a CBR.1 connection policing example, with policing set to 4, where the CDVT depth of the single leaky bucket is not exceeded, and all cells, CLP(0) and CLP(1) are admitted to the network.

Figure 10-12 CBR.1 Connection with Bucket Compliant

Connection setup and compliance status:

CBR.1
 policing=4
 Bkt 1 depth < CDVT (0+1)

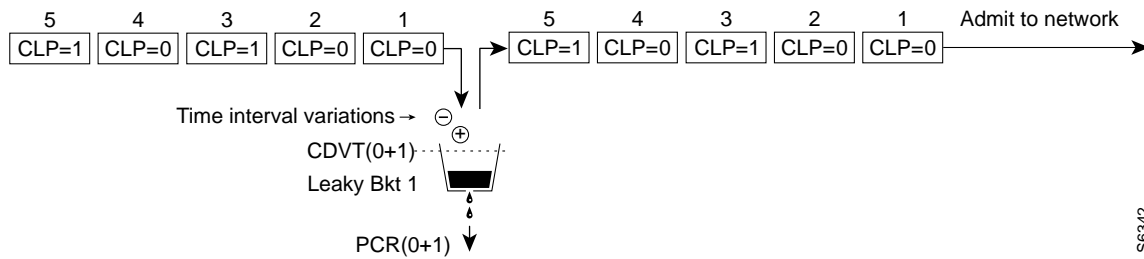
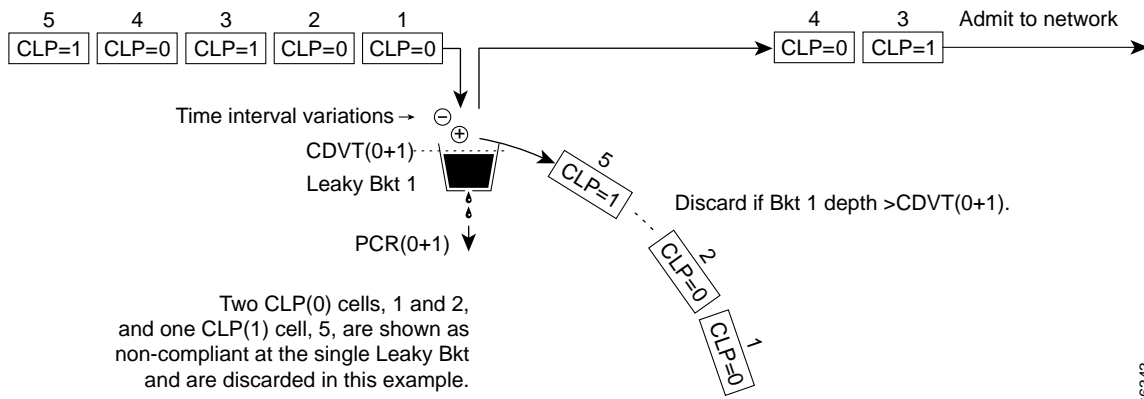


Figure 10-13 shows a CBR connection policing example, with policing =4, where the CDVT(0+1) of the single leaky bucket is exceeded and non-compliant cells are discarded. The leaky bucket only discards cells; it does not tag them

Figure 10-13 CBR.1 Connection, with Bucket Discarding non-Compliant Cells

Connection setup and compliance status:

CBR.1
 policing=4
 Bkt 1 depth > CDVT (0+1)



VBR Dual-Leaky Bucket Policing Examples

The contract for a variable bit rate connection is set up based on an agreed upon sustained cell rate (SCR) with allowance for occasional data bursts at a Peak Cell Rate (PCR) as specified by maximum burst size MBS.

When a connection is added, a VPI.VCI address is assigned, and UPC parameters are configured for the connection. For each cell in an ATM stream, the VPI.VCI addresses are verified and each cell is checked for compliance with the UPC parameters as shown in Figure 10-14.

The VBR cells are not enqueued, but are processed by the policing function and then sent to the network unless discarded.

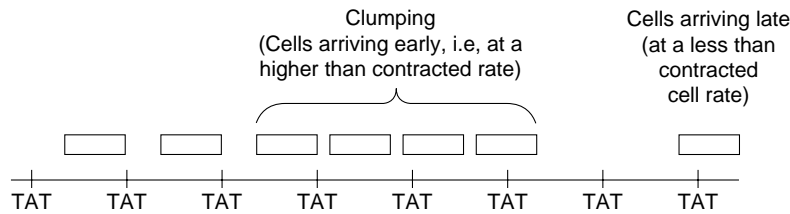
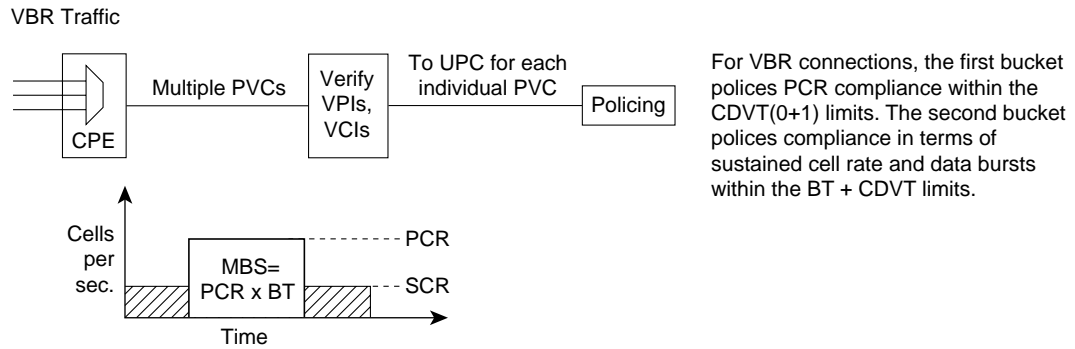
For VBR, traffic policing, depending on selected policing option, is based on:

- Leaky bucket 1, PCR and CDVT
- Leaky bucket 2, SCR, CDVT, and MBS

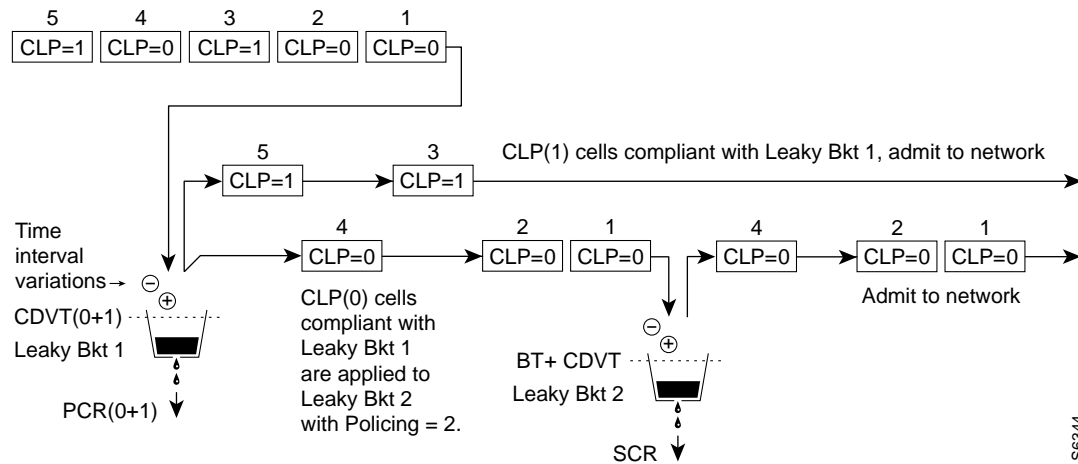
The policing options, selected by entering 1-5 in response to the policing choice prompt, are as follows for VBR connections:

<p>VBR.1 VBR with policing set to 1.</p>	<p>CLP(0+1) cells compliant with leaky bucket 1 are passed to leaky bucket 2; non-compliant cells are discarded. CLP(0+1) cells compliant with leaky bucket 2 are admitted to the network; non-compliant cells are discarded.</p>
<p>VBR.2 VBR with policing set to 2.</p>	<p>CLP(1) cells compliant with leaky bucket 1 are admitted to the network; non-compliant CLP(0+1) cells are dropped. CLP(0) cells compliant with leaky bucket 1 are applied to leaky bucket 2; non-compliant cells are dropped. CLP(0) cells compliant with leaky bucket 2 are admitted to the network; non-compliant cells are dropped.</p>
<p>VBR.3 VBR with policing set to 3.</p>	<p>VBR.3. CLP(1) cells compliant with leaky bucket 1 are admitted to the network; non-compliant CLP(0+1) cells are dropped. CLP(0) cells compliant with leaky bucket 1 are applied to leaky bucket 2; non-compliant cells are dropped. CLP(0) cells compliant with leaky bucket 2 are admitted to the network; non-compliant cells are tagged and admitted to the network.</p>
<p>VBR with policing set to 4.</p>	<p>CLP(0+1) cells compliant with leaky bucket 1 are admitted to the network; non-compliant cells are dropped. Leaky bucket 2 is not active.</p>
<p>VBR with policing set to 5.</p>	<p>Policing is off, so there is no policing of cells on ingress.</p>

Figure 10-14 VBR Connection, UPC Overview



Example: VBR.2
Policing = 2



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Leaky Bucket 1

Leaky bucket 1 polices for the PCR compliance of all cells seeking admission to the network, both those with CLP = 0 and those with CLP = 1. For example, cells seeking admission to the network with CLP set equal to 1 may have either encountered congestion along the user's network or may have lower importance to the user and have been designated as eligible for discard in the case congestion is encountered. If the bucket depth in the first bucket exceeds CDVT (0+1), it discards all cells seeking admission. It does not tag cells.

With policing set to 1 (VBR.1), all cells (CLP=0 and CLP=1) that are compliant with leaky bucket 1, are sent to leaky bucket 2. With policing set to 2 (VBR.2) or to 3 (VBR.3), all CLP=1 cells compliant with leaky bucket 1 are admitted directly to the network, and all CLP=0 cells compliant with leaky bucket 1 are sent to leaky bucket 2.

Leaky Bucket 2

For VBR connections, the purpose of leaky bucket 2 is to police the cells passed from leaky bucket 1 for conformance with maximum burst size MBS as specified by BT and for compliance with the SCR sustained cell rate. The types of cells passed to leaky bucket 2 depend on how policing is set:

- For policing set to 5, cells bypass both buckets.
- For policing set to 4, leaky bucket 2 sees no traffic.
- For policing set to 2 or 3, the CLP(0) cells are admitted to the network if compliant with BT + CDVT of leaky bucket 2. If not compliant, cells may either be tagged (policing set to 3) or discarded (policing set to 2).
- For policing set to 1, the CLP(0) and CLP(1) cells are admitted to the network if compliant with BT + CDVT of leaky bucket 2. If not compliant, the cells are discarded. There is no tagging option.

Examples

Figure 10-15 shows a VBR connection policing example, with policing set to 4, leaky bucket 1 compliant, and all cells being admitted to the network

Figure 10-15 VBR Connection, Policing = 4, Leaky Bucket 1 Compliant

Connection setup
and compliance status:

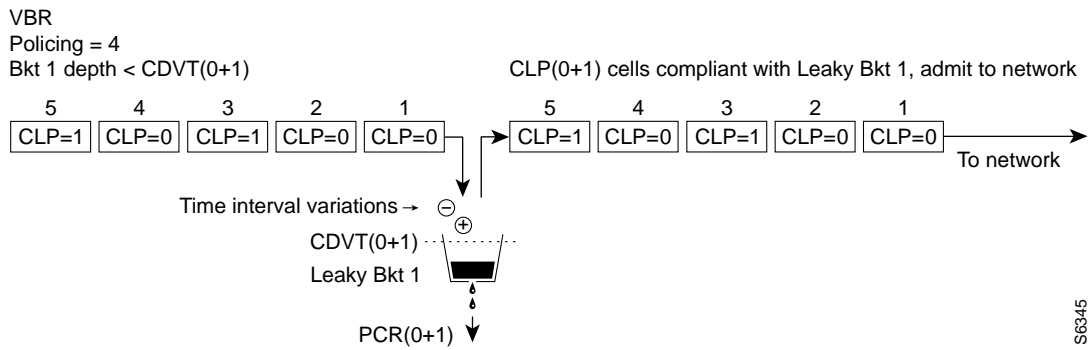


Figure 10-16 shows a VBR connection policing example, with the policing set to 4, and leaky bucket 1 non-compliant which indicates that the connection has exceeded the PCR for a long enough interval to exceed the CDVT (0+1) limit. Non-compliant cells with respect to leaky bucket 1 are discarded

Figure 10-16 VBR Connection, Policing = 4, Leaky Bucket 1 Non-Compliant

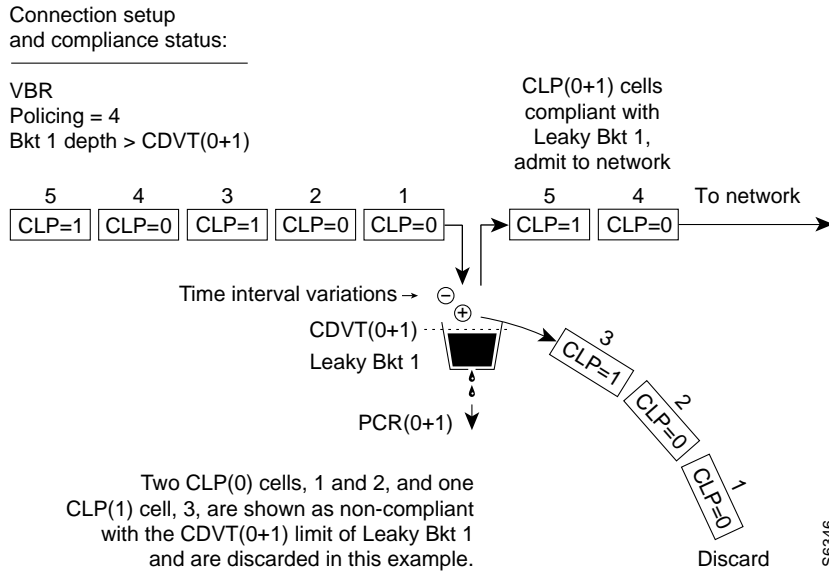
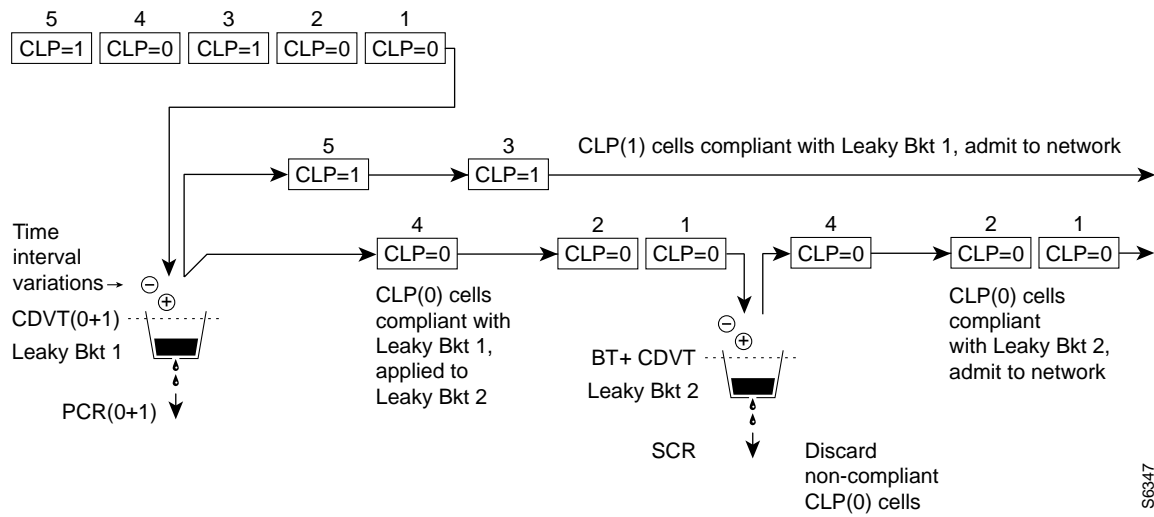


Figure 10-17 shows a VBR.2 connection policing example, with policing = 2, and both buckets compliant. Leaky bucket two is policing the CLP(0) cell stream for conformance with maximum burst size MBS (as specified by BT), and for compliance with the SCR sustained cell rate.

Figure 10-17 VBR.2 Connection, Policing = 2, with Buckets 1 and 2 Compliant

Connection setup
and compliance status:

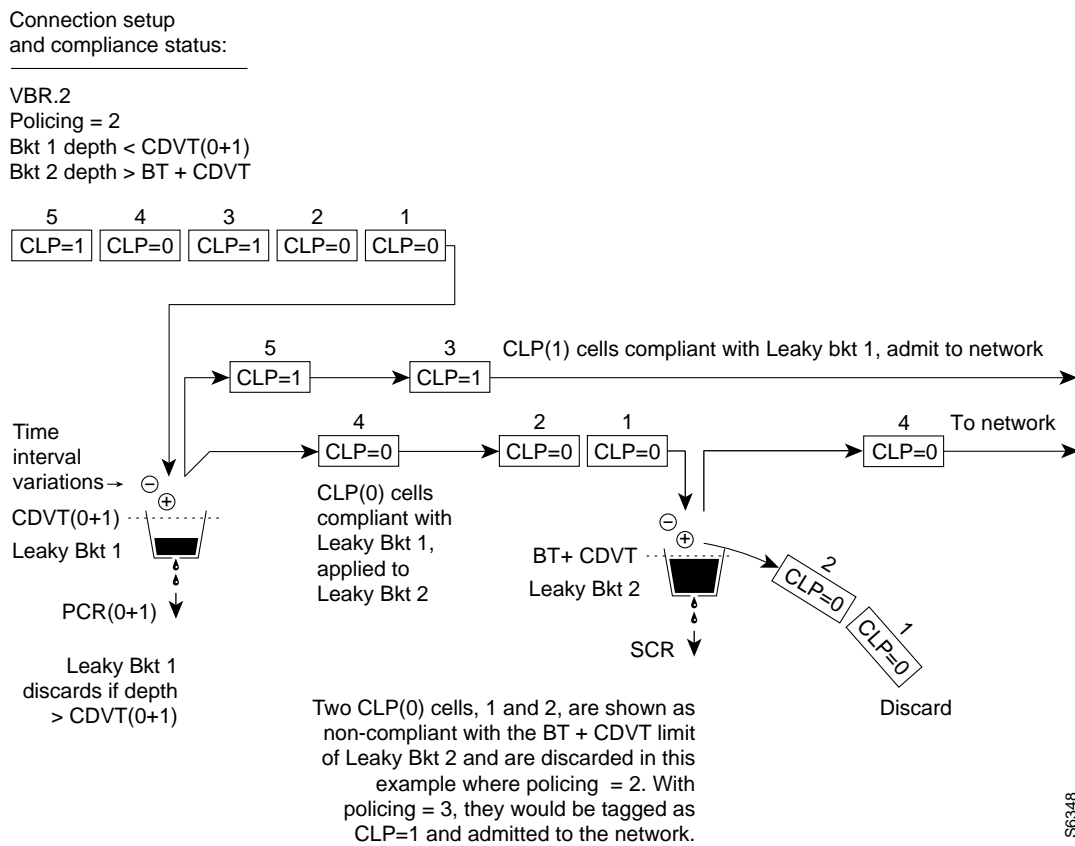
VBR.2
Policing = 2
Bkt 1 depth < CDVT(0+1)
Bkt 2 depth < BT + CDVT



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Figure 10-18 shows a VBR.2 connection policing example, with policing set to 2, and leaky bucket 2 non-compliant. Leaky bucket 2 is shown policing the CLP(0) cell stream for conformance with maximum burst size MBS (as specified by BT), and for compliance with SCR (sustained cell rate). In this example (policing set to 2), CLP tagging is not enabled, so the cells that have exceeded the BT + CDVT limit are discarded. In the example, either the sustained cell rate could have been exceeded for an excessive interval, or a data burst could have exceeded the maximum allowed burst size.

Figure 10-18 VBR.2 Connection, Leaky Bucket 2 Discarding CLP (0) Cells



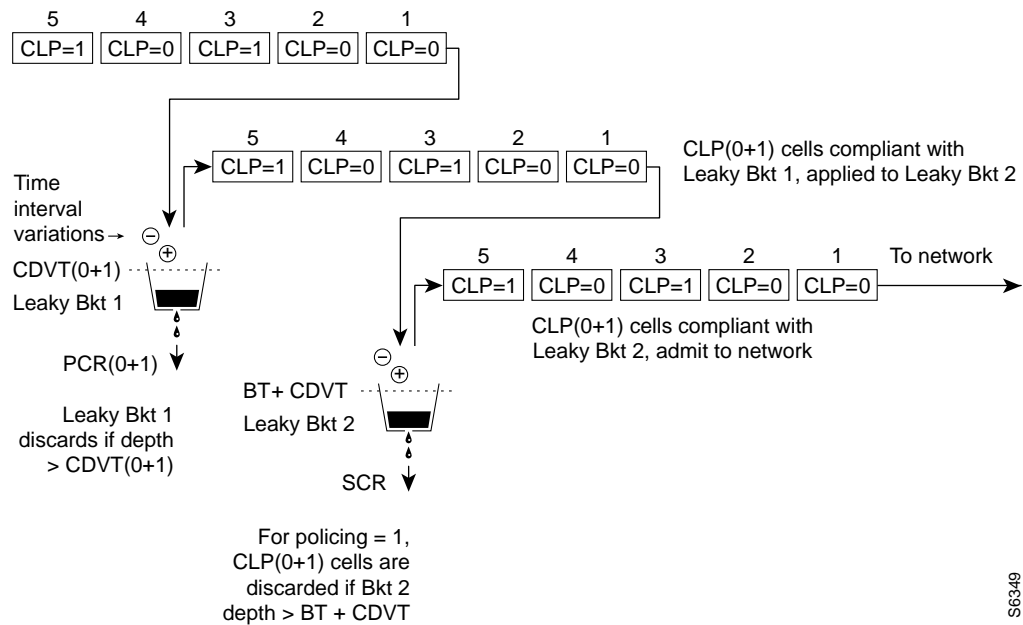
S6348

Figure 10-19 shows a VBR.1 connection policing example, with policing set to 1, and both buckets compliant. Leaky bucket 1 is policing the CLP (0+1) cell stream for conformance with the PCR limit. Leaky bucket 2 is policing the CLP (0+1) cell stream for conformance CDVT plus maximum burst size MBS (as specified by BT), and for compliance with SCR sustained cell rate.

Figure 10-19 VBR.1 Connection, Policing = 1, with Buckets 1 and 2 Compliant

Connection setup and compliance status:

VBR.1
 Policing = 1
 Bkt 1 depth < CDVT(0+1)
 Bkt 2 depth < BT + CDVT



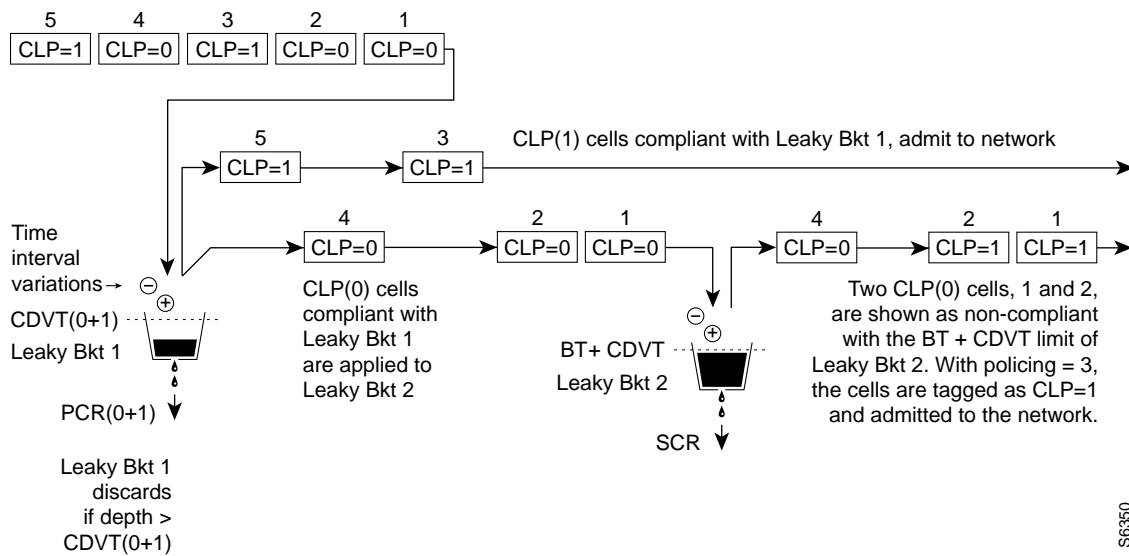
S6349

Figure 10-20 shows a VBR.3 connection policing example, with policing set to 3, and Leaky bucket 2 shown as non-compliant. Leaky bucket 2 is shown policing the CLP(0) cell stream for conformance with maximum burst size MBS (as specified by BT), and for compliance with SCR sustained cell rate. For the policing = 3 selection, CLP tagging is enabled, so the cells that have exceeded the BT + CDVT(0+1) limit are tagged as CLP=1 cells and admitted to the network. In this example, either the sustained cell rate could have been exceeded for an excessive interval, or a data burst could have exceeded the maximum burst size allowed.

Figure 10-20 VBR.3 Connection, Policing = 3, with Bucket 2 non-compliant

Connection setup and compliance status:

VBR.3
 Policing = 3
 Bkt 1 depth < CDVT(0+1)
 Bkt 2 depth > BT + CDVT



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ABR Connection Policing

Available Bit Rate (ABR) connections are policed the same as the VBR connections, but in addition use either the ABR Standard with VSVD congestion flow control method or the ForeSight option to take advantage of unused bandwidth when it is available.

UBR Connection Policing

The contract for a unspecified bit rate connection is similar to the ABR connection service for bursty data. However, UBR traffic is delivered only when there is spare bandwidth in the network.

When a connection is added, a VPI.VCI address is assigned, and UPC parameters are configured for the connection. For each cell in an ATM stream, the VPI.VCI addresses are verified and each cell is checked for compliance with the UPC parameters as shown in Figure 10-21.

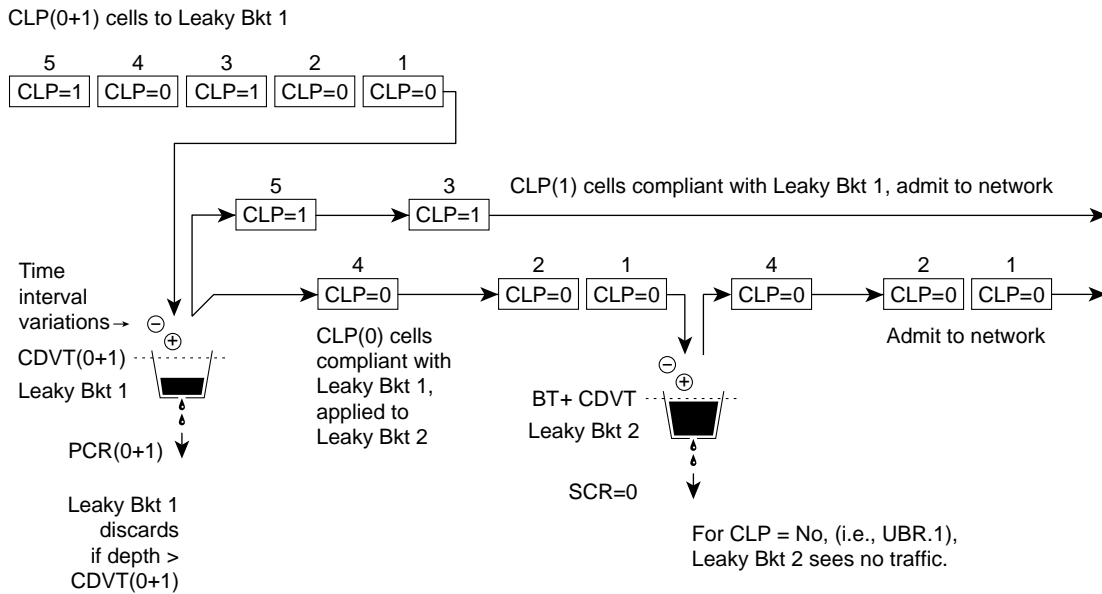
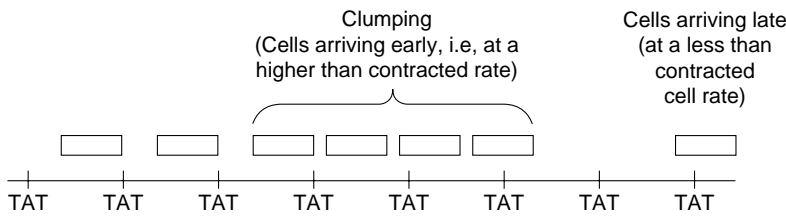
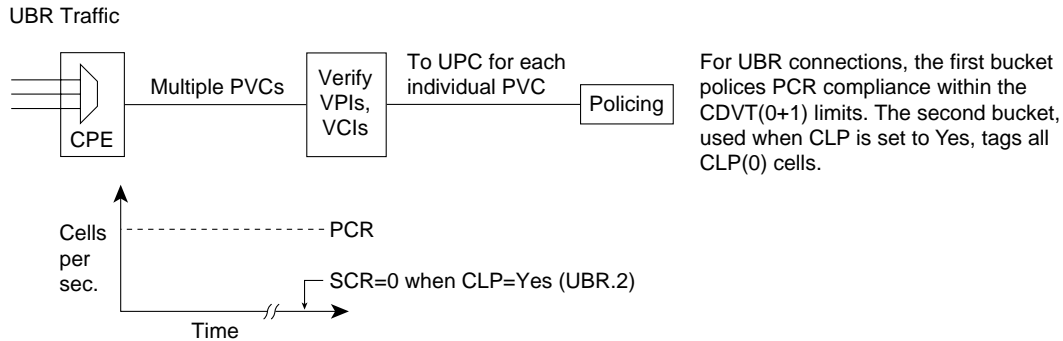
Leaky Bucket 1

Leaky bucket 1 polices the UBR connection for PCR compliance. When CLP=No (UBR.1), all cells that are compliant with leaky bucket 1 are applied to the network. However, these cells are treated with low priority in the network with % utilization default of 1%.

Leaky Bucket 2

When CLP=Yes (UBR.2), CLP(0) cells that are compliant with leaky bucket 1 are sent to leaky bucket 2. Since SCR=0 for leaky bucket 2, the bucket is essentially always full, and all the CLP(0) cells sent to leaky bucket 2 are therefore tagged with CLP being set to 1. This allows the network to recognize these UBR cells as lower priority cells and available for discard in the event of network congestion.

Figure 10-21 UBR Connection, UPC Overview



Note: The notation 0, 1, and 0+1 refers to the types of cell being specified: cells with CLP set to 0, CLP set to 1, or both types of cells, respectively. For example, CLP(0), CLP(1), and CLP(0+1)

LMI and ILMI Parameters

The following is a listing of the LMI and ILMI parameters for the ASI:

For ILMI refer to Table 10-8:

Table 10-8 ILMI Parameters

Parameter	Description
VPI.VCI	VCCI for ILMI signaling channel equal 0.16
Polling Enabled	Keep-alive polling
Trap Enabled	VCC change of state traps
Polling Interval	Time between GetRequest polls
Error Threshold	Number of failed entries before ILMI link failure is declared.
Event Threshold	Number of successful polls before ILMI link failure is cancelled.
Addr Reg Enab	SVC Address Registration procedures enabled.

For the LMI refer to

Table 10-9 LMI Parameters

Parameter	Description
VPI.VCI	VCCI for LMI signaling channel equal 0.31
Polling Enable	Keep-alive polling
T393	Status Enquiry timeout value
T394	Update Status timeout value
T396	Status Enquiry polling timer
N394	Status Enquiry retry count
N395	Update Status retry count

