



Introduction to ATM Traffic Management on the Cisco 7200 Series Routers

In the latest generation of IP networks, with the growing implementation of Voice over IP (VoIP) and multimedia applications, the addition of voice and video traffic to the traditional IP data network has become increasingly common. Voice, video, and data traffic types have different transmission characteristics and service-level requirements.

The ATM technology is well-suited to transport mixed traffic because of its built-in ability to negotiate and guarantee a certain level of quality of service (QoS) from the source to the end device. This makes ATM a desirable transport method for mixed traffic through an IP network over a WAN.

This chapter provides a brief introduction to ATM traffic management, and begins a discussion of some of the concepts associated with traffic management on the Cisco 7200 series routers as an edge device on the User-Network Interface (UNI).

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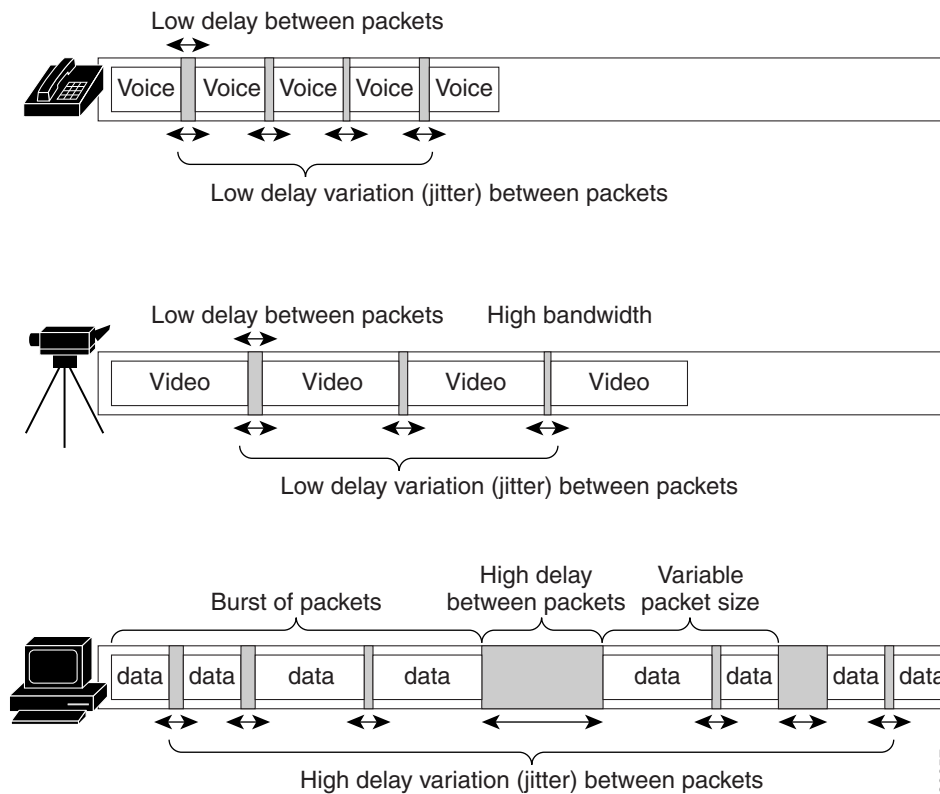
Traffic Characteristics

Voice, video, and data traffic are differentiated by the following transmission characteristics:

- **Voice**—Traffic flows with a regular pattern at a constant rate that is sensitive to delay and delay variation. When compression techniques are in use, voice traffic is more sensitive to error than uncompressed voice.
- **Video**—Real-time video traffic has similar transmission characteristics to voice traffic, but also requires high bandwidth. When compression techniques are in use, video traffic is more sensitive to error than uncompressed video.
- **Data**—Traffic flows with an irregular pattern that is often called *bursty* because of its variability in rate and amount of traffic. Data traffic is not sensitive to delay or delay variation, but it is sensitive to error.

Traffic management is vital to the performance and overall health of the ATM network. ATM uniquely satisfies the different transmission requirements of mixed traffic on a common network through its multiple service categories and QoS implementation.

Figure 1-1 Voice, Video, and Data Transmission Requirements



Traffic Contract

An ATM WAN is frequently a public network owned and managed by a service provider who supports multiple customers. These customers agree upon and pay for a certain level of bandwidth and performance from the service provider over that WAN. This agreement becomes the basis of the traffic contract, which defines the traffic parameters and the QoS that is negotiated for each virtual connection for that user on the network.

References to the traffic contract in an ATM network represent a couple of things. First, the traffic contract represents an actual service agreement between the user and the service provider for the expected network-level support. Second, the traffic contract refers to the specific traffic parameters and QoS values negotiated for an ATM virtual connection at call setup, which are implemented during data flow to support that service agreement.

The traffic contract also establishes the criteria for policing of ATM virtual connections on the network to ensure that violations of the agreed-upon service levels do not occur.

ATM Service Categories and Traffic Parameters

The ATM Forum Traffic Management specifications define several service categories to group traffic according to different transmission characteristics and performance needs. Each ATM service category is qualified by certain traffic parameters and QoS parameters that define the desired network performance for the permanent virtual circuit (PVC) or switched virtual circuit (SVC) on the ATM network.

The traffic parameters, sometimes called *descriptors*, are used to shape the flow of ATM cells. ATM service categories, and their corresponding traffic and QoS parameters, are the basis for differentiating services on the ATM network and for establishing the traffic contract for a particular connection.

Differences in Implementation of Traffic Parameters and QoS in PVCs and SVCs

All PVC and SVC traffic parameters and QoS parameters are established for the duration of a connection. The difference between PVCs and SVCs occurs in the implementation of these parameters.

On PVCs, traffic shaping parameters are based upon a manual configuration on both the edge device (router) and the switch. Therefore, no exchange of service-level information occurs between the edge device and the switch through signaling while a PVC connection is being established. Therefore, it is possible for configuration mismatches to occur between the router and the switch.

However, for SVCs, traffic parameters and QoS parameters are exchanged between the edge device and the switch through signaling. The edge device requests the required performance from the network, and the network responds with what it can provide. From there, the edge device can either accept or reject the connection. This is referred to as a *two-way handshake*.

ATM Service Categories

The following ATM service categories are defined by the ATM Forum specifications and are supported on the Cisco 7200 series router to perform traffic shaping. The ATM service categories can be subdivided by their support for real-time or non-real-time applications.



Note

Cisco Systems does not support the Guaranteed Frame Rate (GFR) service category on the Cisco 7200 series router.

[Table 1-1 on page 1-7](#) provides examples and summarizes the ATM traffic parameters and QoS parameters associated with each service category.

Real-Time Service Categories

There are two ATM service categories that are designed to support real-time applications, which require low cell delay and cell loss:

- **Constant bit rate (CBR)**—Supports real-time applications that request a static amount of bandwidth that is continuously available for the duration of the connection.
- **Real-time variable bit rate (rt-VBR)**—Supports real-time applications that have bursty transmission characteristics.

Non-Real-Time Service Categories

There are three ATM service categories that are designed to support non-real-time applications, which typically support data services:

- **Available bit rate (ABR)**—Supports non-real-time applications that tolerate high cell delay, and can adapt cell rates according to changing network resource availability to prevent cell loss. The ABR service category is characterized by reactive congestion control, where it uses flow control mechanisms to learn about the network conditions and adjust cell rates accordingly.
- **Non-real-time variable bit rate (nrt-VBR)**—Supports non-real-time applications with bursty transmission characteristics that tolerate high cell delay, but require low cell loss.
- **Unspecified bit rate (UBR)**—Supports non-real-time applications that tolerate both high cell delay and cell loss on the network. There are no network service-level guarantees for the UBR service category, and therefore it is a best-effort service.

Cisco-Specific UBR+ Service Category

Cisco Systems has also developed a second UBR service category called UBR+, which implements the Minimum Cell Rate (MCR) traffic parameter:

- **Unspecified bit rate plus (UBR+)** —Supports non-real-time applications that tolerate both high cell delay and cell loss on the network, but request a minimum guaranteed cell rate. As with the UBR service category, there are no network service-level guarantees for UBR+. However, the network can grant a service-level guarantee for the requested MCR.

For a description of MCR, see the [“ATM Traffic Parameters” section on page 1-5](#).

A similar UBR service category is specified in an addendum to the ATM Forum Traffic Management specifications, which discusses implementation of an optional Minimum Desired Cell Rate (MDCR) parameter for the UBR service category.

However, the Cisco Systems implementation and the ATM Forum implementation vary in how the minimum rate is signaled to the ATM network. Cisco Systems uses the existing MCR information element (IE) that is used by the ABR service category, but the parameter has a different interpretation. For UBR+, the MCR parameter represents a desired cell rate; but in ABR, the MCR specifies the lowest acceptable cell rate.

The ATM Forum does not use the MCR IE, but implements a new IE for the MDCR traffic parameter.

**Note**

Cisco Systems introduced support for UBR+ on SVCs only for the PA-A3 ATM port adapter in Cisco IOS Release 11.3 T. It is also available for SVC configuration on the PA-A6 ATM port adapter. However, the UBR+ service category is not supported for PVCs and is not available on the PA-A1 or PA-A2 ATM port adapters. For configuration guidelines and an example, see the [“UBR+ Configuration Guidelines” section on page 5-28](#) and the [“UBR+ Configuration Example” section on page 5-29](#).

ATM Traffic Parameters

The following traffic parameters are used to qualify the different ATM service categories:

- **Minimum Cell Rate (MCR)**—Cell rate (cells per second) at which the edge device is always allowed to transmit.
For UBR+, the MCR is the minimum cell rate *requested* by the edge device as a guaranteed service-level for the SVC.
- **Peak Cell Rate (PCR)**—Cell rate (cells per second) that the edge device cannot exceed. Some service categories have a limit on the number of cells that can be sent at the PCR without penalty for violation of the traffic contract.
- **Cell Delay Variation Tolerance (CDVT)**—Allowable deviation in cell times for a PVC that is transmitting above the PCR. For a given cell interarrival time expected by the ATM switch, CDVT allows for some variance in the transmission rate. It allows a certain number of cells to arrive faster than the expected cell interarrival time without penalty for violation of the traffic contract.
- **Sustainable Cell Rate (SCR)**—Upper boundary for the average rate at which the edge device can transmit cells without loss.
- **Maximum Burst Size (MBS)**—Number of cells that the edge device can transmit up to the PCR for a limited period of time without penalty for violation of the traffic contract.

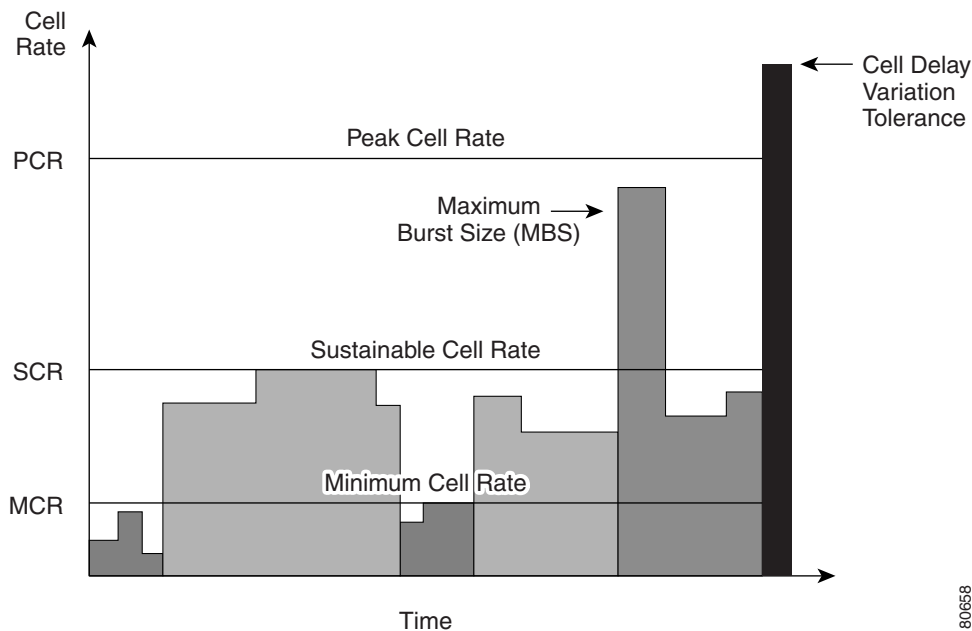
**Note**

To configure traffic shaping parameters for the ATM port adapters, you typically specify a value in terms of bits per second, which uses the same unit of measure as the line rate. However, be aware that ATM transmission rates over the network actually are implemented according to a total number of cell time slots (or cells per second). Each time slot represents a cell time (in microseconds). Further, ATM switches frequently measure bandwidth according to cell times, not bits per second.

[Table 1-1 on page 1-7](#) provides examples and summarizes the ATM traffic parameters and QoS parameters associated with each service category.

Figure 1-2 shows the relationships between the different ATM traffic parameters.

Figure 1-2 Relationships of ATM Traffic Parameters



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ATM QoS Parameters

The ATM Forum specifications define specific QoS parameters that are used to manage cell delay and cell loss over the ATM network for each of the different ATM service categories. Some of these QoS parameters are considered negotiable and some are not.

For SVCs, ATM switches evaluate the requested traffic parameters and QoS parameters using the Connection Admission Control (CAC) algorithm. CAC ensures that the requested QoS can be served throughout the duration of the connection over the network, from the source to the destination, without impacting other connections.

Negotiable QoS Parameters

The following cell delay and cell loss parameters are considered negotiable because the information is exchanged through signaling between the UNI edge device and the network-to-network interface (NNI) switch while an ATM connection is being established.

Cell Delay Parameters

The ATM Forum specifications support two negotiable parameters for cell delay:

- **Maximum cell transfer delay (maxCTD)**—Maximum length of time allowed for the network to transmit a cell from the source UNI device to the destination UNI device.
- **Peak-to-peak cell delay variation (peak-to-peak CDV)**—Maximum variation allowed from the fixed CTD for each cell transmitted from the source UNI device to the destination UNI device. Represents the allowable jitter, or distortion, between cell interarrival times over the network.

Cell Loss Parameters

The ATM Forum specifications support the following negotiable parameter for cell loss:

- **Cell loss ratio (CLR)**—Allowable percentage of cells (lost cells divided by total number of cells transmitted) that the network can discard due to congestion.

Non-Negotiable QoS Parameters

The following QoS parameters are not exchanged during connection setup on the ATM network:

- **Cell error ratio (CER)**—Allowable percentage of cells (errored cells divided by the total number of all transmitted cells) that can be in error.
- **Severely errored cell block ratio (SECBR)**—Allowable percentage of cell blocks (severely errored cell blocks divided by the total number of transmitted cell blocks) that can be severely in error. A cell block is a number of consecutively transmitted cells on a particular connection. A cell block is considered severely errored when more than a maximum number of errored cells, lost cells, or misinserted cells occur within that cell block.
- **Cell misinsertion rate (CMR)**—Allowable rate of misinserted cells (misinserted cells divided by the time period during which misinserted cells were collected). This rate does not include severely errored cell blocks. Misinserted cells are cells that are received with an incorrect VPI/VCI value.

Table 1-1 provides examples and summarizes the ATM traffic parameters and QoS parameters associated with each service category.

Table 1-1 ATM Traffic Parameters and QoS Parameters by Service Category

ATM Service Category	Application Examples	Traffic Parameters	ATM QoS Parameters
ABR	Critical data transfer, such as for defense information where rapid access to network bandwidth is important.	MCR, PCR	CLR (optional)
CBR	Telephone conversations, voice mail, or audio services (radio, or audio library). Videoconferencing, video on demand.	PCR, CDVT	Peak-to-peak CDV, maxCTD, CLR
nrt-VBR	Airline reservations, banking transactions.	PCR, CDVT, SCR, MBS	CLR
rt-VBR	Compressed or packetized voice or video including telephone conversations, voicemail, HDTV.	PCR, CDVT, SCR, MBS	Peak-to-peak CDV, maxCTD, CLR

Table 1-1 ATM Traffic Parameters and QoS Parameters by Service Category (continued)

ATM Service Category	Application Examples	Traffic Parameters	ATM QoS Parameters
UBR	File transfer and e-mail.	PCR (optional) ¹	None supported
UBR+ ²	Interconnecting IP routers with virtual channel connections (VCCs) or virtual path connections (VPCs).	PCR (optional), MCR	None supported

1. Cisco Systems supports specification of the PCR parameter; however, some ATM switches do not support enforcement of PCR and the value becomes informational.
2. UBR+ is a special ATM service category developed by Cisco Systems. It is similar to the ATM Forum's addendum specification for a Minimum Desired Cell Rate (MDCR) parameter for the UBR service category.

ATM QoS and Cisco IOS QoS Distinctions

The term QoS is a frequently used term that can represent many different aspects of data transmission and traffic management on a network. Therefore, it is important to be clear about what is meant by QoS.

It is helpful to your understanding of ATM traffic management on the Cisco 7200 series router if you do not confuse the QoS parameters associated with an ATM service category with the QoS features in the Cisco IOS software that can be implemented for IP over ATM. These are two very distinct areas of QoS.

ATM QoS

The ATM technology defines QoS in terms of the management of cell delay and cell loss over the ATM network. Therefore, ATM QoS represents the end-to-end network performance of cell transmission from the source to the destination, not including the edge router.

The ATM Forum specifications define specific QoS parameters that are used to manage cell delay and cell loss over the ATM network. Technically, the Cisco IOS QoS features supported by ATM have no relevance to these parameters or to the definition of QoS in the ATM Forum specifications.

Cisco IOS QoS Software

Cisco IOS QoS software features do not affect the performance of cell transmission once the cells leave the edge router and are transported over the ATM network. Cisco IOS QoS software affects packets in the Layer 3 queues on the router—not cells over the ATM network.

ATM Adaptation Layers and ATM Service Categories

Like ATM service categories, different ATM Adaptation Layers (AALs) also are defined to support different classifications of traffic types. The primary role of an AAL is to separate data into even, 48-byte chunks called a segmentation and reassembly (SAR) protocol data unit (PDU). Once the AAL creates a 48-byte chunk, the ATM Layer adds a 5-byte header to create a 53-byte ATM cell.

To optimize services for different traffic classifications, each AAL type (other than AAL5) provides different information within the 48-byte PDU. This extra information becomes overhead for the payload in the 48-byte PDU. All AAL types segment data into 48-byte SAR-PDUs, but the encapsulations within those 48 bytes vary by AAL type.

For example, AAL1 uses one byte out of the 48 bytes to support a sequence number field and a sequence number protection field. AAL5 is the most efficient of all of the AAL types because it does not use any of the 48-byte payload for extra information.

The ATM Forum identifies four different types of AALs (AAL3 and AAL4 have been combined), which correspond to the different types of traffic to be supported. [Table 1-2](#) shows the relationship of AAL types to ATM service categories.

Table 1-2 Relationship of AAL Types to ATM Service Categories

AAL Type	ATM Service Category	Application
AAL0 ¹	(Not applicable)	Cell relay over MPLS
AAL1	CBR	Voice
AAL2	rt-VBR	Compressed voice (allows for silent periods) or compressed video; Voice over ATM (VoATM).
AAL3/4 ²	ABR, UBR	No longer used
AAL5	ABR, CBR, nrt-VBR, rt-VBR, UBR	Data

1. AAL0 represents a null adaptation layer, which is used for cell relay over Multiprotocol Layer Switching (MPLS). Support for AAL0 was introduced for the PA-A3 ATM port adapters in Cisco IOS Release 12.0(25)S and Cisco IOS Release 12.2 S. As of Cisco IOS Release 12.0(25)S, it is not supported for the PA-A6 ATM port adapters.
2. AAL3/4 is no longer in use, but is included here to show the evolution of AAL types. AAL5 is a simplified version of AAL3/4.

Port Adapter Support for AAL on the Cisco 7200 Series Routers

AAL5 is one of the most widely used AAL types, and is the default encapsulation type for the ATM port adapters on the Cisco 7200 series router. AAL5 uses the entire 48-byte payload for data.

Different ATM port adapters on the Cisco 7200 series routers support different AAL encapsulation methods.

For more information about the differences in ATM port adapter support, see [Chapter 3, “ATM Traffic Management Hardware and Software Planning.”](#)

CBR for Voice and Data on the Cisco 7200 Series Routers

Cisco documentation differentiates between CBR for voice and CBR for data, depending on the AAL type supporting the CBR virtual connection:

- CBR for voice—Uses AAL1, and includes circuit emulation service (CES) and Voice over ATM applications. A 1-byte AAL1 header uses time stamps, sequence numbers, and other bits to help the ATM network deal with ATM-layer defects such as cell delay variation, cell misinsertion, and cell loss.
- CBR for data—Uses AAL5, but the same interface typically does not support CBR for voice. AAL5 adds an 8-byte trailer with a 4-byte cyclic redundancy check (CRC) for detecting errors in a PDU.

Congestion on an ATM Network

Well-behaved traffic that conforms to the agreed-upon service levels is critical to the performance of the public ATM WAN. Without the proper controls and management in place, there is the potential for certain customers to consume bandwidth above the agreed-upon rate. This can cause congestion, which not only prevents other user traffic from its right to access that bandwidth, but can cause significant degradation to the performance on the network.

The cost of congestion to ATM network performance is better understood when you consider what happens if one or more cells are marked and dropped during transmission of a packet. Consider an AAL5 PDU. It is important to recall that the cells are reassembled and the CRC of a packet is checked at the destination. This means that regardless of when or how many cells are dropped during transmission, all of the remaining cells associated with the packet are still transmitted across the ATM network. Then, when the destination receives the last cell with the end-of-message bit turned on, it reassembles the cells. When an application [such as the Transmission Control Protocol (TCP)] detects an error in the packet due to the lost cells, it requests that the source resend the entire packet. This results in more traffic being sent across the ATM network, creating even more congestion, which makes the problem worse. The congestion problem can grow exponentially out of control.

When congestion occurs, packets are marked and dropped, which causes retransmissions. A disruptive phenomenon called *global synchronization* can occur network wide, particularly with TCP applications. During a global synchronization event, the queues fill and retransmissions occur. If the backoff period (or window) for retransmissions is too close, then when the cells are retransmitted onto the network, the queues again quickly fill and the cells are dropped again.

Even with an ATM network that has been traffic engineered, congestion on the network can occur. The ATM public network also must be configured properly to manage all of the flows from the UNIs and NNIs that it supports. However, effective management of traffic on the ATM network begins with well-managed ATM traffic at the edge devices, such as the Cisco 7200 series router.

Therefore, the primary goal of ATM traffic management is congestion prevention at the UNI interface. If the UNI device can present cells to the public ATM network in a predictable way, then the ATM network can be more efficient and effectively managed.

Traffic Control Functions in ATM Traffic Management

Two of the most important aspects of ATM traffic management are the traffic control functions of shaping and policing. The Cisco 7200 series routers support both of these traffic control functions for ATM.

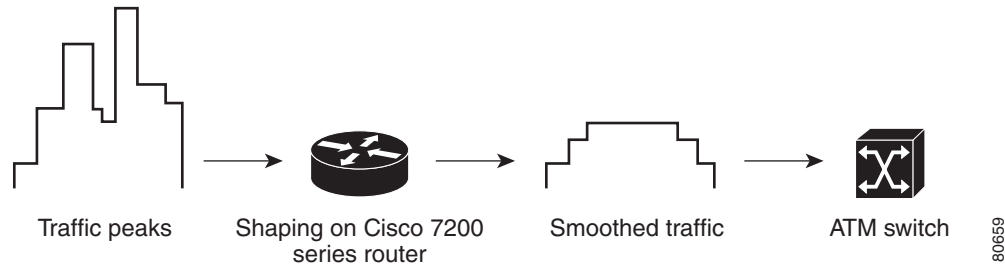
Traffic Shaping

Traffic shaping at the edge device of an ATM network is considered a preventive measure for the control of network congestion. Traffic shaping controls the flow of traffic onto the network to smoothe out peaks of traffic.

The concept of traffic shaping is particularly relevant for data transfer, which is characterized by variable bursts of traffic onto the network. These bursts create peaks of traffic, and can cause periodic violations to the traffic contract by exceeding the allowable rate of transfer. Bursty traffic patterns also make inefficient use of the network bandwidth.

Figure 1-3 shows the effect of shaping peaks of traffic on the Cisco 7200 series router to produce a smoother, more efficient flow of traffic outbound to an ATM switch.

Figure 1-3 Effect of Traffic Shaping on Traffic Peaks



You can implement traffic shaping by configuring the set of traffic parameters associated with a particular ATM service category for a PVC or SVC.



Note

Traffic shaping is sometimes referred to as *traffic conditioning*.

Traffic Shaping on the Cisco 7200 Series Router

The Cisco 7200 series router is normally an edge device located on the UNI side of the ATM network. It is very important to configure traffic shaping on the Cisco 7200 series router to effectively control the traffic going onto the ATM network to conform to the traffic contract—but it is only one aspect of the flow.

When you implement traffic shaping, cells are sent onto the network in consistent patterns of cells with fixed, minimum intercell gaps. This rate is based on the traffic shaping parameters that you configure for that PVC or SVC.

However, by shaping the traffic, and with the likely support of multiple service categories with competing transmission characteristics, you effectively create congestion on the router itself—this is where queueing comes in, and also the availability of certain Cisco IOS QoS software features to manage the performance of the queues.

You begin with traffic shaping to configure the performance levels that you want to support on the ATM network. From there, because traffic shaping produces congestion, you need to optimize the applicable hardware and software queues to increase overall performance of the flow of traffic through the router.

Port Adapter Support for Traffic Shaping on the Cisco 7200 Series Router

It is very important to understand that each ATM port adapter on the Cisco 7200 series routers supports different ATM service categories and also implements traffic shaping functions uniquely.

All ATM port adapters support traffic shaping on the Cisco 7200 series routers *except* the PA-A1 ATM port adapter. Although the PA-A1 does support the UBR service category, this is a best-effort service and technically does not perform the function of shaping the traffic over the PVC.

The PA-A3 ATM port adapter and PA-A6 ATM port adapter provides enhanced functionality to the PA-A1 port adapter, and are highly recommended for ATM traffic shaping. The PA-A6 ATM port adapter is an enhanced version of the PA-A3 ATM port adapter and supports twice as many virtual circuits.

For more information about how traffic shaping is implemented on ATM port adapters on the Cisco 7200 series routers, see [Chapter 2, “Cisco 7200 Series Architecture and Design for ATM Traffic Management.”](#)

For more information about the differences in ATM port adapter support, see [Chapter 3, “ATM Traffic Management Hardware and Software Planning.”](#)

Benefits of Traffic Shaping on the Cisco 7200 Series Router

Traffic shaping on the Cisco 7200 series router provides the following benefits:

- Smooths rates of cell transmission to consistent interarrival times, which prevents ATM switches from marking and dropping traffic.
- Allows you to partition your T1/E1, T3/E3, and OC-3 links into smaller, logical channels.
- Helps prevent traffic from any particular VC from consuming the entire interface bandwidth.
- Allows you to match the router’s interface transmission rate to the speed of a remote target interface so that you have an even, end-to-end connection.
- Allows any packet drops to occur closer to the source of the traffic, which is more efficient than if cell drops occur on the network side. When packet drops occur at the edge device, the retransmission can be handled much more efficiently by the source and without consuming as much network resource than if one or more cells of that packet are dropped on the ATM network. For further information, see the [“Congestion on an ATM Network”](#) section on page 1-10.
- Allows you to buffer some of the traffic waiting to be transmitted to help limit the number of packets that might ordinarily be dropped during any bursts of transmission.
- Allows you to optimize the traffic, rather than having the network side indiscriminately drop cells to force compliance with the traffic contract.

Traffic Policing

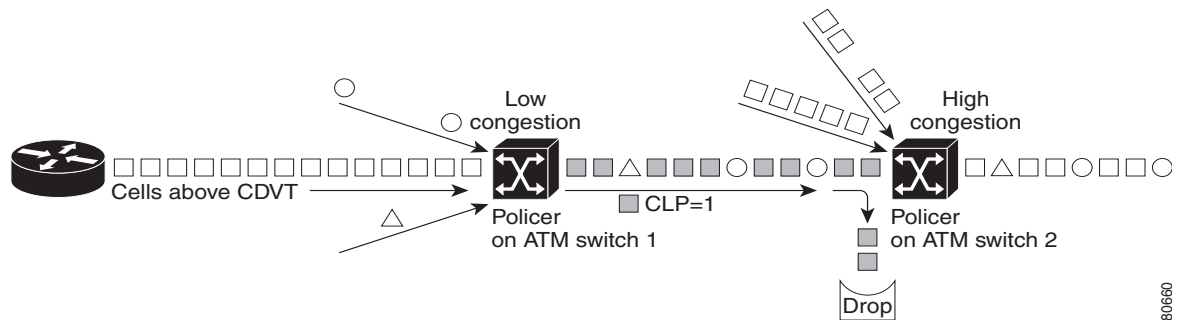
Another method used to control traffic on the ATM network is traffic policing. Traffic policing is typically performed by the ATM switch to monitor connections to ensure that they are in conformance with the traffic contract. Policing is important to maintain good performance on the network and to prevent misuse of network resources by users. This helps ensure that all network users get the service levels for which they are paying.

Traffic policing can be done at the UNI or NNI. Service providers typically implement policing at the UNI, on the first switch at the UNI reference point to the ATM network. The switch uses what is known as Usage Parameter Control (UPC) to police connections at the UNI. UPC applies a mathematical formula to determine whether the traffic over a virtual circuit (VC) complies with the contract.

In ATM, part of the policing function is to mark cells as low priority so that if congestion occurs, these cells are dropped. Cells are said to be *marked* as low priority when the Cell Loss Priority (CLP) bit is set to 1. Switches base this marking on cell arrival times and the traffic contract. If cells are found to be in violation of the traffic contract—that is, cells are arriving at a faster rate than agreed upon for the connection—then the cells are marked as low priority and can be dropped.

Figure 1-4 shows cells arriving at a rate above the CDVT to the first ATM switch. The first ATM switch is not congested, so all of the cells above CDVT are marked (the CLP bit is set to 1) and passed to the next switch on the network. The second ATM switch is experiencing high congestion, so it selectively drops any cells with CLP=1.

Figure 1-4 Traffic Policing and Marking on ATM Switches



Be aware that some service providers can simply drop nonconforming cells (cells transmitting above the traffic contract), regardless of the level of congestion being experienced on the switch. In this situation, it could be that ATM switch 1 in Figure 1-4 drops the cells, rather than marking and passing along in the network.

Cisco 7200 series routers also support setting the CLP bit through simple marking and also through policing.

Traffic Policing on the Cisco 7200 Series Router

Although the switch on an ATM network commonly implements traffic policing by marking and dropping cells, you can also set the CLP bit using a QoS service policy on a Layer 3 queue on the Cisco 7200 series router. However, the Cisco 7200 series policer never drops ATM traffic based on the CLP bit. It merely marks the packet for CLP (the CLP bit is set in the ATM cell header) and continues.

The difference in this approach is that the switch implements marking at Layer 2, but on the Cisco 7200 series router, you can police and mark IP packets at Layer 3 using QoS service policies.

On the Cisco 7200 series router, you can set the CLP bit for ATM cells in a couple of ways:

- You can configure simple marking for all traffic matching a policy class—this is called *class-based packet marking*. When you implement class-based packet marking, all packets that match the class are marked. Congestion on the VC is not a consideration.
- You can police packets for certain rate criteria using a QoS service policy on a Layer 3 queue. When you implement traffic policing for a VC, the policer determines whether traffic conforms to configured contract values and then, according to your configuration, acts on violations by setting the CLP bit. The advantage over class-based packet marking is that the marking is performed on packets according to rate-conformance criteria, rather than on all packets in a class.



Note

The Committed Access Rate (CAR) feature is considered a legacy form of policing and is no longer recommended for use on the Cisco 7200 series routers. Newer, class-based policing mechanisms are now available for some ATM port adapters using the modular QoS CLI (MQC) configuration method.

Benefits of Traffic Policing on the Cisco 7200 Series Router

By marking packets on the router, you can have some control over which traffic is marked and dropped on the network. In this way, cells are not randomly marked as low priority by the switch on the ATM network due to traffic violations.

Design Objectives for ATM Traffic Management

The result of successful ATM traffic management is the efficient transport of traffic through the network with minimization of congestion, while providing fair and sufficient bandwidth access for all service categories when needed.

To efficiently transport mixed traffic through an ATM network, the challenge lies in meeting the following design objectives over the network:

- Prevent congestion on the network by creating a more consistent flow of traffic at the edge device—this is known as *traffic shaping*.
- Control cell delay and cell loss while satisfying the transmission requirements of the different traffic types—this is the basis of QoS for ATM.
- Maximize the use of network bandwidth to fulfill the traffic contract, but prevent a particular application or location from monopolizing the bandwidth—this is part of queue management on the Cisco 7200 edge device; and, on the ATM network, the enforcement of bandwidth usage is known as *traffic policing*.

Related Documentation

The following table provides information about additional resources that you can read to learn more about some of the topics discussed in this chapter:

For more information about:	Refer to the following publications:
ATM technical standards	Approved ATM Forum Specifications
ATM technology and other Cisco Systems products	<i>Cisco ATM Solutions</i> , Cisco Press
Cisco IOS QoS software features	<i>Cisco IOS Quality of Service Solutions Configuration Guide</i>

Next Steps

This book focuses on how to implement traffic management functions and optimize the overall flow of ATM traffic on the Cisco 7200 series router. It emphasizes traffic management for the PA-A3 and PA-A6 ATM port adapters.

Before you implement traffic shaping to manage your ATM traffic, it is important that you understand how the hardware and software architectural concepts on the Cisco 7200 series router apply to the flow of ATM traffic.

[Chapter 2, “Cisco 7200 Series Architecture and Design for ATM Traffic Management,”](#) provides detailed explanations of the hardware and software concepts that are applicable to ATM traffic management on the Cisco 7200 series router.

