Video over ATM Switched Virtual Circuits on the Cisco MC3810

This document describes Cisco IOS configuration for video over Asynchronous Transfer Mode (ATM) switched virtual circuits (SVCs), introduced with the plug-in video dialing module for the Cisco MC3810 multiservice access concentrator. It includes the following sections:

Feature Overview

Video over ATM SVCs expands the capabilities of the Cisco MC3810 multiservice access concentrator to provide cost-effective, dynamic, and flexible videoconferencing system support. Using a plug-in video dialing module (VDM) to provide an RS-366 dialing interface to an H.320 video codec, the Cisco MC3810 automatically accepts dial-out requests from the video system. The codec connects to one of the Cisco MC3810 serial ports and also to the Cisco MC3810 RS-366 dial-up port.

The current feature also improves PVC support by permitting PVC connections with automatic connection through a serial port. Each codec must place a call to the other videoconferencing system prior to the expiration of the video codec time-out period (set on the codec, usually one minute). Using a video dial map, each system reconciles the dialed number with a PVC that has already been configured, allowing fast connectivity.

Service providers, educational organizations, and enterprises can concentrate streams for video with packet data on a single high-speed ATM link without a separate ATM access multiplexer. Here are some features of the Cisco's ATM SVC implementation:

- Video traffic uses circuit emulation service (CES) encapsulation and ATM Adaptation Layer 1 (AAL1) so that multiple ATM SVCs can comprise a constant bit rate (CBR) virtual circuit to the destination.
- The implementation adheres to the required features of ATM Forum User-Network Interface (UNI) specification, version 4.0, simultaneously supporting permanent virtual circuits (PVCs) and SVCs.
- Video over ATM SVCs support codec speeds of 128, 384, 768, and 1,152 kilobits per second (Kbps).
- The Cisco MC3810, responding to the design of many leading H.320-based video systems, receives the called-party information from the RS-366 interface, then reconciles the dialed address with a standard 20-octet ATM network service access point (NSAP) address.

Figure 1 Sample ATM Video Application

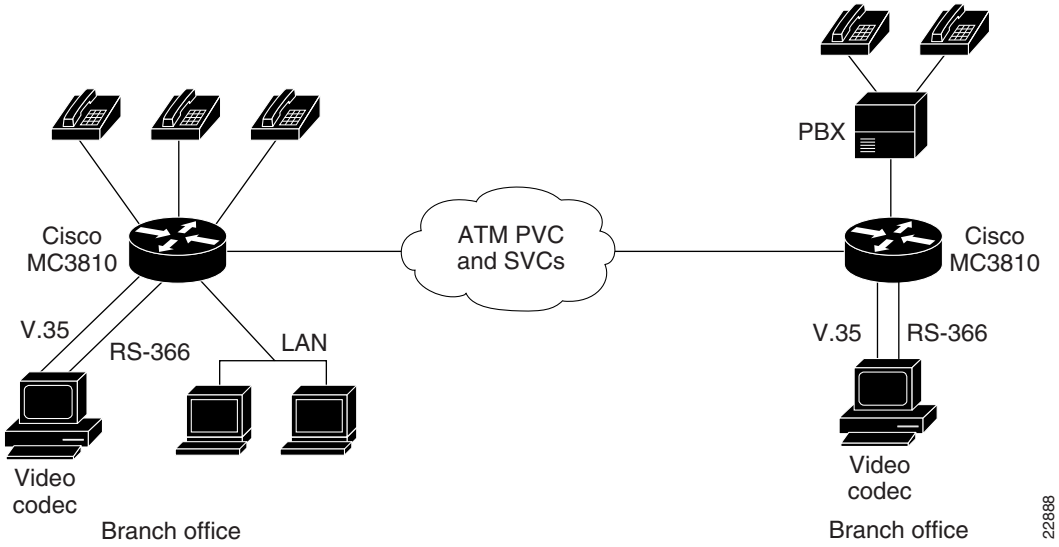
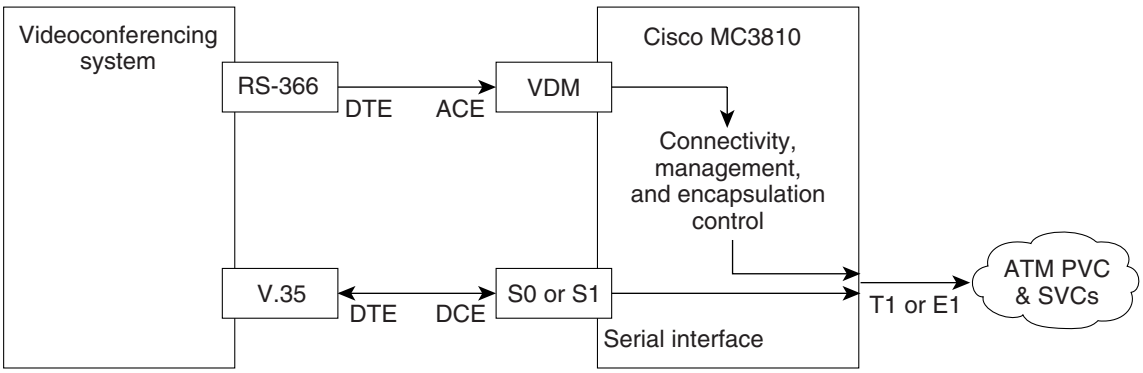


Figure 2 shows how the physical interfaces interact with software, the codec, and video data to handle connectivity and video functionality. The VDM's Automatic Calling Equipment (ACE) provides the RS-366 interface to the video codec while one of the Cisco MC3810 serial interfaces connects to the video codec data terminal equipment (DTE) interface. The Video Call Manager (ViCM) software manages video calls that travel over a T1 or E1 facility through the Cisco MC3810 Multiflex Trunk (MFT) interface.

Figure 2 Physical Interfaces and Their Functions



DTE=data terminal equipment
DCE=data communications equipment
ACE=automatic calling equipment
VDM=video dialing module

22889

Benefits

The primary benefit of this feature is its support of video SVCs, which provide an easy-to-use method of video communications:

- When SVCs are used, a video call begins with a codec dialing a remote system.
- Then, the local Cisco MC3810 maps the dialed number to a remote ATM SVC address by using the video dial-map.
- Next, an ATM SVC call is set up between the local and remote Cisco MC3810 multiservice access concentrators.
- Finally, the Cisco MC3810 multiservice access concentrators signal the video codecs to begin sending video data. Connection through a serial port is automatic.

SVCs offer the following benefits:

- Dynamic resource allocation is more efficient and flexible than in nailed-up PVC connections, which remain intact until they are removed.
- SVCs, in many cases, mean favorable service-provider pricing.
- SVCs are easier for video callers to use than PVCs.
- SVCs reduce the delays that occur in networks where PVCs require multiple hops.
- Interface requirements are determined by total bandwidth needs—rather than by the number of different remote connections.

The Cisco MC3810 multiservice access concentrator formerly supported nondial PVCs for ATM traffic with explicit connection through a serial port. With this release, the Cisco MC3810 supports dial PVCs, where each party dials the other in order to make a video connection.

Restrictions

The following restrictions apply to video over ATM using SVCs:

- Point-to-point connectivity for ATM SVC video does not support tandem switching and network (local) hunting.
- You can connect only one video codec to a Cisco MC3810.
- For video SVCs, the ATM service class is not configurable. It is automatically set to CBR, which is the standard service class for video.

The following features are not supported:

- Direct E.164 addressing
- Available Bit Rate (ABR) service
- Tandem networking
- Leaf-initiated joins (LIJs)
- ATM anycast, communication between one sender and the nearest of several receivers in a group
- Generic Identifier Transport (GIT), which uses an information element to carry identifiers between two users
- Switched Virtual Path service, which is the grouping of SVCs to define a path (usually within a single application) where the switch directs calls as appropriate
- Proxy signaling, where, for example, IP traffic is identified by class or precedence and an IP router rather than the source host signals an ATM layer

Related Features and Technologies

The Cisco MC3810, in addition to supporting video and voice over ATM SVCs and PVCs, also supports data over ATM SVCs. *Wide-Area Networking Configuration Guide* and *Wide-Area Networking Command Reference* provide more information about the commands and configuration steps required for this capability.

Related Documents

For information about Cisco IOS configuration for video applications, see the following Cisco IOS Release 12.0 documents:

- *Voice, Video, and Home Applications Configuration Guide*
- *Voice, Video, and Home Applications Command Reference*

For information about ATM IOS configuration, see the following Cisco IOS Release 12.0 documents:

- *Wide-Area Networking Configuration Guide*
- *Wide-Area Networking Command Reference*

For information about hardware installation as well as video and ATM IOS configuration uniquely for the Cisco MC3810, see the following Cisco documents:

- *Cisco MC3810 Multiservice Concentrator Hardware Installation*
- *Cisco MC3810 Multiservice Access Concentrator Software Configuration Guide*
- *Cisco MC3810 Multiservice Access Concentrator Software Command Reference*

Supported Platforms

This feature is supported on the Cisco MC3810 multiservice access concentrator.

Supported Standards, MIBs, and RFCs

No MIBs are supported by this feature.

No RFCs are supported by this feature.

Other Standards

- ATM Forum document af-uni-0010.002, ATM User-Network Interface Specification V3.1 (1994), including support for the following types of information elements:
  - Traffic Descriptor
  - Broadband Bearer Capability
  - ATM Addressing Information
- ATM Forum document af-sig-0061.000, ATM UNI Signaling Specification V4.0 (1996), with the exceptions noted in “Restrictions” on page 4
- ITU recommendation Q.2931
- ITU-T X.213 and OSI Network Service Access Point (NSAP) addressing
- ATM Forum document af-ilmi-0065.000, Integrated Local Management Interface (1996)
- ATM Forum document af-saa-0032.000, Circuit Emulation
- ATM Forum document af-vtoa-0078.000, Circuit Emulation Service Interoperability Specification Version 2.0
- EIA RS-366-A signaling interface
- V.35 data interface

Prerequisites

This feature requires specific hardware and software:

- Cisco IOS Software Release 12.0(5)XK or 12.0(7)T or later releases
- A configured ATM network
- A Cisco MC3810 video dialing module (VDM) and a Multiflex Trunk (MFT) module for ATM network connectivity
- Two cables are required:
  - A new Cisco serial V.35 DCE cable (product number 72-1721-01) that includes a Ringing Indicator (RI) conductor. This cable carries the video stream between the Cisco MC3810 and the video equipment. Videoconferencing equipment often uses the V.35 RI as the incoming call alerting signal. The Cisco standard serial V.35 cables do not include the RI conductor.
  - A Cisco RS-366 ACE cable (product number 72-1722-01) to connect the VDM to the videoconferencing equipment RS-366 dial-up DTE port.

For additional information about installation and other hardware considerations, see *Cisco MC3810 Multiservice Concentrator Hardware Installation*.

Configuration Tasks

To configure video over ATM SVCs, perform the following tasks:

- Set up clock sources and T1/E1 controller settings.
- Configure serial interfaces.
- Set up the ATM interface, including signaling and management PVCs.
- Configure video and ATM dial peers.

These tasks do not represent all the configuration tasks required to set up your ATM network. For more information, see the *Cisco MC3810 Multiservice Access Concentrator Software Configuration Guide* and to the examples shown in the "Configuration Examples" section on page 23.

Configuring Network Clocks and Controllers

Because real-time video communications require a continuous and tightly meshed data stream to avoid loss of information, you must synchronize source and destination devices to a single master clock. In the example below, the clock source is derived from a device attached to T1 controller 0; then it is distributed to the devices attached to the local Cisco MC3810 serial ports and to T1 controller 1. Clock source decisions should be based on the network configuration, and a hierarchy of clock sources can be set up, so that backup clock sources are available. For details, see Chapter 4, "Configuring Synchronized Clocking," in *Cisco MC3810 Multiservice Access Concentrator Software Configuration Guide.*

This configuration task also includes the basic steps required for ATM support over T1/E1 controller 0.

Step	Command	Purpose
1	`Router# configure terminal`	Enter global configuration mode.
2	`Router(config)# controller {T1 | E1} 0`	Enter controller configuration mode for controller T1/E1 0. ATM traffic is supported on controller T1/E1 0 only.
3	`Router(config-controller)# clock source line`	Configure controller T1/E1 0 to obtain the Cisco MC3810 clock source from an attached network device. This is the default setting.
4	`Router(config-controller)# no shutdown`	Activate the controller.
5	`Router(config)# controller {T1 | E1} 1`	Enter controller configuration mode for controller T1/E1 1.
6	`Router(config-controller)# clock source internal`	Configure controller T1/E1 1 to obtain its clocking from the internal network clock Phase-Lock-Loop (PLL). Controller T1/E1 1 obtains clocking from the T1/E1 0 controller source, so that both controllers use the same clock source.
7	`Router(config-controller)# no shutdown`	Activate the controller.
8	`Router(config-controller)# exit`	Exit controller configuration mode.

9	`Router(config-controller)# framing esf`
	or
	`Router(config-controller)# framing crc4`
		Set the framing to Extended SuperFrame (ESF) format, which is required for ATM on T1. This setting is automatic for T1 when ATM mode is set.
		Set the framing to CRC4, which is required for ATM on E1. This setting is automatic for E1 when the ATM mode is set.

10	`Router(config-controller)# linecode b8zs`
	or
	`Router(config-controller)# linecode hdb3`
		Set the line coding to binary zero 0 substitution (B8ZS), which is required for ATM on T1. This setting is automatic for T1 when the ATM mode is set.
		Set the line coding to HDB3, which is required for ATM on E1. This setting is automatic for E1 when the ATM mode is set.
		Note When the E1 controller is specified, you must also configure scrambling on the ATM 0 interface. See Step 4 of "Configuring ATM Interfaces" on page 11.

Step	Command	Purpose
11	`Router(config-controller)# mode atm`	Configure the controller for ATM traffic. This allows the controller to support ATM encapsulation and create virtual ATM interface 0 for SVCs and PVCs. Controller framing is automatically set to extended superframe (ESF) on T1 and to CRC4 on E1. The line coding is automatically set to B8ZS on T1 and to HDB3 on E1. Channel groups, CAS groups, Common Channel Signaling (CCS) groups or clear channels are not allowed on the trunk because ATM traffic occupies all the DS0s.
12	`Router(config-controller)# exit`	Exit controller configuration mode.
13	`Router(config)# network-clock base rate {56k | 64k}`	Set the network clock base rate for the serial ports. For video stream rates of 384, 768, 1.152, or 1.28 kbps (see Step 3), set the rate to 64 kbps. The default is 56 kbps. **Note** At this point, you can also configure network protocol settings such as IP hosts. For more information, see the Cisco IOS Release 12.0 network protocol configuration and command reference guides.

Verifying Network Clock and Controller Configuration

To verify the configuration of network clock sources and controller settings, follow the steps below:

Step 1 Enter the privileged EXEC command **show network-clocks** to see the status of clock source settings. In this example, the "inactive config" clock setting is the current configuration:

```
Router# show network-clocks

Priority 1 clock source(inactive config): T1 0
Priority 1 clock source(active config) : T1 0
Clock switch delay: 10
Clock restore delay: 10
T1 0 is clocking system bus for 9319 seconds.
Run Priority Queue: controller0
```

Step 2 Enter the privileged EXEC command **show controllers t1** or **show controllers e1** to see the status of T1 or E1 controllers, as in the following example:

```
router# show controller t1 1
T1 1 is up.
  Applique type is Channelized T1
  Cablelength is long gain36 0db
  No alarms detected.
  Slot 4 CSU Serial #07789650 Model TEB HWVersion 4.70 RX level = 0DB
  Framing is ESF, Line Code is B8ZS, Clock Source is Internal.
  Data in current interval (819 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 1:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 2:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
     .
```

```
  .
  .
  Data in Interval 96:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Total Data (last 24 hours)
     0 Line Code Violations, 0 Path Code Violations,
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs

!
Router# show controllers E1 1
E1 1 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  Slot 4 Serial #06868949 Model TEB HWVersion 3.80
  Framing is CRC4, Line Code is HDB3, Clock Source is Internal.
  Data in current interval (292 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
    .
    .
    .
  Total Data (last 66 15 minute intervals):
     9 Line Code Violations, 0 Path Code Violations,
     1 Slip Secs, 0 Fr Loss Secs, 4 Line Err Secs, 0 Degraded Mins,
     5 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

Configuring Serial Interfaces

This configuration task includes the basic steps required for setting up a serial port for the video codec.

Step	Command	Purpose
1	`Router# configure terminal`	Enter global configuration mode.
2	`Router(config)# interface serial {0 | 1}`	Enter interface configuration mode either for Serial 0 or Serial 1, depending on where the video codec is connected.
3	`Router(config-if)# clock rate network rate`	Configure the network clock speed for DCE mode, in bits per second, corresponding to the video stream rate you are using. The rate must be a multiple of the value set with the **network-clock base-rate** command in Step 13 of "Configuring Network Clocks and Controllers" on page 7. Make sure this setting is 384000, 768000, or 1152000. 768000 is a common setting.
4	`Router(config-if)# encapsulation atm-ces`	Configure the interface for ATM encapsulation circuit emulation service (CES), which is required for video codec support.

Step	Command	Purpose
5	`Router(config-if)# serial restart-delay` *count*	The **serial restart-delay** command allows you to set the amount of time that the router waits before trying to bring up a serial interface when the interface goes down. The router resets the hardware each time the restart timer expires. This command is often used with dial backup and with the **pulse-time** command, which sets the amount of time to wait before redealing when a DTR dialed device fails to connect. *count* is a value from 0 to 900 in seconds. This is the frequency at which the hardware is reset. A value of 0 means that the hardware is not reset when down. In this way, if the interface is used to answer a call, it does not cause DTR to drop, which can cause the modem to disconnect.

Verifying Serial Interface Configuration

Enter the privileged EXEC command **show interfaces serial** command to see the status of all serial interfaces or of a specific serial interface, as shown in the example below. You can use this command to check the encapsulation, scrambling, and serial restart delay settings:

```
Router# show interface serial0
Serial0 is down, line protocol is down
  Hardware is PQUICC Serial Trans
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 65/255, rxload 1/255
  Encapsulation CES-ATM, loopback not set
  Keepalive not set
  Scramble enabled
  Restart-Delay is 0 secs
  Last input never, output never, output hang never
  Last clearing of "show interface" counters 5d13h
  Queueing strategy: fifo
  Output queue 0/100, 101 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     13452224 packets input, 1526136219 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     215189699 packets output, 1654453088 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
  Cable attached: V.35 (DCE)
  Hardware config: V.35; DCE; PLL nx64K;
  DSR = UP   DTR = DOWN   RTS = DOWN   CTS = DOWN   DCD = DOWN
```

Configuring ATM Interfaces

In this section, the ATM interface is set up, including PVCs to carry signaling for SVCs. The video NSAP addressing commands specify session target information for SVC video communications.

In addition, the following steps include procedures for configuring a dial PVC for videoconferencing.

Step	Command	Purpose
1	`Router# configure terminal`	Enter global configuration mode.
2	`Router(config)# interface atm0`	Enter interface configuration mode for ATM 0—the only interface that supports video over ATM.
3	`Router(config-if)# ip address` *ip-address mask*	For IP protocol communications, assign the IP address and subnet mask to the interface.
4	`Router(config-if)# atm scramble-enable`	(E1 configuration only) Helping to ensure reliability, scrambling randomizes the ATM cell payload frames to avoid continuous non-variable bit patterns and improve the efficiency of ATM's cell delineation algorithms.
5	`Router(config-if)# atm video aesa {default |`*esi-address*`}`	This command sets the unique ATM end-station address (AESA) for an ATM video interface that is using SVC mode. The **default** keyword automatically creates an NSAP address for the interface, based on a prefix from the ATM switch (26 hexadecimal characters), the MAC address (12 hexadecimal characters) as the ESI (end station identifier), and a selector byte (two hexadecimal characters). The *esi-address* option requires that you enter 12 hexadecimal characters as the ESI. The ATM switch provides the prefix, and the video selector byte provides the remaining characters. You can view the assigned address by using the **show atm video-voice address** command.

Step	Command	Purpose
6	`Router(config-if)# pvc [name] vpi/vci ilmi`	Create an ATM PVC for ILMI management purposes and enter PVC configuration mode. The optional *name* is a unique label that can be up to 16 characters long. It identifies to the processor the virtual path identifier-virtual channel identifier (VPI-VCI) pair to use for a particular packet. The ATM network VPI of this PVC is an 8-bit field in the header of the ATM cell. The *vpi* value is unique only on a single link, not throughout the ATM network, because it has local significance only. The *vpi* value must match that of the switch. Valid values are from 0 to 255, but the value is usually 0 for ILMI communications. If a value is not specified, the *vpi* value is set to 0. You cannot set both *vpi* and *vci* to 0; if one is 0, the other cannot be 0. For ILMI communications, this value is typically 16. The VCI is a 16-bit field in the header of the ATM cell. The VCI value is unique only on a single link, not throughout the ATM network, because it has only local significance. To set up communication with the ILMI, enter the **ilmi** keyword for ATM adaptation layer encapsulation; the associated *vpi* and *vci* values are ordinarily 0 and 16, respectively. **Note** Typically, the low values 0 to 31 are reserved for specific traffic (for example, F4 OAM, SVC signaling, ILMI, and so on). Do not use them for other PVCs.
7	`Router(config-if-atm-pvc)# pvc [name] vpi/vci qsaal`	See the explanations in Step 6 for the *name*, *vpi*, and *vci* values. To enable the signaling for setup and tear-down of SVCs, specify the Q.SAAL (Signaling ATM Adaptation Layer) encapsulation; the associated *vpi* and *vci* values are ordinarily 0 and 5, respectively. You cannot create this PVC on a subinterface.
8	`Router(config-if-atm-pvc)# pvc [name] vpi/vci`	This command sets up a PVC for communications. The optional *name* is a unique label that can be up to 16 characters long. The ATM network VPI of this PVC is an 8-bit field in the header of the ATM cell. Valid values are from 0 to 255, but the values from 0 to 31 are usually reserved for particular services (such as ILMI). You cannot set both *vpi* and *vci* to 0; if one is 0, the other cannot be 0. The VCI is a 16-bit field in the header of the ATM cell.
9	`Router(config-if-atm-pvc)# protocol protocol protocol-address [[no] broadcast]`	Use this command to map a protocol address to the PVC.

Step	Command	Purpose
10	`Router(config-if-atm-pvc)# cbr rate`	Use this command to configure the constant bit rate (CBR) for the ATM for an ATM PVC. Real-time video requires CBR. The valid range for the *rate* value is from 56 to 10,000 kbps. To set the rate that corresponds to the desired video speed, use a value that is 17 percent higher than the rate set on the serial DCE interface (see Step 3 in "Configuring Network Clocks and Controllers" on page 7). For example, if you specify a DCE clock rate of 768 kbps, the result is 899 kbps: 768 x 1.17 = 899 kbps
11	`Router(config-if-atm-pvc)# encapsulation aal1`	AAL1 encapsulation is necessary for videoconferencing using PVCs.
12	`Router(config-if-atm-pvc)# exit`	Return to interface configuration mode.
13	`Router(config-if)# interface atm 0 [.subinterface-number {multipoint | point-to-point}]`	Optionally, you can create and configure a subinterface. This is useful when you wish to configure an extra parameter on the ATM interface. For example, you can specify one IP address on the main interface, as shown in Step 3; then, configure a second IP address on a subinterface. *subinterface-number* is a value in the range from 1 to 4294967293. Use the **multipoint** keyword when your network is fully meshed and you wish to communicate with multiple routers. The **point-to-point** keyword configures the subinterface for communication with one router, as in a hard-wired connection. There is no default for this parameter.

Verifying ATM Interface Configuration

To verify ATM interface configuration, follow the steps below:

Step 1 Enter the **show atm pvc** command with the VPI/VCI specified to see the PVCs that are set up for ILMI management and Q.SAAL signaling, as in the following examples:

```
Router# show atm pvc 0/5
ATM0: VCD: 2, VPI: 0, VCI: 5, Connection Name: SAAL
UBR, PeakRate: 56
AAL5-SAAL, etype:0x4, Flags: 0x26, VCmode: 0x0
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s), OAM retry
frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not Managed
ILMI VC state: Not Managed
InARP DISABLED
InPkts: 2044, OutPkts: 2064, InBytes: 20412, OutBytes: 20580
InPRoc: 2044, OutPRoc: 2064, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
OAM cells received: 0
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 0
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutRDI: 0
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
```

```
OAM cell drops: 0
Compress: Disabled
Status: INACTIVE, State: NOT_IN_SERVICE
!
Router# show atm pvc 0/16
ATM0: VCD: 1, VPI: 0, VCI: 16, Connection Name: ILMI
UBR, PeakRate: 56
AAL5-ILMI, etype:0x0, Flags: 0x27, VCmode: 0x0
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s), OAM retry
frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not Managed
ILMI VC state: Not Managed
InARP DISABLED
InPkts: 398, OutPkts: 421, InBytes: 30493, OutBytes: 27227
InPRoc: 398, OutPRoc: 421, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
OAM cells received: 0
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 0
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutRDI: 0
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
OAM cell drops: 0
Compress: Disabled
Status: INACTIVE, State: NOT_IN_SERVICE
```

Step 2 Enter the privileged EXEC **show interface atm 0** command to see information about the ATM interface, as in the following example:

```
Router# show interface atm 0
ATM0 is up, line protocol is up
  Hardware is PQUICC Atom1
  Internet address is 9.1.1.6/8
  MTU 1500 bytes, sub MTU 1500, BW 1536 Kbit, DLY 20000 usec,
     reliability 255/255, txload 22/255, rxload 11/255
  NSAP address: 47.009181000000000002F26D4901.000011116666.06
  Encapsulation ATM
  292553397 packets input, -386762809 bytes
  164906758 packets output, 1937663833 bytes
  0 OAM cells input, 0 OAM cells output, loopback not set
  Keepalive not supported
  Encapsulation(s):, PVC mode
  1024 maximum active VCs, 28 current VCCs
  VC idle disconnect time: 300 seconds
  Signalling vc = 1, vpi = 0, vci = 5
  UNI Version = 4.0, Link Side = user
  Last input 00:00:00, output 2d05h, output hang never
  Last clearing of "show interface" counters never
  Input queue: -1902/75/0 (size/max/drops); Total output drops: 205
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 67000 bits/sec, 273 packets/sec
  5 minute output rate 136000 bits/sec, 548 packets/sec
     76766014 packets input, 936995443 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     367264676 packets output, 3261882795 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Step 3 Enter the privileged EXEC **show atm vc** command to see how SVCs and PVCs are set up, as in the following example:

```
Router# show atm vc
 VCD /                                            Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells  Sts
0           1           0     5   PVC    SAAL     UBR       56               UP
0           2           0    16   PVC    ILMI     UBR       56               UP
0           3           34   35   PVC    AAL1     CBR  768    768             UP
0           4           38   39   SVC     CES     CBR  768    768             UP
```

Step 4 Enter the privileged EXEC **show atm video-voice address** command to see information about the ATM interface address, which is particularly helpful because the address is assigned automatically through the **atm voice aesa** command. The following example also confirms that the ILMI status is confirmed—the ILMI PVC is set up to allow SVC management:

```
Router# show atm video-voice address
nsap address                                       type         ilmi status
47.0091810000000002F26D4901.00107B4832E1.FE   VOICE_AAL5   Confirmed
47.0091810000000002F26D4901.00107B4832E1.C8   VIDEO_AAL1   Confirmed
```

Configuring Video Dial Peers

In this section, the video dial peers are set up to support the local codec and the remote video system.

Step	Command	Purpose
1	`Router# configure terminal`	Enter global configuration mode.
2	`Router(config)# port signal` *slot/port*	Specify the slot where the VDM is located and the port for the RS-366 interface. The *slot* value is either 1 or 2. The Cisco MC3810 VDM has only one video port, so the *port* value is 0.
3	`Router(config)# dial-peer video` *tag* `videoatm`	Define a video ATM dial peer for the remote system and enter dial-peer configuration mode. Video dial peers are persistent and exist until they are specifically removed with the **no** form of the **dial-peer video** command. The *tag* value identifies the dial peer and must be unique on the Cisco MC3810. Do not duplicate a specific tag number. Valid values are from 1 to 10000.
4	`Router(config-dialpeer)# destination-pattern` *string* [**T**]	Configure the dial peer's destination pattern so that the system can reconcile dialed digits with the peer's NSAP address. The string is a series of digits that specify the E.164 or private dialing plan telephone number. Valid entries are the digits 0 through 9 and the letters A through D. The plus symbol (+) is not valid. You can enter the following special characters: • The star character (*) and the pound sign (#) that appear on standard touch-tone dial pads can appear in any dial string—but not as leading characters (for example, *650). • The period (.) acts as a wildcard character. • The comma (,) can be used only in prefixes and inserts a one-second pause. • The timer (T) character can be used to configure variable-length dial plans.

Step	Command	Purpose
5	`Router(config-dialpeer)# session target ATM0 {svc nsap address | pvc [name | vpi/vci}`	Configure the ATM session target for the dial peer. Make sure that you specify ATM 0 as the interface. Through SVCs and a video map, dialed digits are reconciled with the remote ATM interface's video NSAP address. If you are using PVCs to send video data, you can also specify a PVC defined on the ATM interface as a session target by using a name or a VPI/VCI combination. For additional information, see the *Voice, Video, and Home Applications Configuration Guide* for Cisco IOS Release 12.0.
6	`Router(config-dialpeer)# exit`	Complete the configuration of this dial peer.
7	`Router(config)# dial-peer video tag videocodec`	Define a video ATM dial peer for the local video codec. The tag value identifies the dial peer and must be unique on the Cisco MC3810. Do not duplicate a specific tag number. Valid values are from 1 to 10000.
8	`Router(config-dialpeer)# destination-pattern string`	Configure the dial peer's destination pattern. See Step 4 for more information.
9	`Router(config-dialpeer)# port signal slot/port`	Specify the slot where the VDM is located and the port for the RS-366 interface. The *slot* value is either 1 or 2. The Cisco MC3810 has only one video port, so the *port* value is 0.
10	`Router(config-dialpeer)# port media interface`	Specify the serial interface by using the name Serial and a port of either 0 or 1, depending on where the local codec is connected.
11	`Router(config-dialpeer)# nsap nsap-address`	This command specifies the NSAP address for the codec. *nsap-address* is a unique 40-digit hexadecimal number.

Verifying Video Dial-Peer Configuration

To verify the dial-peer configuration, enter the privileged EXEC **show dial-peer video** command. In the following example, note that the third dial peer uses a PVC specified with a VPI/VCI value while the second uses an SVC. The first dial peer is for the local codec.

```
Router# show dial-peer video
Video Dial-Peer 1
      type = videocodec, destination-pattern = 111
      port signal = 1/0, port media = Serial1
      nsap = 47.0091810000000050E201B101.00107B09C6F2.C8
Video Dial-Peer 2
      type = videoatm,   destination-pattern = 222
      session-target = ATM0 svc nsap 47.0091810000000050E201B101.00E01E92ADC2.C8
Video Dial-Peer 3
      type = videoatm,   destination-pattern = 333
      session-target = ATM0 pvc 70/70
```

Troubleshooting Video over ATM SVCs and PVCs

When problems occur with video over PVCs or SVCs, follow the steps below to look first for common problems before progressing to more complex possible issues.

Note If you are using dial PVCs (rather than SVCs) for video communications, ensure that both parties dial one another within the timeout period that is set on the codec. This is usually one minute.

Step 1 Check the LEDs on the RS-366 interface. If the green LED is not lit, there may be a hardware problem or the correct image may not be loaded. For more information, see *Cisco MC3810 Multiservice Concentrator Hardware Installation*.

Step 2 Make sure that the ATM interface, serial ports, and controllers are set to **no shutdown**.

Step 3 Check the serial interface configuration.

(a) If you are using dial PVCs for video, do not include the **ces connect** serial interface command because this command does not provide mapping to the ATM interface for PVCs (or SVCs) for the dial video feature. Instead, create dial PVCs under ATM interface configuration, as shown in "Configuring ATM Interfaces" on page 11. If **ces connect** has been configured, it appears in **show running-config** command output under serial interface 0 or 1.

(b) Enter the privileged EXEC **show interfaces serial** command. Ensure that the serial interface communications circuitry is operational, as shown in the last line of the **show interfaces serial** command output:

```
DSR = UP   DTR = UP   RTS = UP   CTS = UP   DCD = UP
```

Step 4 (For SVCs only) On both Cisco MC3810 multiservice access concentrators, make sure that ILMI and Q.SAAL PVCs are set up in order to allow SVC communications. The privileged EXEC **show atm pvc** command displays information about configured PVCs, including the ILMI and Q.SAAL PVCs.

```
Router# show atm pvc
 VCD /                                          Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells  Sts
0           1            0     5   PVC    SAAL     UBR        56               UP
0           2            0    16   PVC    ILMI     UBR        56               UP
```

Step 5 (For dial PVCs only) On both Cisco MC3810 multiservice access concentrators, make sure that PVCs are set up to allow dial PVC connections and that CBR is the configured service class (SC). In addition, the bit rate must correspond to the rate set on the serial interface. The privileged EXEC **show atm pvc** command displays information about configured PVCs.

```
Router# show atm vc
 VCD /                                          Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells  Sts
0           3            38   35   PVC    AAL1     CBR  384    384              UP
```

Step 6 (For SVCs only) Ensure that NSAP addresses are set up and confirmed as operational under the ATM interfaces of the Cisco MC3810 multiservice access concentrators on both sides of the communication. Enter the privileged EXEC **show atm video-voice address**

or **show atm ilmi-status** command, as shown in the following example. **show atm ilmi-status** provides more details about the ILMI PVC than does the **show atm video-voice address** command.

```
router# show atm video-voice address
nsap address                                        type         ilmi status
47.0091810000000002F26D4901.00107B4832E1.FE   VOICE_AAL5   Confirmed
47.0091810000000002F26D4901.00107B4832E1.C8   VIDEO_AAL1   Confirmed

router# show atm ilmi-status

Interface : ATM0 Interface Type : Private UNI (User-side)
ILMI VCC : (0, 16) ILMI Keepalive : Enabled (5 Sec 4 Retries)
ILMI State:       UpAndNormal
Peer IP Addr:     10.1.1.11       Peer IF Name:     ATM1/0/0
Peer MaxVPIbits:  8               Peer MaxVCIbits:  14
Active Prefix(s) :
47.0091.8100.0000.0002.f26d.4901
End-System Registered Address(s) :
47.0091.8100.0000.0002.f26d.4901.0000.1111.5555.05(Confirmed)
47.0091.8100.0000.0002.f26d.4901.0010.7b48.32e1.fe(Confirmed)
47.0091.8100.0000.0002.f26d.4901.0010.7b48.32e1.c8(Confirmed)
```

Step 7 Check for clocking problems. Enter the privileged EXEC command **show controllers t1** or **show controllers e1** command to check for slip errors, as shown in the following excerpt from the command output:

```
 .
 .
 .
 Data in current interval (819 seconds elapsed):
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 1:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 2:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
  Data in Interval 3:
     0 Line Code Violations, 0 Path Code Violations
     0 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
     0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
    .
    .
    .
```

A few slip errors may not indicate a problem with clocking. However, if there are numerous errors, especially incrementing numbers of errors, check the following possibilities:

- The network clocks are not set to the same clock rate. Enter the **show network-clocks** command on the devices to ensure that these clock rates match.
- The Cisco MC3810 multiservice access concentrators may not be using the same clock source. For example, if there are two back-to-back Cisco MC3810 multiservice access concentrators and one is using an internal clock source, the other must use the line clock source in order to obtain clocking from the same device. Enter the privileged EXEC commands **show network-clocks** and **show**

controllers t1 or **show controllers e1** to see the clock source settings. For additional guidance, see Chapter 4, "Configuring Synchronized Clocking," in *Cisco MC3810 Multiservice Access Concentrator Software Configuration Guide.*

Step 8 Check the functionality of the Service-Specific Connection-Oriented Protocol (SSCOP). Enter the privileged EXEC **show sscop** command. See the following excerpt from the command output:

```
router# show sscop
SSCOP details for interface ATM0
   Current State = Data Transfer Ready
```

Interpretation of the command output requires familiarity with SSCOP, so unless you are familiar with the protocol, just use the command to ensure that the protocol is in a state of readiness. If you need to make changes, see the Cisco IOS Release 12.0 documents, *Wide-Area Networking Configuration Guide* and *Wide-Area Networking Command Reference*.

Note If you plan to adjust SSCOP parameters, you may wish to complete the rest of the troubleshooting steps before doing so.

Step 9 Enter the **show dial-peer video** command on the local and remote concentrators to verify that each has been configured properly to communicate with the other.

```
Router1# show dial-peer video
dial-peer video 111 videocodec
 nsap 47.009181000000000002F26D4901.00107B4832E1.C8
 port signal 1/0
 port media Serial0
 destination-pattern 121
!
dial-peer video 221 videoatm
 destination-pattern 221
 session target ATM0 svc nsap 47.009181000000000002F26D4901.00107B09C645.C8

Router2# show dial-peer video
dial-peer video 111 videocodec
 nsap 47.009181000000000002F26D4901.00107B09C645.C8
 port signal 1/0
 port media Serial0
 destination-pattern 221
!
dial-peer video 121 videoatm
 destination-pattern 121
 session target ATM0 svc nsap 47.009181000000000002F26D4901.00107B4832E1.C8
```

Step 10 Enter the **show video call summary** command to quickly check the status of calls on the local and remote multiservice access concentrators. "ViCM" is the internal video call manager.

When no call is in progress, the output looks like this:

```
Router# show video call summary
Serial0:ViCM = Idle, Codec Ready
```

When a call is starting, the output looks like this:

```
Router# show video call summary
Serial0:ViCM = Call Connected
```

When a call is disconnecting, the output looks like this:

```
Router# show video call summary
Serial0:ViCM = Idle
```

Step 11 Enter the privileged EXEC **show call history video record** command to see information about current and recent video calls, allowing analysis of possible problems.

```
router# show call history video record
CallId = 4
CalledNumber = 221
CallDuration = n/a - call is in progress
DisconnectText = n/a - call is in progress
SVC: call ID = 8598630
Remote NSAP = 47.0091810000000002F26D4901.00107B09C645.C8
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 414, vpi = 0, vci = 158
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0


CallId = 3
CalledNumber = 221
CallDuration = 557 seconds
DisconnectText = local hangup
SVC: call ID = 8598581
Remote NSAP = 47.0091810000000002F26D4901.00107B09C645.C8
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 364, vpi = 0, vci = 108
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0


CallId = 2
CalledNumber = n/a - incoming call
CallDuration = 125 seconds
DisconnectText = local hangup
SVC: call ID = 8598484
Remote NSAP = n/a
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 264, vpi = 0, vci = 273
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0


CallId = 1
CalledNumber = n/a - incoming call
CallDuration = 171651 seconds
DisconnectText = remote hangup
SVC: call ID = 8594356
Remote NSAP = n/a
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 7, vpi = 0, vci = 39
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0
```

Step 12 Enter the **debug video vicm** command to follow in-progress calls carefully. Comments are framed in asterisks (*).

```
router# debug video vicm
Video ViCM FSM debugging is on

***** Starting Video call *****

router# SVC HANDLE in rcvd:0x80001B:
```

```
00:42:55:ViCM - current state = Idle, Codec Ready
00:42:55:ViCM - current event = SVC Setup
00:42:55:ViCM - new state = Call Connected

00:42:55:ViCM - current state = Call Connected
00:42:55:ViCM - current event = SVC Connect Ack
00:42:55:ViCM - new state = Call Connected

*****Video Call Disconnecting*****

router#
00:43:54:ViCM - current state = Call Connected
00:43:54:ViCM - current event = SVC Release
00:43:54:ViCM - new state = Remote Hangup

00:43:54:ViCM - current state = Remote Hangup
00:43:54:ViCM - current event = SVC Release Complete
00:43:54:ViCM - new state = Remote Hangup
mc3810_video_lw_periodic:Codec is not ready
mc3810_video_lw_periodic:sending message

00:43:55:ViCM - current state = Remote Hangup
00:43:55:ViCM - current event = DTR Deasserted
00:43:55:ViCM - new state = Idle
mc3810_video_lw_periodic:Codec is ready
mc3810_video_lw_periodic:sending message

00:43:55:ViCM - current state = Idle
00:43:55:ViCM - current event = DTR Asserted
00:43:55:ViCM - new state = Idle, Codec Ready
```

Monitoring and Maintaining Video over ATM SVCs and PVCs

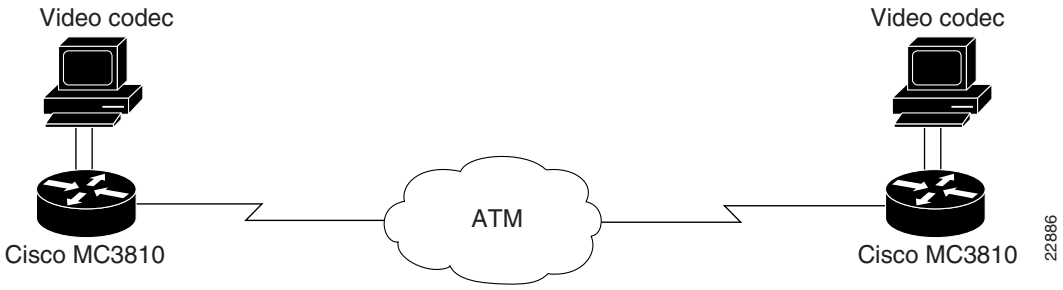
Command	Purpose
Router# **show network-clocks**	Displays clock settings.
Router# **show controllers t1/e1**	Displays information about controller configuration and errors.
Router# **show controllers rs366**	Displays information about the RS.366 controller interface.
Router# **show interfaces serial**	Displays information about serial interface configuration.
Router# **show atm vc**	Displays information about all configured PVCs and SVCs.
Router# **show interface atm0**	Displays information about ATM interface configuration.
Router# **show controllers atm**	Displays ATM controller information, including queue, memory, and buffer statistics.
Router# **show atm video-voice address**	Displays NSAP addresses configured on the ATM interface along with their status.
Router# **show atm ilmi-status**	Displays detailed information about the ILMI PVC and its functions.
Router# **show sscop**	Displays technical information about SSCOP status and readiness.
Router# **show video dial-peer**	Displays information about configured video dial peers.
Router# **show video call summary**	Displays summary information about the current status of the video call manager.
Router# **show call history video record**	Displays detailed information about calls in progress and recent calls.

Configuration Examples

This configuration excerpts in this section illustrate how two Cisco MC3810 multiservice access concentrators communicate back to back as shown in Figure 3.

These examples do not show complete configurations but focus on the specific requirements of ATM video SVCs and PVCs, not on complete ATM setup.

Figure 3 Sample Configuration: Two Cisco MC3810s using ATM SVCs and/or PVCs for Videoconferencing



Initially, the network clocks are set up on each router so that video codecs can operate at a multiple of 64 Kbps.

```
hostname MC3810A
!
network-clock base-rate 64k
ip subnet-zero
ip wccp version 2
ip host router 225.255.255.254
!
appletalk routing
ipx routing 1111.0045.0005
```

```
hostname MC3810B
!
network-clock base-rate 64k
ip subnet-zero
ip wccp version 2
ip host router 225.255.255.254
!
appletalk routing
ipx routing 1111.0045.0002
```

The following commands show the configuration of the T1 0 controller, which is for ATM service. ESF framing and B8ZS are required for ATM. The default clock source is line, and the default for the T1 1 controller automatically becomes internal.

```
controller T1 0
 framing esf
 linecode b8zs
 mode atm
!
```

```
controller T1 0
 framing esf
 linecode b8zs
 mode atm
!
```

Serial interface 0 connects to the local video codec. The restart delay is set to 0 minutes so that the hardware is not reset when it goes down. The clock rate of 384 kbps is the speed at which the video images are transmitted.

```
interface Serial0
 no ip address
 no ip directed-broadcast
 encapsulation atm-ces
 no ip route-cache
 no ip mroute-cache
 no keepalive
 serial restart-delay 0
 clockrate network 384000
```

```
interface Serial0
 no ip address
 no ip directed-broadcast
 encapsulation atm-ces
 no ip route-cache
 no ip mroute-cache
 no keepalive
 serial restart-delay 0
 clockrate network 384000
```

The following commands show how to configure the ATM interface and set up PVCs to supply Q.SAAL signaling and ILMI management for SVC communications. Note that you can also specify the NSAP address by using the **atm video aesa** command with an ESI value.

```
interface ATM0
 ip address 9.1.1.5 255.0.0.0
 no ip directed-broadcast
 no ip route-cache
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm ilmi-keepalive
 atm video aesa default
```

```
interface ATM0
 ip address 9.1.1.6 255.0.0.0
 no ip directed-broadcast
 no ip route-cache
 atm pvc 1 0 5 qsaal
 atm pvc 2 0 16 ilmi
 atm ilmi-keepalive
 atm video aesa default
```

The following examples show dial PVCs for video communications. Constant Bit Rate (CBR) is required for reliable video. The CBR speed is set at 117 percent of the video data rate of 384 kbps, which is configured on serial interface 0.

```
pvc 10 32 69
  cbr 449
  encapsulation aal1
```

```
pvc 11 33 70
  cbr 449
  encapsulation aal1
```

The following examples show dial peers set up for SVC video. Specify local peers through the **port signal** command, which indicates the slot location of the VDM and the port location of the RS-366 interface. Enter the **port media** command to specify the serial interface for the codec connection. The two configurations are shown one after the other rather than side by side.

The commands are as follows for MC3810A:

```
dial-peer video 111 videocodec
 nsap 47.0091810000000002F26D4901.00107B4832E1.C8
 port signal 1/0
 port media Serial0
 destination-pattern 121
!
dial-peer video 221 videoatm
 destination-pattern 221
 session target ATM0 svc nsap 47.0091810000000002F26D4901.00107B09C645.C8
```

The commands are as follows for MC3810B:

```
dial-peer video 111 videocodec
 nsap 47.0091810000000002F26D4901.00107B09C645.C8
 port signal 1/0
 port media Serial0
 destination-pattern 221
!
dial-peer video 121 videoatm
 destination-pattern 121
 session target ATM0 svc nsap 47.0091810000000002F26D4901.00107B4832E1.C8
```

Command Reference

This section documents new or modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0 command reference publications.

- **atm scramble-enable**
- **atm video aesa**
- **dial-peer video**
- **nsap**
- **port media**
- **port signal**
- **serial restart-delay**
- **session target**
- **show atm video-voice address**
- **show controllers rs366**
- **show call history video record**
- **show video call summary**

In Cisco IOS Release 12.0(1)T or later releases, you can search and filter the output for **show** and **more** commands. This functionality is useful when you need to sort through large amounts of output, or if you want to exclude output that you do not need to see.

To use this functionality, enter a **show** or **more** command followed by the "pipe" character (|), one of the keywords **begin**, **include**, or **exclude**, and an expression that you want to search or filter on:

command **|** {**begin | include | exclude**} *regular-expression*

In the following example of the **show atm vc** command, you want the command output to begin with the first line where the expression "PeakRate" appears:

show atm vc | begin PeakRate

For more information on the search and filter functionality, refer to the Cisco IOS Release 12.0(1)T feature module titled *CLI String Search*.

atm scramble-enable

Scrambling improves data reliability on E1 links by randomizing the ATM cell payload frames to avoid continuous non-variable bit patterns and improve the efficiency of ATM's cell delineation algorithms. The **no** form disables scrambling.

atm scramble-enable

no atm scramble-enable

Syntax Description

This command has no arguments or keywords.

Defaults

By default, payload scrambling is off.

Command Mode

Interface configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM interface configuration on the Cisco MC3810.

Usage Guidelines

Enable scrambling on E1 links only. On T1 links, the default B8ZS line encoding normally ensures sufficient reliability.

The scrambling setting must match that of the far end.

Example

On a Cisco MC3810, the following example shows how to set the ATM0 E1 link to scramble payload:

```
interface atm0
 atm scramble-enable
```

atm video aesa

The **atm video aesa** ATM interface configuration command sets the unique ATM end-station address (AESA) for an ATM video interface that is using SVC mode. The **no** form of this command removes any configured address for the interface.

atm video aesa [**default** | *esi-address*]

no atm video aesa

Syntax Description

default	The **default** keyword automatically creates an NSAP address for the interface, based on a prefix from the ATM switch (26 hexadecimal characters), the MAC address (12 hexadecimal characters) as the ESI (end station identifier), and a selector byte (two hexadecimal characters).
esi-address	Enter 12 hexadecimal characters as the end-station identifier (ESI). The ATM switch provides the prefix (26 hexadecimal characters), and the video selector byte provides the remaining two hexadecimal characters.

Default

The **default** keyword is the default.

Command Mode

Interface configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM interface configuration on the Cisco MC3810.

Usage Guidelines

You cannot specify the ATM interface NSAP address in its entirety. The system creates either all of the address or part of it, depending on how you use this command.

Example

On a Cisco MC3810, the following example shows the ATM interface NSAP address set automatically:

```
interface atm0
 atm video aesa default
```

On a Cisco MC3810, the following example shows the ATM interface NSAP address set to a specific ESI value:

```
interface atm0/1
 atm video aesa 444444444444
```

Related Command

Command	Description
show atm video-voice address	Allows you to review the address assigned to an ATM interface.

dial-peer video

To define a video ATM dial peer for a local or remote video codec, specify video-related encapsulation, and enter dial-peer configuration mode, enter the **dial-peer video** global configuration command. The video dial peer is persistent and remains until you use the **no** form of the command to remove it.

dial-peer video *tag* {**videocodec | videoatm**}

no dial-peer video *tag* {**videocodec | videoatm**}

Syntax Description

tag	Digits defining a particular dial peer. Defines the dial peer and assigns the protocol type to the peer. Valid entries are from 1 to 10000. The tag must be unique on the router.
videocodec	This keyword specifies a local video codec connected to the router.
videoatm	This keyword specifies a remote video codec on the ATM network.

Default

No video dial peer is configured.

Command Mode

Global configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM interface configuration on the Cisco MC3810.

Usage Guidelines

The *tag* value that you assign must be unique to the device.

Video dial peers are persistent and remain until explicitly removed using the **no** form of the command.

Example

On a Cisco MC3810, the following example shows the setup of a local video dial peer designated as 10:

```
dial-peer video 10 videocodec
```

Related Command

Command	Description
show dial-peer video	Displays details about all video dial peers or a specified video dial peer, or provides summary information about all video dial peers.

nsap

To specify the network service access point (NSAP) address for a local video dial peer, enter the **nsap** dial-peer configuration command. The **no** form of the command removes any configured NSAP address from the dial peer.

nsap *nsap-address*

no nsap

Syntax Description

nsap-address	Enter a 40-digit hexadecimal number; the number must be unique on the device.

Default

No video dial peer NSAP address is configured.

Command Mode

Dial-peer configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM video dial-peer configuration on the Cisco MC3810.

Usage Guidelines

The address must be unique on the router.

Example

On a Cisco MC3810, the following example sets up an NSAP address for the local video dial peer designated as 10:

```
dial-peer video 10 videocodec
 nsap 47.0091810000000002F26D4901.333333333332.02
```

Related Commands

Command	Description
dial-peer video	Sets up a video dial peer for a local or remote codec.
show dial-peer video	Displays details about all video dial peers or a specified video dial peer; or provides summary information about all video dial peers.

port media

For a local video dial peer, enter the **port media** video dial-peer configuration command to specify the serial interface where the local video codec is connected. The **no** form of the command removes any configured locations from the dial peer.

port media *interface*

no port media

Syntax Description

interface	Enter *Serial* and the number *1* or *0*.

Default

No interface is specified.

Command Mode

Dial-peer configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM video dial-peer configuration on the Cisco MC3810.

Example

On a Cisco MC3810 local video dial peer designated as 10, the following example shows serial interface 0 as the specified interface for the codec:

```
dial-peer video 10 videocodec
 port media Serial0
```

Related Commands

Command	Description
port signal	For a local video dial peer, specifies the slot location of the video dialing module (VDM) and the port location of the RS-366 interface for signaling.
show dial-peer video	Displays details about all video dial peers or a specified video dial peer, or provides summary information about all video dial peers.

port signal

For a local video dial peer, enter the **port signal** video dial-peer configuration command to specify the slot location of the video dialing module (VDM) and the port location of the RS-366 interface for signaling. The **no** form of the command removes any configured locations from the dial peer.

port signal *slot/port*

no port signal

Syntax Description

slot	Enter either 1 or 2 as the slot location of the VDM.
port	Enter the port location of the RS-366 interface. The Cisco MC3810 VDM has only one port, so the *port* value is always 0.

Default

No locations are specified.

Command Mode

Dial-peer configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for ATM video dial-peer configuration on the Cisco MC3810.

Example

On a Cisco MC3810, the following example shows how to set up the VDM and RS-366 interface locations for the local video dial peer designated as 10:

```
dial-peer video 10 videocodec
 port signal 1/0
```

Related Commands

Command	Description
port media	Specifies the interface where the local codec is connected.
show dial-peer video	Displays details about all video dial peers or a specified video dial peer, or provides summary information about all video dial peers.

serial restart-delay

To set the amount of time that the router waits before trying to bring up a serial interface when it goes down, use the **serial restart-delay** interface configuration command. The **no** form of the command sets the delay to the default.

serial restart-delay *count*

no serial restart-delay

Syntax Description

count	*count* is a value from 0 to 900 in seconds. This is the frequency at which the hardware is reset.

Default

0 is the default value.

Command Mode

Interface configuration

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for serial interface configuration on the Cisco MC3810.

Usage Guidelines

The router resets the hardware each time the serial restart timer expires. This command is often used with the dial backup feature and with the **pulse-time** command, which sets the amount of time to wait before redialing when a DTR dialed device fails to connect.

When the *count* value is set to the default of 0, the hardware is not reset when it goes down. In this way, if the interface is used to answer a call, it does not cause DTR to drop, which can cause a communications device to disconnect.

Example

On Cisco MC3810 interface Serial 0, this examples shows the restart delay set to 0:

```
interface Serial0
 serial restart-delay 0
```

Related Commands

Command	Description
pulse-time *seconds*	Enables pulsing DTR signal intervals on the serial interfaces.
show interface serial	Displays details about serial interface configuration.

session target

To configure an ATM network-specific address for a permanent virtual connection (PVC) or switch virtual connection (SVC) dial peer, enter the ATM form of the **session target** dial-peer configuration command. The **no** form of the command disables the feature.

session target atm *interface* {**svc nsap** *nsap-address* | **pvc** {*name* | *vpi/vci* | *vci*}

no session target

Syntax Description

interface	Specifies the ATM interface number on the Cisco MC3810. The only valid number is 0.
nsap-address	For SVC communications, a 40-digit hexadecimal number for the session target network service access point (NSAP) address.
name	The name of the session target ATM PVC.
vpi/vci	The ATM network virtual path identifier (VPI) and virtual channel identifier (VCI) of this PVC.
vci	The ATM network virtual channel identifier (VCI) of this PVC

Default

Enabled with no IP address or domain name defined.

Command Mode

Dial-peer configuration

Command History

Release	Modification
11.3(1)T	This command was introduced.
11.3(1 MA	Support was added for VoFR, VoATM, and VoHDLC dial peers on the Cisco MC3810.
12.0(3)XG and 12.0(4)T	The *cid* option was added for Frame Relay dial peers.
12.0(5)XK and 12.0(7)T	Support was added for voice and video ATM SVCs on the Cisco MC3810.

Usage Guidelines

Enter the ATM-specific version of this command to specify an ATM PVC or SVC for voice or video communications.

Through SVCs and a video map, dialed digits are reconciled with the remote ATM interface's video NSAP address,

Examples

The following example shows an ATM video dial peer configured for SVC communications:

```
dial-peer video 10 videoatm
 destination-pattern 221
 session target ATM0 svc nsap 47.0091810000000002F26D4901.444444444444.01
```

The following example shows a session target for Voice over ATM that uses PVCs. The session target is for a PVC with VPI-VCI values of 100/100:

```
dial-peer voice 12 voatm
 destination-pattern 13102221111
 session target atm0 pvc 100/100
```

Related Commands

Command	Description
dial-peer video	Sets up a video dial peer for a local or remote codec.
show dial-peer video	Displays details about all video dial peers or a specified video dial peer, or provides summary information about all video dial peers.
show dial-peer voice	Displays details about configured voice dial peers.

show atm video-voice address

To display the network service access point (NSAP) address for the ATM interface, enter the **show atm video-voice address** privileged EXEC command.

show atm video-voice address

Syntax Description

There are no keywords or arguments

Default

No default behavior or values.

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for the Cisco MC3810.

Usage Guidelines

Enter this command to review ATM interface NSAP addresses that have been assigned with the **atm video aesa** or **atm voice aesa** command and to ensure that ATM management is confirmed for those addresses.

Example

On a Cisco MC3810, the following example displays information about ATM interface NSAP addresses:

```
router# show atm video-voice address
nsap address                                    type         ilmi status
47.0091810000000002F26D4901.00107B4832E1.FE   VOICE_AAL5   Confirmed
47.0091810000000002F26D4901.00107B4832E1.C8   VIDEO_AAL1   Confirmed
```

Table 1 describes the fields in the command output.

Table 1 show atm video-voice address Fields

Field	Description
ilmi status	Indicates whether an ILMI PVC is set up and operational to manage SVC communications.
nsap address	ATM interface NSAP address.
type	Interface ATM encapsulation type.

Related Command

Command	Description
show atm ilmi-status	Provides details about the status of ILMI management.

show call history video record

To display information about video calls, enter the privileged EXEC **show call history video record** command.

show call history video record

Syntax Description

There are no keywords or arguments.

Default

No default behavior or values.

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for the Cisco MC3810.

Usage Guidelines

Use this command to review statistics about recent incoming and outgoing video calls.

Example

On a Cisco MC3810, the following example displays information about two video calls:

```
Router# show call history video record

CallId = 4
CalledNumber = 221
CallDuration = 39006 seconds
DisconnectText = remote hangup
SVC: call ID = 8598630
Remote NSAP = 47.0091810000000002F26D4901.00107B09C645.C8
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 414, vpi = 0, vci = 158
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0


CallId = 3
CalledNumber = 221
CallDuration = 557 seconds
DisconnectText = local hangup
SVC: call ID = 8598581
Remote NSAP = 47.0091810000000002F26D4901.00107B09C645.C8
Local NSAP = 47.0091810000000002F26D4901.00107B4832E1.C8
vcd = 364, vpi = 0, vci = 108
SerialPort = Serial0
VideoSlot = 1, VideoPort = 0
```

Table 2 describes the fields in the command output.

Table 2 show call history video record Fields

Field	Description
CalledNumber	The called number for an outgoing call.
CallID	Global call identifier for this call.
DisconnectText	Descriptive text explaining the reason for disconnect.
Local NSAP	NSAP address for the calling (local) dial peer.
Remote NSAP	NSAP address for the called (remote) dial peer.
SerialPort	Serial interface of the local video codec.
SVC: Call ID	The SVC call ID.
vcd	ATM virtual circuit descriptor (VCD) for the virtual circuit (VC) that carried this call.
vci	ATM network virtual channel identifier (VCI) for the virtual circuit that carried this call.
VideoPort	Port location of the RS-366 interface.
VideoSlot	Slot location of the video dial module (VDM).
vpi	ATM network virtual path identifier (VPI) for the virtual circuit that carried this call.

show controllers rs366

To display information about the RS-366 video interface on the video dialing module (VDM), enter the privileged EXEC **show controllers rs366** command.

show controllers rs366 *slot port*

Syntax Description

slot	Slot location of the VDM module. On the Cisco MC3810, this value is either 1 or 2. If you do not enter the correct location, the command is rejected.
port	Port location of the RS-366 interface in the VDM module. On the Cisco MC3810, this value is 0.

Default

No default behavior or values.

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for the Cisco MC3810.

Usage Guidelines

The table below explains the meaning of the fields in the **show controllers rs366** command.

Field	Meaning
STATUS	Last interrupt status
STATE	Current state of the state machine
LSR	Line status register of the VDM
LCR	Line control register of the VDM
ICSR	Interrupt control and status register of the VDM
EXT	Extended register of the VDM
T1 through T5	Timeouts 1 through 5 of the watchdog timer in milliseconds
Dial string	Most recently dialed number collected by the driver. 0xC at the end of the string indicates the EON (end of number) character.

Example

On a Cisco MC3810, the following example displays information about the RS-366 controller:

```
Router# show controller rs366 0 1

RS366:driver is initialized in slot 1, port 0:

STATUS STATE LSR  LCR  ICSR EXT  T1     T2     T3     T4     T5
0x02   0x01  0x00 0x50 0xE0 0x00 5000   5000   5000   20000  10000
Dial string:
121C
```

show dial-peer video

To display dial-peer configuration, enter the privileged EXEC **show dial-peer video** command.

show dial-peer video [*number*] [**summary**]

Syntax Description

number	(Optional) A specific video dial peer. This option displays configuration information for a single dial peer identified by the argument *number*. Valid entries are any integers that identify a specific dial peer, from 1 to 32767.
summary	(Optional) Displays a summary of all video dial-peer information.

Default

No default behavior or values.

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for the Cisco MC3810.

Usage Guidelines

Use this command to review video dial-peer configuration.

Example

On a Cisco MC3810, the following example displays detailed information about all configured video dial peers:

```
Router# show dial-peer video
Video Dial-Peer 1
      type = videocodec, destination-pattern = 111
      port signal = 1/0, port media = Serial1
      nsap = 47.0091810000000050E201B101.00107B09C6F2.C8
Video Dial-Peer 2
      type = videoatm,   destination-pattern = 222
      session-target = ATM0 svc nsap 47.0091810000000050E201B101.00E01E92ADC2.C8
Video Dial-Peer 3
      type = videoatm,   destination-pattern = 333
      session-target = ATM0 pvc 70/70
```

The dial-peer information is specified for each dial peer, which is identified by a unique ID number (in the example above, 1, 2, and 3) that was defined using the **dial-peer video** command. Table 3 describes the fields in the command output.

Table 3 show dial-peer video Fields

Field	Meaning
destination-pattern	Destination pattern (telephone number) for this peer.
nsap	NSAP address of a local video dial peer.
port signal	The slot where the video dial module (VDM) is located and the port for the RS-366 interface.
port media	The serial interface where the local codec is connected.
session-target	Session target of this remote dial peer, including the ATM interface identifier and NSAP address.
type	Specified using the **dial-peer video** command, indicates a local (**videocodec**) or remote (**videoatm**) dial peer.

show video call summary

To display summary information about video calls and the current status of the Video Call Manager (ViCM), enter the **show video call summary** privileged EXEC command.

show video call summary

Syntax Description

There are no keywords or arguments.

Default

No default behavior or values

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was introduced for the Cisco MC3810.

Usage Guidelines

Use this command to quickly look at the status of current calls. In Cisco IOS Releases 12.0(5)XK and 12.0(7)T, there can be only one video call in progress.

Examples

On a Cisco MC3810, the following example displays information about the ViCM when no call is in progress on the serial interface that connects to the local video codec:

```
Router# show video call summary
Serial0:ViCM = Idle, Codec Ready
```

When a call is starting, the output looks like this:

```
Router# show video call summary
Serial0:ViCM = Call Connected
```

When a call is disconnecting, the output looks like this:

```
Router# show video call summary
Serial0:ViCM = Idle
```

Related Command

Command	Description
show call history video record	Provides details about current and recent video calls.

Debug Command

This section documents a new **debug** command, **debug video vicm**.

debug video vicm

To display debug messages for the Video Call Manager (ViCM) that handles video calls, enter the privileged EXEC **debug video vicm** command. The **no** form of the command disables ViCM debugging.

[**no**] **debug video vicm**

Syntax Description

This command has no arguments or keywords.

Default

Debugging for the ViCM is not enabled.

Command History

Release	Modification
12.0(5)XK and 12.0(7)T	This command was first introduced for the Cisco MC3810.

Example

The following example shows output when you use the **debug video vicm** command. Comments are enclosed in asterisks (*).

```
router# debug video vicm
Video ViCM FSM debugging is on

***** Starting Video call *****

router# SVC HANDLE in rcvd:0x80001B:

00:42:55:ViCM - current state = Idle, Codec Ready
00:42:55:ViCM - current event = SVC Setup
00:42:55:ViCM - new state = Call Connected

00:42:55:ViCM - current state = Call Connected
00:42:55:ViCM - current event = SVC Connect Ack
00:42:55:ViCM - new state = Call Connected

*****Video Call Disconnecting*****

router#
00:43:54:ViCM - current state = Call Connected
00:43:54:ViCM - current event = SVC Release
00:43:54:ViCM - new state = Remote Hangup

00:43:54:ViCM - current state = Remote Hangup
00:43:54:ViCM - current event = SVC Release Complete
00:43:54:ViCM - new state = Remote Hangup
mc3810_video_lw_periodic:Codec is not ready
mc3810_video_lw_periodic:sending message

00:43:55:ViCM - current state = Remote Hangup
00:43:55:ViCM - current event = DTR Deasserted
00:43:55:ViCM - new state = Idle
mc3810_video_lw_periodic:Codec is ready
mc3810_video_lw_periodic:sending message
```

```
00:43:55:ViCM - current state = Idle
00:43:55:ViCM - current event = DTR Asserted
00:43:55:ViCM - new state = Idle, Codec Ready
```

Glossary

AAL—ATM Adaptation Layer. Service-dependent sublayer of the data link layer. The AAL accepts data from different applications and presents it to the ATM layer in the form of 48-byte ATM payload segments. AALs consist of two sublayers: convergence sublayer (CS) and segmentation and reassembly (SAR). AALs differ on the basis of the source-destination timing used, whether they use constant bit rate (CBR) or variable bit rate (VBR), and whether they are used for connection-oriented or connectionless mode data transfer. At present, the four types of AAL recommended by the ITU-T are AAL1, AAL2, AAL3/4, and AAL5.

AAL1—ATM adaptation layer 1. One of four AALs recommended by the ITU-T. AAL1 is used for connection-oriented, delay-sensitive services requiring constant bit rates, such as uncompressed video and other isochronous traffic.

AESA—ATM End System Address

ATM—Asynchronous Transfer Mode. International standard for cell relay in which multiple service types (such as voice, video, or data) are conveyed in fixed-length (53-byte) cells. Fixed-length cells allow cell processing to occur in hardware, thereby reducing transit delays. ATM is designed to take advantage of high-speed transmission media such as E3, SONET, and T3.

B8ZS—binary 8-zero substitution. Line-code type, used on T1 and E1 circuits, in which a special code is substituted whenever 8 consecutive zeros are sent over the link. This code is then interpreted at the remote end of the connection. This technique guarantees ones density independent of the data stream.

CBR—constant bit rate. QoS class defined by the ATM Forum for ATM networks. CBR is used for connections that depend on precise clocking to ensure undistorted delivery.

CES—circuit emulation service. Enables users to multiplex or concentrate multiple circuit emulation streams for voice and video with packet data on a single high-speed ATM link without a separate ATM access multiplexer**.**

E1—European digital carrier facility used for transmitting data through the telephone hierarchy. The transmission rate for E1 is 2.048 megabits per second (Mbps).

ESF—Extended Superframe. Framing type used on T1 circuits that consists of 24 frames of 192 bits each, with the 193rd bit providing timing and other functions. ESF is an enhanced version of Superframe format.

ESI—end station identifier

ILMI—Interim Local Management Interface. Specification developed by the ATM Forum for incorporating network-management capabilities into the ATM User-Network Interface (UNI).

IMA—Inverse Multiplexing for ATM, a standard protocol defined by the ATM Forum in 1997.

ISDN—Integrated Services Digital Network. Communication protocol, offered by telephone companies, that permits telephone networks to carry data, voice, and other source traffic.

NSAP—network service access point. Network addresses, as specified by ISO. An NSAP is the point at which OSI Network Service is made available to a transport layer (Layer 4) entity.

PVC—permanent virtual circuit. Virtual circuit that is permanently established. PVCs save bandwidth associated with circuit establishment and tear down in situations where certain virtual circuits must exist all the time. In ATM terminology, called a permanent virtual connection.

QoS—quality of service. Measure of performance for a transmission system that reflects its transmission quality and service availability.

SAR—segmentation and reassembly. One of the two sublayers of the AAL CPCS, responsible for dividing (at the source) and reassembling (at the destination) the PDUs passed from the CS. The SAR sublayer takes the PDUs processed by the CS and, after dividing them into 48-byte pieces of payload data, passes them to the ATM layer for further processing.

SONET—Synchronous Optical Network. High-speed (up to 2.5 Gbps) synchronous network specification developed by Bellcore and designed to run on optical fiber. STS-1 is the basic building block of SONET.

SVC—switched virtual circuit. Virtual circuit that is dynamically established on demand and is torn down when transmission is complete. SVCs are used in situations where data transmission is sporadic. Called a switched virtual connection in ATM terminology.

T1—Digital WAN carrier facility. T1 transmits DS-1-formatted data at 1.544 Mbps through the telephone switching network, using alternate mark inversion or B8ZS coding.

UNI—User-Network Interface. ATM Forum specification that defines an interoperability standard for the interface between ATM-based products (a router or an ATM switch) located in a private network and the ATM switches located within the public carrier networks. Also used to describe similar connections in Frame Relay networks.

VBR—variable bit rate. QoS class defined by the ATM Forum for ATM networks. VBR is subdivided into a real time (RT) class and non-real time (NRT) class. VBR (RT) is used for connections in which there is a fixed timing relationship between samples. VBR (NRT) is used for connections in which there is no fixed timing relationship between samples, but that still need a guaranteed QoS.

VC—virtual circuit. Logical circuit created to ensure reliable communication between two network devices. A virtual circuit is defined by a VPI/VCI pair, and can be either permanent (PVC) or switched (SVC). Virtual circuits are used in Frame Relay and X.25. In ATM, a virtual circuit is sometimes called a virtual channel.

VCI—virtual channel identifier. 16-bit field in the header of an ATM cell. The VCI, together with the virtual path identifier (VPI), is used to identify the next destination of a cell as it passes through a series of ATM switches on its way to its destination. ATM switches use the VPI/VCI fields to identify the next network virtual channel link (VCL) that a cell needs to transit on its way to its final destination.

VCL—virtual channel link. Connection between two ATM devices. A VCC is made up of one or more VCLs.

VPI—virtual path identifier. 8-bit field in the header of an ATM cell. The VPI, together with the VCI, is used to identify the next destination of a cell as it passes through a series of ATM switches on its way to its destination. ATM switches use the VPI/VCI fields to identify the next VCL that a cell needs to transit on its way to its final destination.