

- Asynchronous Transfer Mode -

Asynchronous Transfer Mode (ATM)

Asynchronous Transfer Mode (ATM) is a high-speed, **non-broadcast** Layer 2 technology, similar in many respects to Frame Relay.

In addition to supporting higher bandwidths, ATM integrates QoS mechanisms directly into the technology. ATM is thus a very flexible technology, supporting data, voice and video traffic.

Other Layer 2 technologies, such as Ethernet or Token Ring, support variable-sized packets. For example, Ethernet packets are 1514 bytes by default, but the MTU can be changed. ATM utilizes fixed-sized packets called **cells**. Each cell is exactly **53 bytes**. Because the cell size is always consistent, traffic can be routed or switched far more efficiently.

Two ATM interface types exist:

- **User-Network Interface (UNI)** – connects an ATM end-user device to an ATM switch or router
- **Network-Network Interface (NNI)** – connects an ATM switch to another ATM switch

ATM, like Frame Relay, builds **Virtual Channels** (or **Circuits**) between ATM devices. These virtual channels can be **permanent (PVC)** or **switched (SVC)**, and are **one-way**.

Each virtual channel is identified by a **Virtual Channel Identifier (VCI)**, the equivalent of a Frame-Relay DLCI. The VCI is only locally significant to the router/switch.

Multiple virtual channels can then be bundled together into a **Virtual Path**, which is identified by a **Virtual Path Identifier (VPI)**. Like VCI's, a VPI is only locally significant. A VPI essentially identifies a "route" between two ATM devices.

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ATM Layers

ATM is comprised of an **ATM Adaptation Layer (AAL)**, which dictates how upper layer information (IP addresses, TCP ports, etc) gets “packaged” into an ATM cell.

There are various AAL “types,” each dictating a different class of service for specific traffic:

- **AAL-1** – Intended for voice and video traffic, and other such delay-sensitive traffic. Utilizes **Constant Bit Rate (CBR)** to provide “consistent” bandwidth and timing.
- **AAL-2** – Also intended for voice and video traffic. Supports a **Variable Bit Rate (VBR)**, instead of a “constant” bit rate. Thus traffic rates and bandwidth *will* vary. VBR can either be **Real Time (VBR-RT)** or **Non-Real Time (VBR-NRT)**.
- **AAL-3/4** – Legacy layer intended for **Switched MultiMegabit Data Service (SMDS)** traffic.
- **AAL-5** – Intended for data traffic. Utilizes **Unspecified Bit Rate (UBR)** and **Available Bit Rate (ABR)**, where bandwidth and traffic rate are never guaranteed. Essentially a “best-effort” form of service. However, AAL-5 can also support CBR and VBR, if necessary.

The order of priority for ATM’s classes of service (from highest to lowest):

- **CBR**
- **VBR-RT**
- **VBR-NRT**
- **ABR**
- **UBR and UBR+**

ATM Encapsulations

This guide will concentrate on the AAL-5 implementation of ATM. Several AAL-5 encapsulation types exist, including:

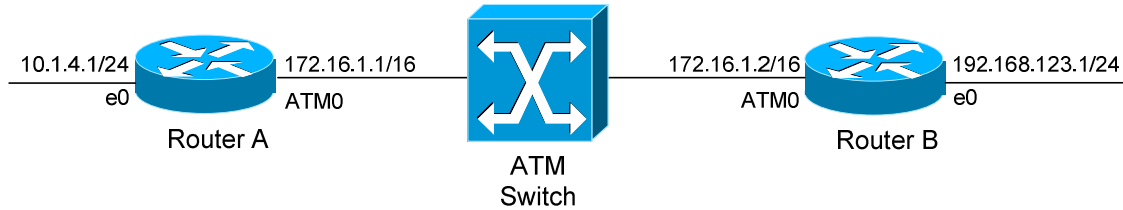
- **aal5snap** – The default encapsulation type for an ATM interface. Supports multiplexing two or more Layer 3 protocols over the same PVC.
- **aal5mux** – Used to dedicate the PVC to a single Layer 3 protocol.

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Basic ATM PVC Configuration



Basic configuration of an ATM interface is not difficult:

```
RouterA(config)# interface atm0
RouterA(config-if)# ip address 172.16.1.1 255.255.0.0
```

Next, the PVC must be identified with a VPI/VCI combination, and the encapsulation type must be defined. This information is often supplied by the ATM provider:

```
RouterA(config)# interface atm0
RouterA(config-if)# pvc 0/200
RouterA(config-if-vc)# encapsulation aal5mux ip
```

The *pvc* command creates a Permanent Virtual Channel with a VPI of 0 and a VCI of 200. Recall that the VPI identifies the **path**, and that multiple channels (VCIs) can exist in this path.

The *encapsulation* type was configured as *aal5mux*. Remember that *aal5mux* dedicates the virtual channel to a single Layer 3 protocol, thus the *ip* protocol was also specified.

Finally, much like Frame Relay, the virtual circuit must be **mapped** to a Layer 3 address in order to communicate with the remote router:

```
RouterA(config)# interface atm0
RouterA(config-if)# pvc 0/200
RouterA(config-if-vc)# protocol ip 172.16.1.2 broadcast
RouterA(config-if-vc)# protocol ip 172.16.1.1
```

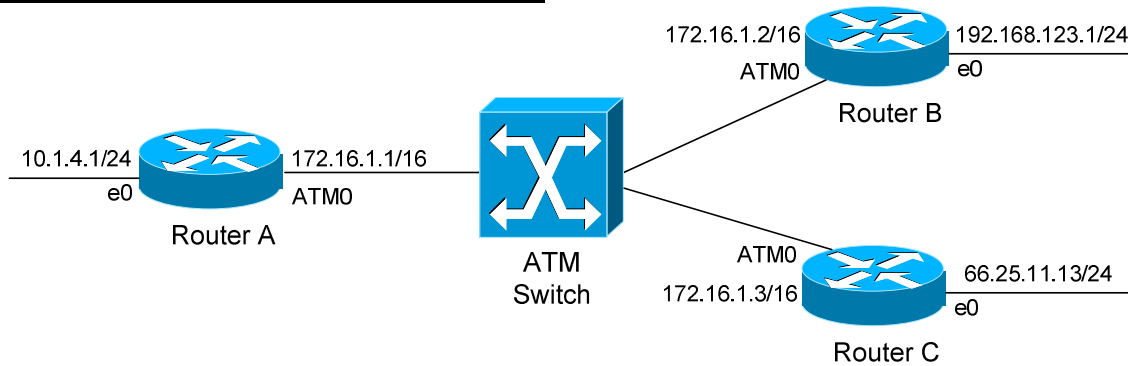
The mapped *protocol* is *ip*, pointing to the remote router's IP address of 172.16.1.2. Because ATM is a **non-broadcast multi-access (NMBA)** medium, the *broadcast* parameter must be specified to direct broadcasts to the remote router's IP. Otherwise, routing protocols like OSPF and EIGRP will be unable to form neighbor relationships.

The final *protocol ip* command points to the IP of the local ATM interface, allowing the router to ping itself.

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Configuring Multipoint ATM PVCs



Recall that multiple VCI's can be configured on an interface. Configuration is not difficult:

```
RouterA(config)# interface atm0
RouterA(config-if)# no shut
RouterA(config-if)# ip address 172.16.1.1 255.255.0.0

RouterA(config-if)# pvc 0/200
RouterA(config-if-vc)# encapsulation aal5mux ip
RouterA(config-if-vc)# protocol ip 172.16.1.2 broadcast

RouterA(config-if)# pvc 0/201
RouterA(config-if-vc)# encapsulation aal5mux ip
RouterA(config-if-vc)# protocol ip 172.16.1.3 broadcast
```

A unique VCI must be used for each destination. For simplicity, each PVC can be assigned a descriptive **name**:

```
RouterA(config-if)# pvc TOROUTERB 0/200
RouterA(config-if)# pvc TOROUTERC 0/201
```

Using Inverse-Arp for ATM PVCs

The previous examples demonstrated the static configuration of PVC-to-Layer 3 mappings. This information can be dynamically discovered using **Inverse-Arp**:

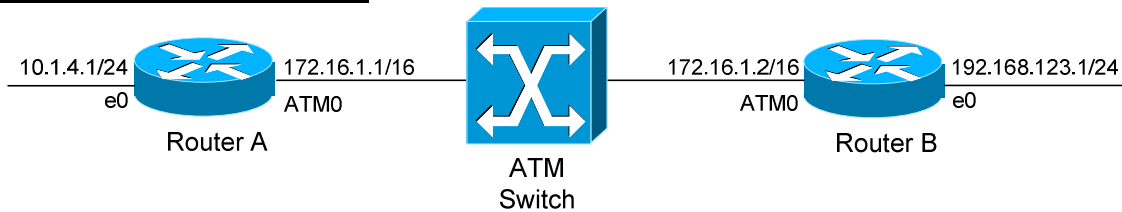
```
RouterA(config)# interface atm0
RouterA(config-if)# pvc 0/200
RouterA(config-if-vc)# encapsulation aal5mux ip
RouterA(config-if-vc)# inarp 15
```

Inverse-ARP is automatically enabled by default, but will be disabled if a static mapping is configured.

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Configuring ATM SVCs



An ATM PVC is a permanent circuit, as its name would indicate. An ATM SVC is created and torn down as needed. In order for an SVC to be established, two **system PVCs** must be configured:

```
RouterA(config)# interface atm0
RouterA(config-if)# ip address 172.16.1.1 255.255.0.0
RouterA(config-if)# pvc 0/5 qsaal
RouterA(config-if)# pvc 0/16 ilmi
```

The *qsaal* and *ilmi* PVCs are used for signaling and management between the ATM switch and router. ILMI (or Integrated Local Management Interface) serves the same function as Frame Relay's LMI. QSAAL is used for call setup.

The above VPI/VCI values are the defaults for QSAAL and ILMI. The ATM provider should provide the values for any customized signaling channels.

Please note: ATM can use ILMI to automatically discover PVCs too, using the following command:

```
RouterA(config)# interface atm0
RouterA(config-if)# atm ilmi-pvc-discovery
```

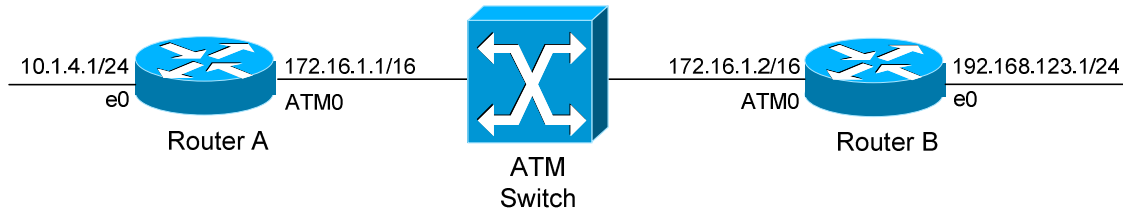
The router's ATM address must be specified. ATM utilizes the standard OSI **NSAP (Network Service Access Point)** address (an addressing standard used by other technologies as well, such as IS-IS). The ATM NSAP is comprised of three parts:

- The 13-byte **Switch Prefix**, assigned by the ATM provider, which identifies the ATM switch or "domain"
- The 6-byte MAC address of the local ATM interface, also known as the **End System Identifier (ESI)**
- The 1-byte NSAP **Selector field**

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Configuring ATM SVCs (continued)

If the ILMI PVC is *not* configured, then the entire NSAP address must be manually specified:

```
RouterA(config)# interface atm0
RouterA(config-if)# atm nsap-address AB.1111.22.CDEF33.AB12.AF12.BF3C.1111.2222.3333.00
```

Rather long, yes? The *AB.1111.22.CDEF33.AB12.AF12.BF3C* portion of the *nsap-address* identifies the switch prefix. The *1111.2222.3333* portion identifies the ESI (or MAC address). The *00* identifies the NSAP Selector field.

However, if the ILMI PVC *is* configured, the ATM switch will provide the switch prefix automatically. Thus, only the ESI and NSAP Selector must be manually specified:

```
RouterA(config)# interface atm0
RouterA(config-if)# atm esi-address 111122223333.00
```

Notice that no periods separate the MAC address in this syntax.

The *atm nsap-address* and *atm esi-address* commands cannot be used together. One will override the other.

Finally, the SVC must be created, and pointed to a *destination* NSAP address:

```
RouterA(config)# interface atm0
RouterA(config-if)# svc MYSVC CC.2222.33.CDEF33.AB12.AF12.BF3C.4444.5555.6666.00
```

Notice that the name *MYSVC* was assigned to the *svc*.

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Configuring ATM QoS

The first step in configuring QoS for ATM is to create a **vc-class** that contains the appropriate QoS parameters:

```
Router(config)# vc-class atm MYCLASS
Router(config-vc-class)# encapsulation aal5snap
Router(config-vc-class)#ubr 1000
Router(config-vc-class)#ubr+ 2000 256
Router(config-vc-class)#abr 2000 256
```

The *vc-class* command creates an *atm* QoS policy called *MYCLASS*.

The ATM *encapsulation* is configured as *aal5snap*.

Traffic marked for *ubr* is given a **Peak Cell Rate (PCR)** of *1000* Kbps. PCR is essentially a “best effort” rate of bandwidth.

Traffic marked for *ubr+* is given both a PCR (*2000*) and **Minimum Cell Rate (MCR)** of *256* Kbps. Traffic marked for *abr* is also given both a PCR and MCR.

The *vc-class* must then be applied to an interface:

```
Router(config)# interface atm0
Router(config-if)# class-int MYCLASS
```

Or, the *vc-class* can be directly applied to a PVC:

```
Router(config)# interface atm0
Router(config-if)# pvc 0/200
Router(config-if-vc)# class-vc MYCLASS
```

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PPP over ATM

To configure PPP encapsulation over an ATM connection:

```
RouterA(config)# username NAME password PASSWORD
RouterA(config)# interface atm0/0.111
RouterA(config-if)# pvc 0/111
RouterA(config-if)# protocol ppp Virtual-Template1
RouterA(config)# interface Virtual-Template1
RouterA(config-if)# ip address 10.1.1.1 255.255.255.0
RouterA(config-if)# ppp authentication chap
RouterA(config-if)# ppp chap hostname RouterA
```

Troubleshooting ATM

To view the status of all configured ATM PVCs:

```
Router# show atm pvc
```

To view the status of all configured ATM SVCs:

```
Router# show atm svc
```

To view the Layer 3 maps to remote ATM hosts:

```
Router# show atm map
```

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