Asynchronous Transfer Mode (ATM)

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ATM

- By the mid 1980s, three types of communication networks had evolved.
- The telephone network carries voice calls, television network carries video transmissions, and newly emerging computer network carries data.
- Telephone companies realized that voice communication was becoming a commodity service and that the profit margin would decrease over time.
- They realized that data communication was increasing.
- The telecommunication industry decided to expand its business by developing networks to carry traffic other than voice.

Goal of ATM (extremely ambitious)

- Universal Service
- Support for all users
- Single, unified infrastructure
- Service guarantees
- Support for low-cost Devices

ATM

- The phone companies created Integrated Service Digital Network (ISDN) and Asynchronous Transfer Mode (ATM).
- ATM is intended as a universal networking technology that handles voice, video, and data transmission.
- ATM uses a connection-oriented paradigm in which an application first creates a virtual channel (VC), uses the channel for communication, and then terminates it.
- The communication is implemented by one or more ATM switches, each places an entry for the VC in its forwarding table.

ATM

- There are two types of ATM VCs: a PVC is created manually and survive power failures, and an SVC is created on demand.
- When creating a VC, a computer must specify quality of service (QoS) requirements.
- The ATM hardware either reserves the requested resources or denies the request.

Development of ATM

- ATM designers faced a difficult challenge because the three intended uses (voice, video, and data) have different sets of requirements.
- For example, both voice and video require low delay and low jitter (i.e. low variance in delay) that make it possible to deliver audio and video smoothly with gaps or delays in the output.
- Video requires a substantially higher data rate than audio.
- Most data networks introduce jitter as they handle packets.

Development of ATM

- To allow packet switches to operate at high speeds and to achieve low delay, low jitter, and echo cancellation, ATM technology divides all data into small, fixed-size packets called cells.
- Each ATM cell contains exactly 53 octets.
- 5 octets for header
- 48 octets for data

ATM Cell Structure

Bits: 0 7

Flow Control	VPI (First 4 bits)	
VPI (Last 4 bits)	VCI (First 4 bits)	
VCI (Middle 8 bits)		
VCI (Last 4 bits)	Payload type	PRIO
Cyclic Redundancy Check		

48 Data Octets start here

ATM design and cells

- ATM was designed to be completely general. We will large cell for data and small cell for voice.
- In ATM, cell size is chosen as a compromise between large cells and small cells.
- Header is 10% of the payload area.
- In Ethernet: data => 1500 octets
  header => 14 octets
  cell tax =>1%
- In ATM: data => 48 octets
  header => 5 octets
  cell tax => 10%

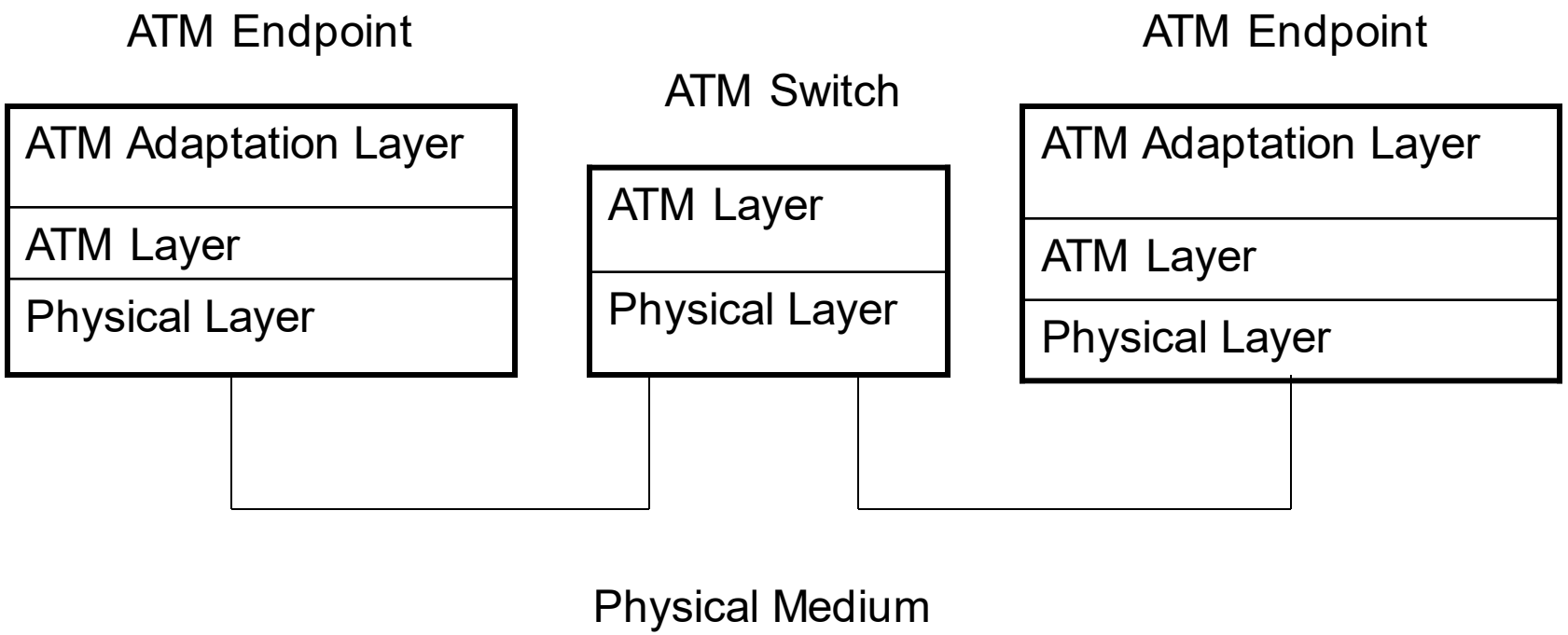
ATM : Connection oriented

- After the establishment of a connection between sender and receiver, the network hardware returns a connection identifier (a binary value) to each of the two computers.
- When sender sends cells, it places the connection identifier in each cell header.
- When it receives a cell, an ATM switch extracts the connection identifier and consults a table to determine how to forward the cell.

VPI/VCI

- Formally, an ATM connection is known as a virtual channel (VC).
- ATM assigns each VC a 24-bit identifier that is divided into 2 parts to produce a hierarchy.
- The first part, a virtual path identifier (VPI), specifies the path the VC follows through the network.
- A VPI is 8 bits long.
- The second part, a Virtual Channel Identifier (VCI), specifies a single VC within the path.
- A VCI is 16 bits long.

ATM Protocol Layers



ATM Protocol Layer

- **Physical Layer**: The lowest layer in the ATM protocol. It describes the physical transmission media. We can use shielded and unshielded twisted pair, coaxial cable, and fiber-optic cable.
- **ATM Layer**: It performs all functions relating to the routing and multiplexing of cells over VCs. It generates a header to the segment streams generated by the AAL. Similarly, on receipt of a cell streams, it removes the header from the cell and pass the cell contents to the AAL protocol. To perform all these functions, the ATM layer maintains a table which contains a list of VCIs.

ATM Protocol Layer

- **ATM Adaptation Layer**: Top layer in the ATM protocol Model. It converts the submitted information into streams of 48-octet segments and transports these in the payload field of multiple ATM cells. Similarly, on receipt of the stream of cells relating to the same call, it converts the 48-octet information field into required form for delivery to the particular higher protocol layer. Currently five service types have been defined. They are referred to as AAL1-5. AAL1 and AAL2 are connection oriented. AAL1 provides a constant bit rate (CBR) service, where as AAL2 provides a variable bit rate (VBR) service. Initially, AAL 3 was defined to provide connection oriented and VBR service. Later, this service type was dropped and it is now merged with AAL 4. Both AAL ¾ and AAL 5 provide a similar connectionless VBR service.

Disadvantages

- ATM has not been widely accepted. Although some phone companies still use it in their backbone networks.
- The expense, complexity and lack of interoperability with other technologies have prevented ATM from becoming more prevalent.

Disadvantages

- Expense: ATM technology provides a comprehensive lists of services, even a moderate ATM switch costs much more than inexpensive LAN hardware. In addition, the network interface card needed to connect a computer to an ATM network is significantly more expensive than a corresponding Ethernet NIC.
- Connection Setup Latency: ATM's connection-oriented paradigm introduces significant delay for distant communication. The time required to set up and tear down the ATM VC for distant communication is significantly larger than the time required to use it.

Disadvantages

- Cell Tax: ATM cell headers impose a 10% tax on all data transfer. In case of Ethernet, cell tax is 1%.
- Lack of Efficient Broadcast: Connection-oriented networks like ATM are sometimes called Non Broadcast Multiple Access (NBMA) networks because the hardware does not support broadcast or multicast. On an ATM network, broadcast to a set of computers is 'simulated' by arranging for an application program to pass a copy of the data to each computer in the set. As a result, broadcast is in efficient.

Disadvantages

- Complexity of QoS: The complexity of the specification makes implementation cumbersome and difficult. Many implementations do not support the full standard.
- Assumption of Homogeneity: ATM is designed to be a single, universal networking system. There is minimal provision for interoperating with other technologies