

# Lecture (06)

## ATM I

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## Agenda

- Introduction
- ATM protocol architecture

## Introduction

### Features and characteristics

- ATM, also known as cell relay,
- ATM takes advantage of the reliability and fidelity of modern digital facilities to provide faster packet switching than X.25.
- ATM transfer data in discrete chunks, and allows multiple logical connections to be multiplexed over a single physical interface (like X.25 and frame relay).

## Introduction (cont,..)

### Advantages

- ATM uses a fixed-sized chunks, called **cells**.
- ATM is a streamlined protocol uses minimal error and flow control capabilities.
- This reduces the overhead of processing ATM cells and reduces the number of overhead bits required with each cell, thus enabling ATM to operate at high data rates.
- The use of fixed-size cells simplifies the processing required at each ATM node, again supporting the use of ATM at high data rates.
- small cells may reduce queuing delay for a high-priority cell, because it waits less if it arrives slightly behind a lower-priority cell that has gained access to a resource

## Introduction (cont,..)

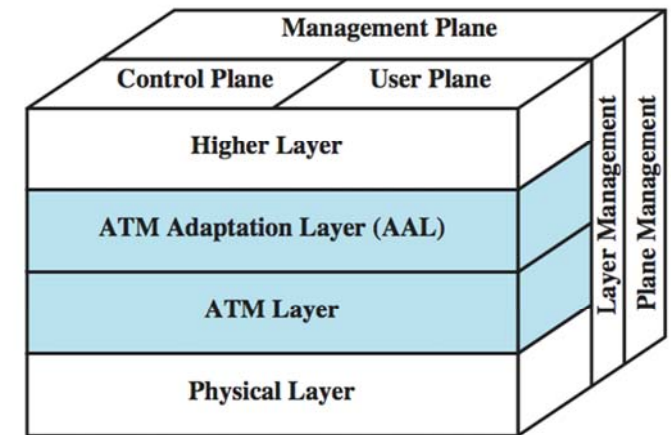
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- it appears that fixed-size cells can be switched more efficiently, which is important for the very high data rates of ATM.
- fixed-size cells, it is easier to implement the switching mechanism in hardware.

## ATM protocol architecture

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### ATM protocol architecture (3 layers, 3 plans)



## ATM protocol architecture (cont,..)

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- 1. The physical layer** involves the specification of a transmission medium and a signal encoding scheme.
  - The data rates specified at the physical layer range from 25.6 Mbps to 622.08 Mbps.
  - Other data rates, both higher and lower, are possible.
- 2. ATM Layer**
  - defines the transmission of data in fixed-size cells
  - defines the use of logical connections.

## ATM protocol architecture (cont,..)

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### 3. ATM adaptation Layer

- Makes ATM network able to transferee data comes from any other protocol.
- The AAL maps higher-layer information into ATM cells
- collects information from ATM cells for delivery to higher layers.

## ATM protocol architecture (cont,..)

### ATM protocol Reference Model Planes

- **User plane:** Provides for user information transfer, along with associated controls (e.g., flow control, error control)
- **Control plane:** Performs call control and connection control functions
- **Management plane:**
  - performs management functions related to a system as a whole
  - provides coordination between all the planes, and layer management,
- **layer management:** performs management functions relating to resources and parameters residing in its protocol entities

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## ATM protocol architecture (cont,..)

### virtual channel connections (VCC):

- A VCC is analogous to a virtual circuit in X.25; it is the basic unit of switching in an ATM network.
- A VCC is set up
  - between two end users through the network and a
  - variable-rate,
  - full-duplex flow
  - fixed-size cells is exchanged over the connection.
- VCCs are also used for
  - user-network exchange (control signaling) and
  - network-network exchange (network management and routing).

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## ATM protocol architecture (cont,..)

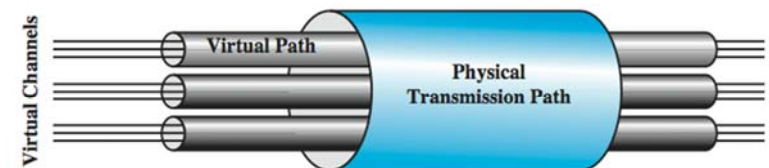
- So Network management actions are applied to a small number of groups of connections instead of a large number of individual connections.

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## ATM protocol architecture (cont,..)

### virtual path connection (VPC)

- A bundle of VCCs that have the same endpoints.
- All of the cells flowing over all of the VCCs in a single VPC are switched together.



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## ATM protocol architecture (cont,..)

### Why?

- Trend in high-speed networking in which the control cost of the network is becoming an increasingly higher proportion of the overall network cost.
- virtual path technique decrease control cost by grouping connections sharing common paths through the network into a single unit.

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## ATM protocol architecture (cont,..)

### VPC advantages

- 1. Simplified network architecture:** network transport transactions applied to a group of virtual channels which share the logical path (same route)
- 2. Increased network performance and reliability:** The network deals with fewer, aggregated entities.
- 3. Reduced processing and short connection setup time:**
  - All the work is done during virtual path setup.
  - Reserve capacity/path, for any in coming cells
  - virtual channel connections can be established by executing simple control functions at the endpoints of the virtual path (Rx, Tx)

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## ATM protocol architecture (cont,..)

- no call processing is required at transit nodes.
- addition of new virtual channels to an existing virtual path involves minimal processing.

### 4. Enhanced network services:

- The virtual path is used internal to the network but is also visible to the end user.
- Thus, the user may define closed user groups or closed networks of virtual channel bundles.

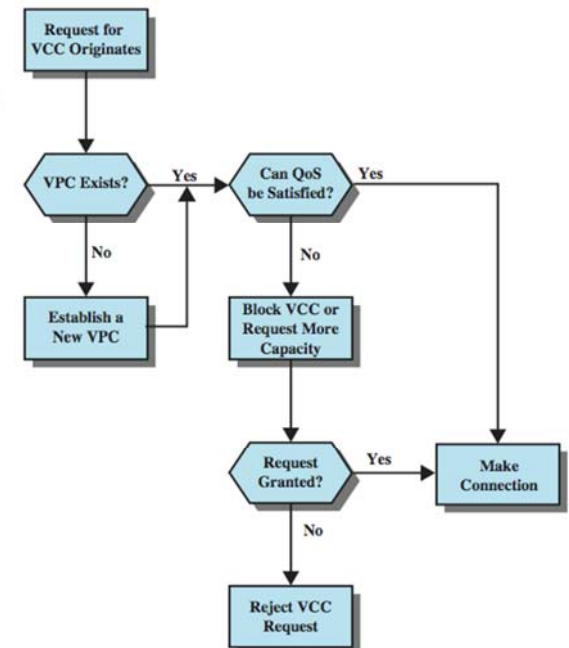
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## ATM protocol arch

### VCC Call Establishment Using VPCs

- setting up a virtual path connection is decoupled from the process of setting up an individual virtual channel connection



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## ATM protocol architecture (cont,..)

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- **The virtual path control mechanisms include**
  - calculating routes,
  - allocating capacity, and
  - storing connection state information.
- **To set up a virtual channel,**
  - there must first be a VPC to the required destination node
  - VPC has sufficient available capacity to support the virtual
  - VPC has appropriate quality of service.
- **A virtual channel is setup** by storing the required state information (virtual channel/virtual path mapping).

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## ATM protocol architecture (cont,..)

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### VCC classification regarding users

- Endpoints of a VCC may be
  - end users,
  - network entities, or an
  - end user and a network entity.
- cells are delivered in the same order in which they are sent

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## ATM protocol architecture (cont,..)

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- 1. Between end users:**
  - carry end-to-end user data.
  - carry control signaling between end users
- 2. Between an end user and a network entity:**
  - Used for user-to-network control signaling,
  - A user-to-network VPC can be used to aggregate traffic from an end user to a network exchange or network server.

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## ATM protocol architecture (cont,..)

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### 3. Between two network entities:

- Used for network traffic management and routing functions.
- A network-to-network VPC can be used to define a common route for the exchange of network management information.

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## ATM protocol architecture (cont,..)

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### VP/VC Characteristics

#### 1. Quality of service (QoS):

- cell loss ratio and cell delay variation.

#### 2. Switched and semi permanent virtual channel connections

- A switched VCC is an on-demand connection, which requires a call control signaling for setup and tearing down.
- A semi-permanent VCC is one that is of long duration and is setup by configuration or network management action.

#### 3. Cell sequence integrity

- sequence of cells sent within a VCC is preserved.

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## ATM protocol architecture (cont,..)

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### 4. Traffic parameter negotiation and usage monitoring

- Traffic parameters can be negotiated between a user and the network for each VCC, including
  - average rate,
  - peak rate,
  - burstiness, and
  - peak duration.
- The network monitors the input of cells to the VCC, ensuring negotiated parameters are not violated.

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## ATM protocol architecture (cont,..)

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### Other VC distinct characteristics (not available for VPC)

#### 1. Virtual channel identifier restriction within a VPC

- One or more virtual channel identifiers, or numbers, may not be available to the user of the VPC but may be reserved for network use.
- Examples include VCCs used for network management.

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## ATM protocol architecture (cont,..)

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### VCC control signaling

#### Propose

Establishment and release of VPCs and VCCs

#### where?

Takes place on separate connections from those that are being managed

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## ATM protocol architecture (cont,..)

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### Type of VCC control channels?

#### 1. Semi-permanent VCCs:

- used for user-to-user signaling exchange.

#### 2. meta-signaling channel:

- used for user-network exchange
- a low rate channel used for establishment of permanent control channel, which will be used for call control.

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## ATM protocol architecture (cont,..)

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### 3. user to network signaling virtual channel

- used to set up VCCs which carries user data

### 4. user to user signaling virtual channel

- used to allow the two end users, without network intervention, to establish and release user-to-user VCCs to carry user data.

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## ATM protocol architecture (cont,..)

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### VPC control signaling

#### 1. Semi-permanent VPC

- A VPC can be established on a semi-permanent basis by prior agreement.

#### 2. Customer controlled

- VPC establishment/release may be customer controlled.
- In this case, the customer uses a signaling VCC to request the VPC from the network.

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## ATM protocol architecture (cont,..)

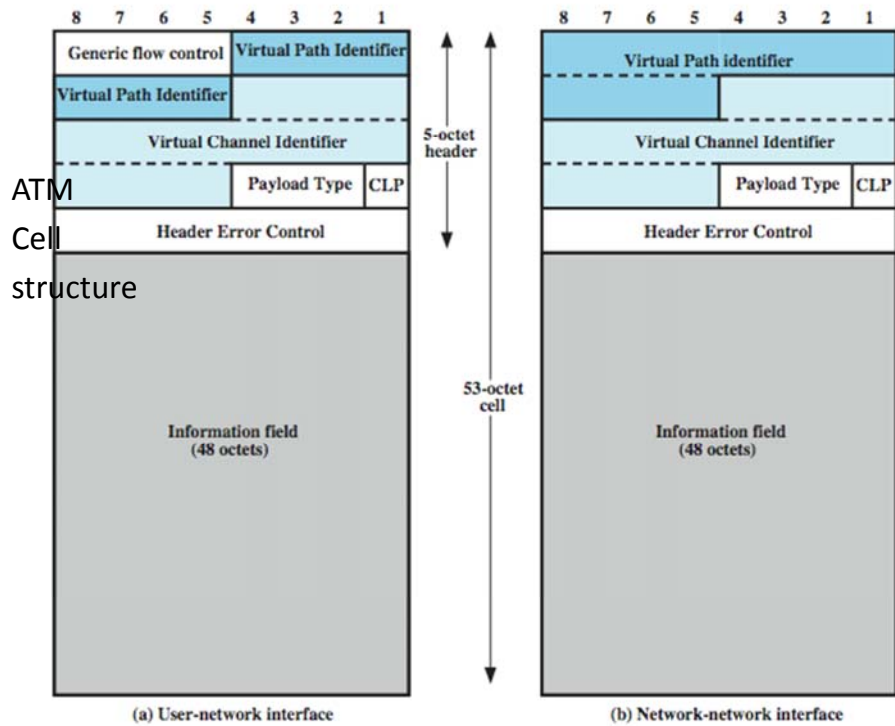
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### 3. Network controlled

- VPC establishment/release may be network controlled.
- In this case, the network establishes a VPC for its own convenience.
- The path may be network-to-network, user-to-network, or user-to-user.

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## ATM protocol architecture (cont,..)

- ATM uses a fixed-size cells, consisting of a 5- octet header and a 48-octet information field.

Field	interface	details
<b>Generic Flow Control (GFC)</b>	4 bits user-network interface	Control cell flow only at the local user-network interface
<b>Virtual Path Identifier (VPI)</b>	8 bits → user-network interface 12 bits → network2network interface.	constitutes a routing field for the network.
<b>Virtual Channel Identifier (VCI)</b>	8 bits all	routing to and from the end user.

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## ATM protocol architecture (cont,..)

Field	interface	details
<b>Payload Type (PT)</b>	3 bits all	Bit1: type of information in the information field (0=user information). Bit2: congestion has been experienced Bit3: types of ATM SDUs (Service Data Unit)
<b>cell loss priority (CLP)</b>	1 bit all	0 cell is a relatively higher priority, 1 cell may ne discard within the network. So it provides guidance to the network in the event of congestion
<b>Header Error Control (HEC)</b>	8 bits all	used for both error control and synchronization

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## ATM protocol architecture (cont,..)

### Generic Flow Control

- GFC used to control traffic flow at user to network interface (UNI) to solve short term overload.
- two sets of procedures are used:
  - uncontrolled transmission
  - controlled transmission.
- every connection is identified as either subject to flow control or not.
- there may be one group of controlled connections say(Group A) that is the default [one-queue model],
- or controlled traffic may be classified into two groups of controlled connections say (Group A and Group B); [two-queues model]

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## ATM protocol architecture (cont,..)

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### **GFC - Single Group of Connections [one queue model]**

- The controlled equipment (terminal equipment - TE), initializes some variables:
  - TRANSMIT is a flag initialized to SET (1),
  - GO\_CNTR, which is a credit counter, is initialized to 0.
  - GO\_VALUE, is either initialized to 1 or set to some larger value at configuration time.
- And two signals HALT,& SET

## ATM protocol architecture (cont,..)

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1. If TRANSMIT = 1, cells on uncontrolled connections may be sent at any time.  
If TRANSMIT = 0, no cells may be sent on either controlled or uncontrolled connections.
2. If a HALT signal is received from the controlling equipment,  
→TRANSMIT is set to 0  
remains at zero until a NO\_HALT signal is received, then  
→TRANSMIT is set to 1.

## ATM protocol architecture (cont,..)

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3. If TRANSMIT = 1 and there is no cell to transmit on any uncontrolled connections, then
  - If GO\_CNTR > 0, then the TE may send a cell on a controlled connection.  
The TE marks that cell as a cell on a controlled connection and decrements GO\_CNTR.
  - If GO\_CNTR = 0, then the TE may not send a cell on a controlled connection.
4. The TE sets GO\_CNTR to GO\_VALUE upon receiving a SET signal; a null signal has no effect on GO\_CNTR

## ATM protocol architecture (cont,..)

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### **Why using HALT signal?**

- to limit the effective ATM data rate and should be cyclic.
- For example, to reduce the data rate over a link by half, the HALT command is issued by the controlling equipment so as to be in effect 50% of the time.
- This is done in a predictable, regular pattern over the lifetime of the physical connection.

## ATM protocol architecture (cont,..)

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### **GFC – two Group of Connections [Two queues model]**

- For the two-queue model, there are two counters, each with a current counter value and an initialization value:
  - GO\_CNTR\_A,
  - GO\_VALUE\_A,
  - GO\_CNTR\_B,
  - GO\_VALUE\_B.
- This enables the network to control two separate groups of connections.

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Thanks,...