جامعة الأهرام الكندية
AHRAM CANADIAN UNIVERSITY

Lecture (06)
ATM I

Dr. Ahmed ElShafee

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

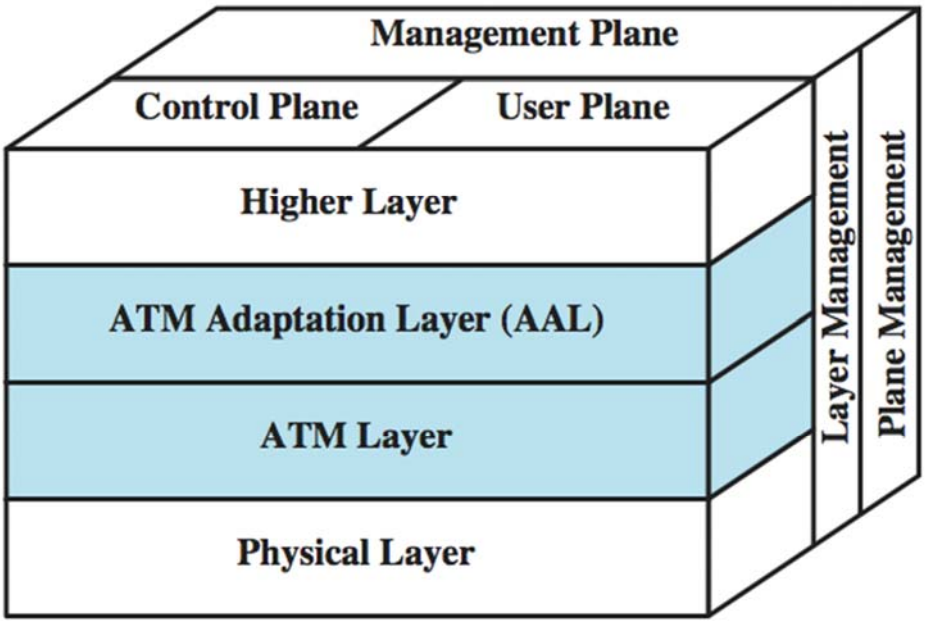
- ATM uses a fixed-sized chunks, called **cells.**
- ATM is a streamlined protocol uses minimal error and flow control capabilities.
- This reduces the overhead of processing ATM cells and reduces the number of overhead bits required with each cell, thus enabling ATM to operate at high data rates.
- 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,..)

- 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

ATM protocol architecture (3 layers, 3 plans)



ATM protocol architecture (cont,..)

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,..)

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

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).

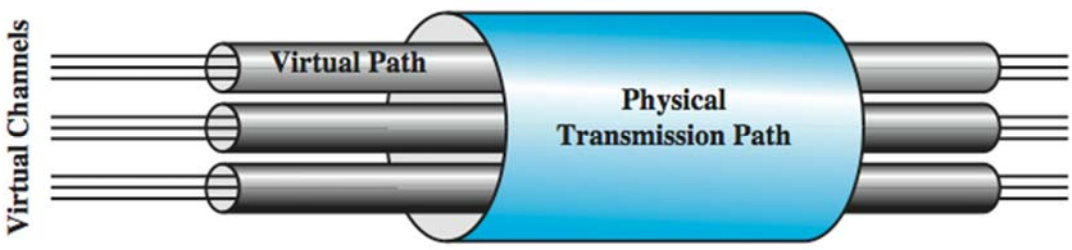
ATM protocol architecture (cont,..)

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

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.



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.

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)

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.

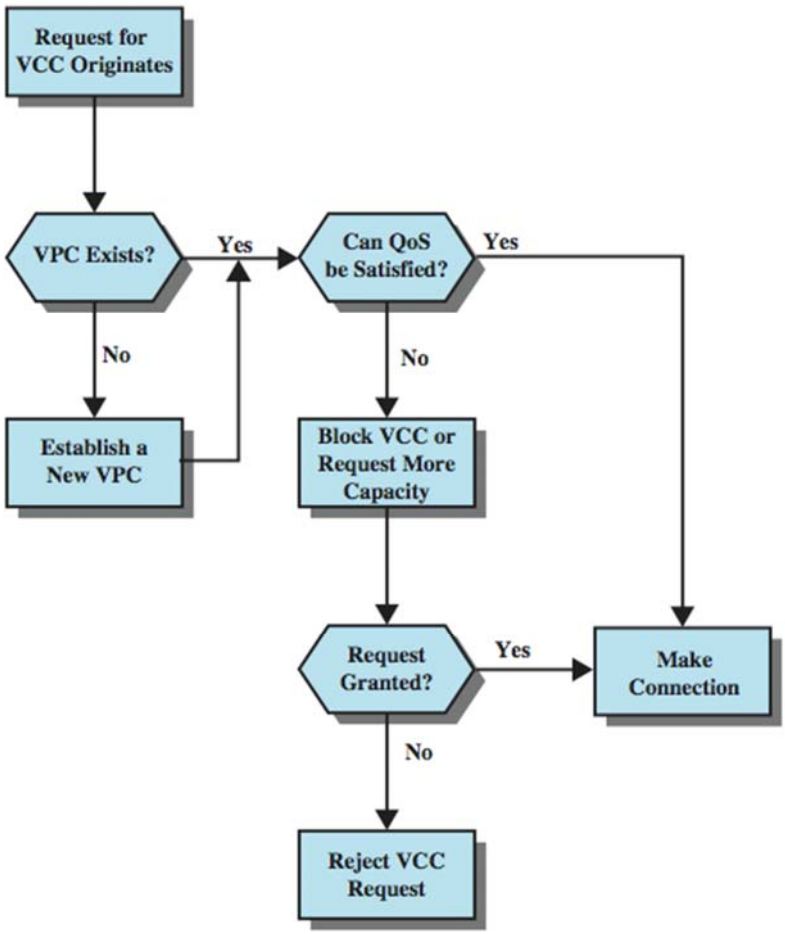
4. Enhanced network services:

- 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.

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



ATM protocol architecture (cont,..)

- **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).

ATM protocol architecture (cont,..)

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

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

VCC control signaling

Propose

Establishment and release of VPCs and VCCs

where?

Takes place on separate connections from those that are being managed

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

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.

ATM protocol architecture (cont,..)

VPC control signaling

1. Semi-permanent VPC

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

2. Customer controlled

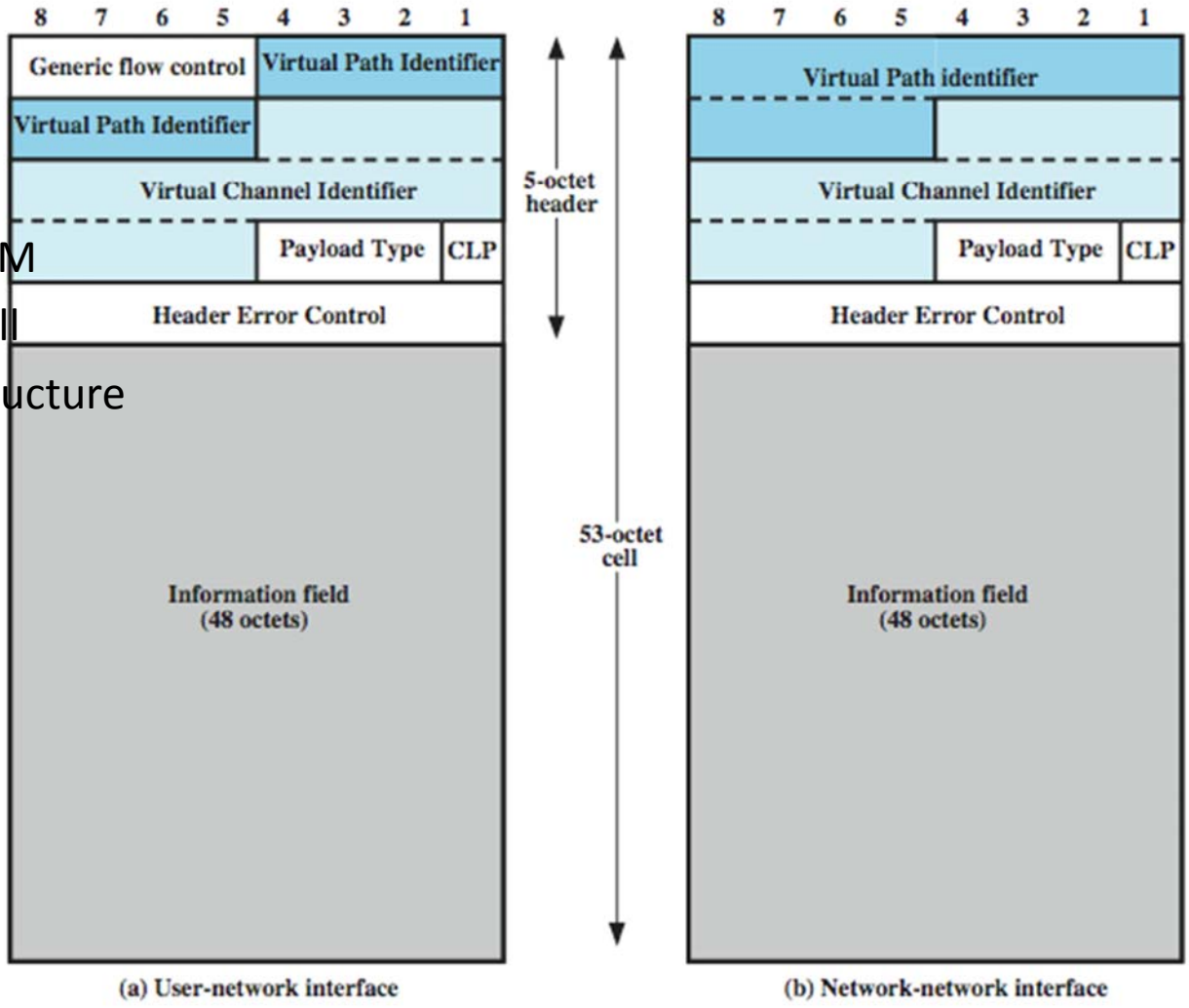
- VPC establishment/release may be customer controlled.
- In this case, the customer uses a signaling VCC to request the VPC from the network.

ATM protocol architecture (cont,..)

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.

ATM Cell structure



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

ATM protocol architecture (cont,..)

Field	interface	details
Payload Type (PT)	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)
cell loss priority (CLP)	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
Header Error Control (HEC)	8 bits all	used for both error control and synchronization

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]

ATM protocol architecture (cont,..)

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,..)

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,..)

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,..)

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,..)

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.

Thanks,…