Communications in Distributed Systems

UNIT-2: Communications in Distributed Systems

- Basics of Communication Networks
- Layered Protocols
- ATM Models
- Client-Server Models
- Blocking and Non-Blocking Primitives
- Buffered and Un-Buffered Primitives
- Reliable and Unreliable Primitives
- Message Passing
- Remote Procedure Calls

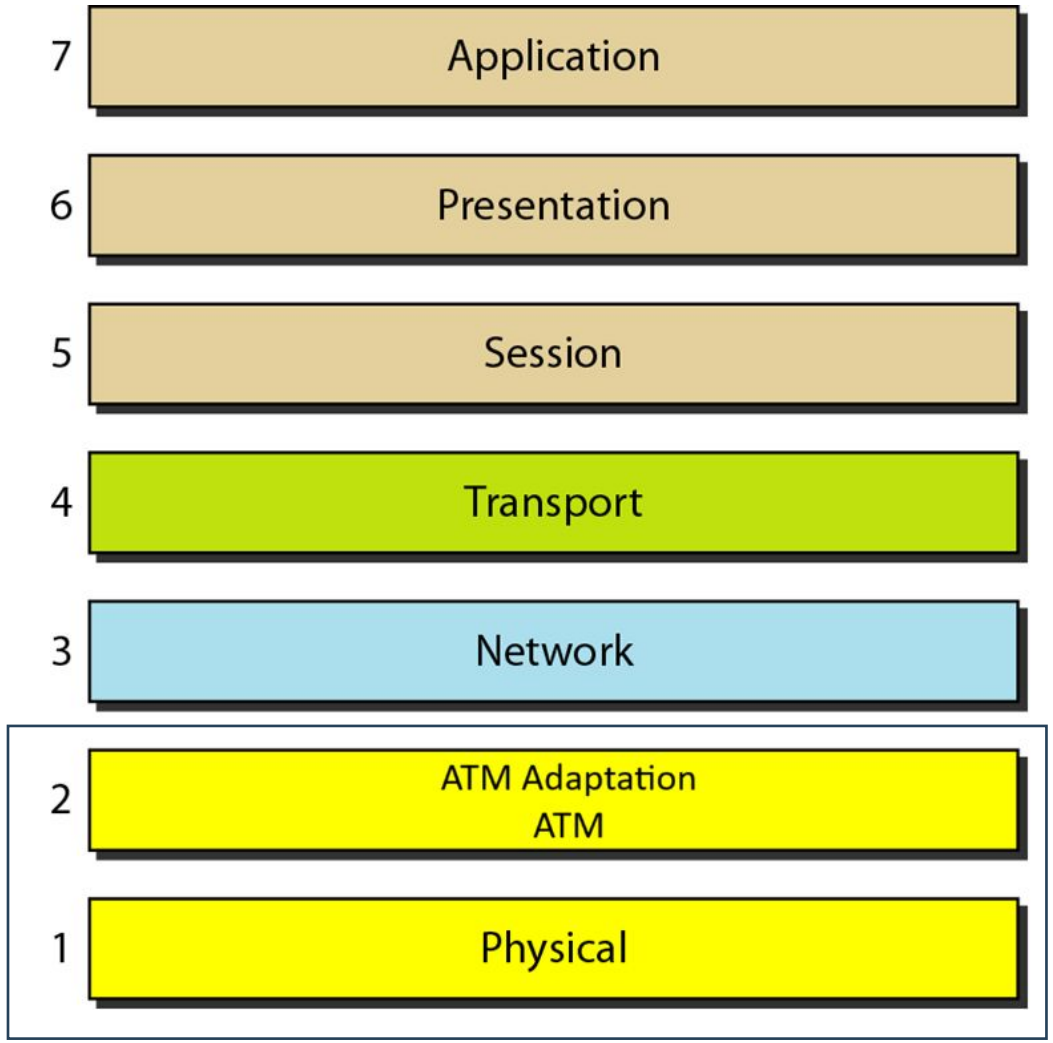
#1: Asynchronous Transfer Mode (ATM)

- ATM is the cell relay protocol designed by ATM forum and adopted by ITU-T
- It is a cell switching and multiplexing technology that combines benefits of both circuit switching and packet switching
- ATM working principles
  - Sender first establishes a connection (virtual circuit) to the receiver(s)
  - A route is determined from sender to receiver
  - Routing information is stored in the switches along the way
  - Packets can be sent through this connection by sender
  - Packets are chopped into small fixed-sized units (cell) by hardware
  - Routing information purged from switches when connection is not required

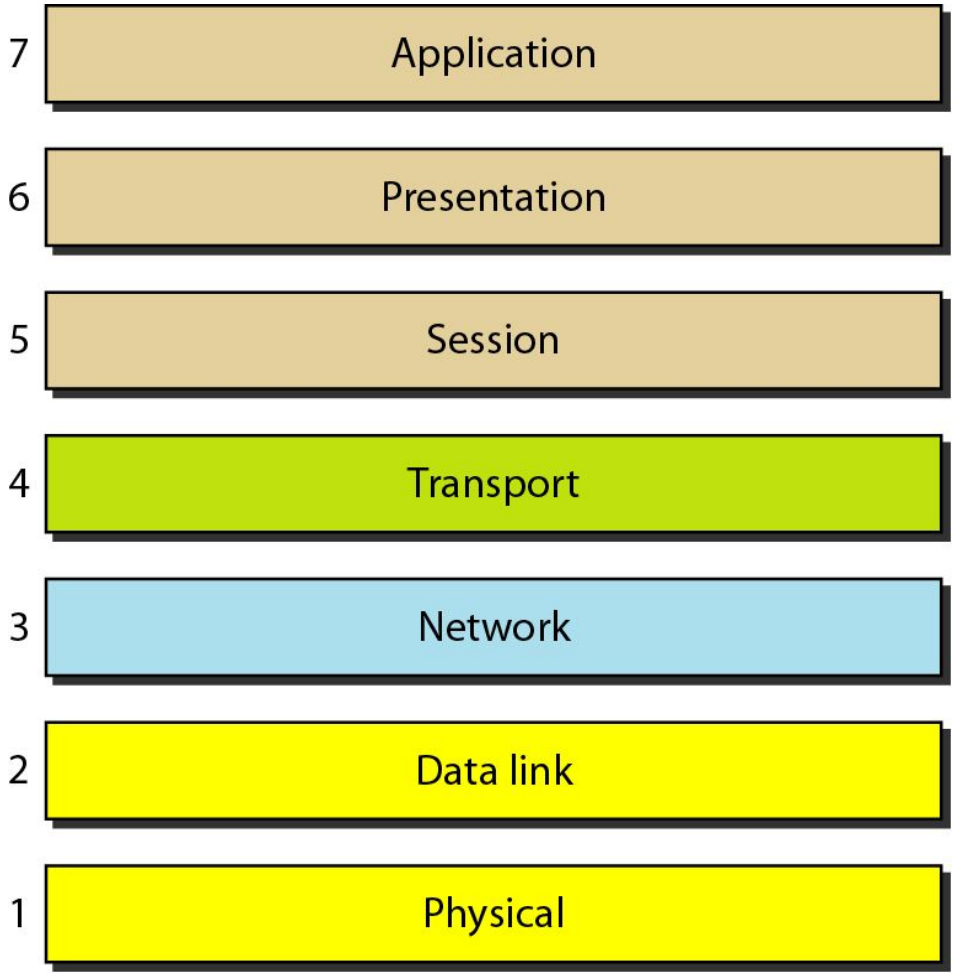
ATM Advantages

- A single network is used to transport voice, data, broadcast television, videotapes, radio.
- It is used for video conferencing, video-on-demand, teleconferencing, access to thousands of remote databases
- Cost saving
- ATM uses cell switching which handles both point-to-point and multicasting efficiently
- ATM allows rapid switching as its cell (or packet) size is fixed

#2 ATM Layers



ATM Reference Model



ISO/OSI Model

2.1: ATM Physical Layer

- In the Physical Layer, ATM is synchronous as it transmits empty cells while no data to be send.
- It uses SONET (Synchronous Optical NETwork) in physical Layer.
- In SONET, frame size is 810 bytes (overhead: 36 bytes, payload: 744 bytes), gross data rate 51.840 Mbps.
- Basic 51.840 Mbps channel is called OC-1.
- OC-12 and OC-48 are used for long-haul transmission.

2.2: ATM Layer

- GFC is used for flow control.
- VPI and VCI together identify path and circuit of a cell
- Payload type distinguishes data cells from control cells
- CLP identifies the less important cells which drop if congestion occurs
- CRC identifies redundancy and correct it

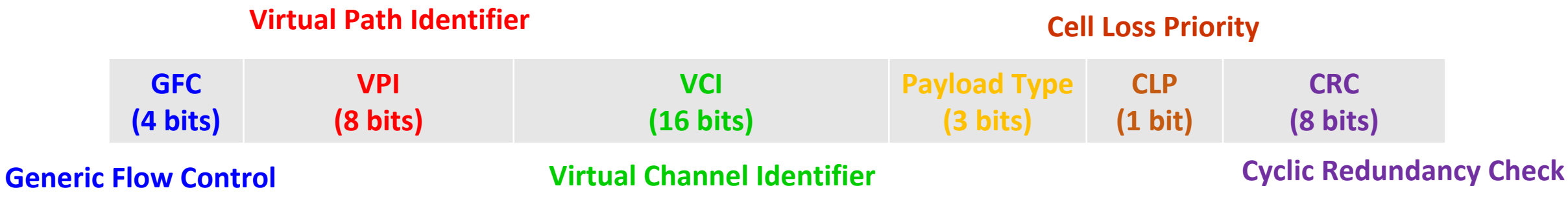


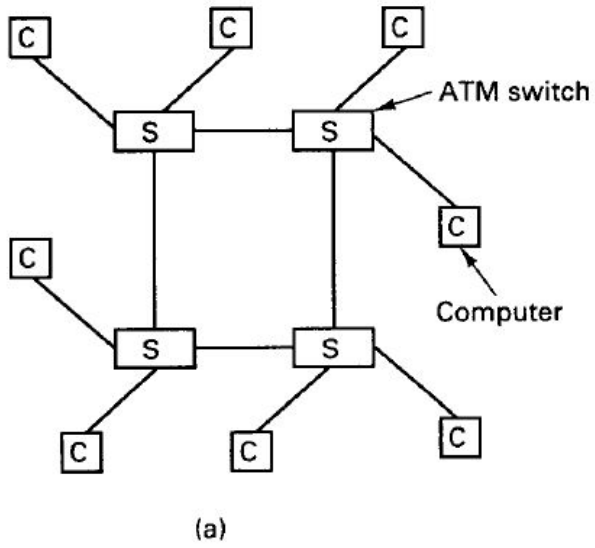
Figure: User-to-Network Cell Header Layout

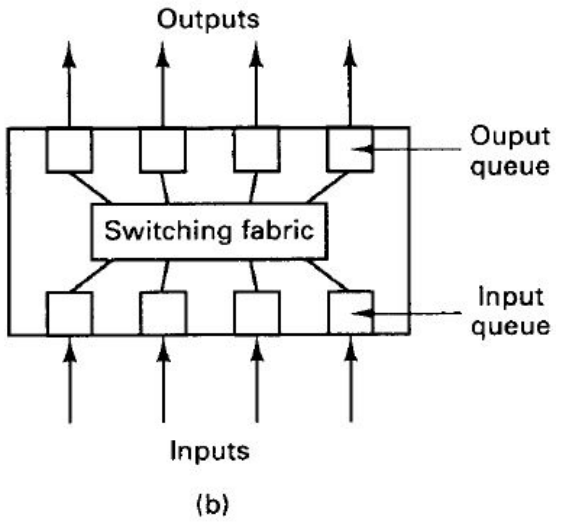
2.3: ATM Adaptation Layer

- Adaptation Layer has four classes
  - Constant bit rate traffic (for audio and video)
  - Variable bit rate traffic but with bounded delay
  - Connection-oriented data traffic
  - Connectionless data traffic
- Simple and Efficient Adaptation Layer (SEAL)
  - 1 bit of ATM *header*, 1 bit of *Payload Type*
  - Payload Type field is set to 1 for last cell, otherwise 0
  - Last cell contains 8 bytes tailer with four fields
  - Tailer contains packet length (2 bytes), checksum (4 bytes)
  - There are no use of first two fields (1 byte each field)

#3: ATM Switching

- Network built with 4 switches and 8 computers
- Cells can be switched different computers by traversing switches
- Switching fabric connects input and output lines and ensures parallel switching
- Head-of-line blocking problem
- Solution: Keep copy of a cell in a output buffer queue





(a) ATM Switching Network

(b) Inside of One Switch

#4: ATM Implications for Distributed Systems

- High-speed network but latency remains
- Flow control
- Transcontinental Delay
- Cell drops during congression

#5: ATM Advantages

- High-speed, fast-switched integrated data, voice, and video communication.
- A standards-based solution formalized by the International Telecommunication Union (ITU)
- Interoperability with standard LAN/WAN technologies
- QoS technologies that enable a single network connection to reliably carry voice, data, and video simultaneously.

Q&A

Homework Questions

1) State advantages of ATM over traditional switching technology.
2) Describe *head-of-line blocking* problem in ATM switching network. What can be the possible solution?
3) What is the probability that a totally garbled ATM header will be accepted as being correct?
4) An ATM system is transmitting cells at the OC-3 rate. Each packet is 48 bytes long, and thus fits into cell. An interrupt takes 1 microsecond. What fraction of the CPU is devoted to interrupt handling? Now repeat this problem for 1024-byte packet.

Thank You!