IT301: Data Communication & Computer Network(DCCN)

Class: B. Tech (CS) Sec A
Semester : V
Teacher: Dr. Amritanjali

Week 2

Syllabus

Module I

- **Data Communications and Networking**: Overview A Communications Model, Data Communications, Data Communication Networking, The Need for Protocol Architecture, A Simple Protocol Architecture, OSI, The TCP/IP Protocol Architecture, Data TransmissionConcepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity. (8L)

Module II

- **Transmission Media and Signal Encoding Techniques:** Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission.Digital Data Digital Signals, Digital Data Analog Signals, Analog Data Digital Signals, Analog Data Analog Signals. (8L)

Module III

- **Digital Data Communication Techniques and Data Link Control:** Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations, Interfacing, Flow Control, Error Control, High-Level Data Link Control (HDLC). (8L)

Module IV

- Multiplexing, Circuit Switching and Packet Switching Multiplexing Frequency Division Multiplexing, Synchronous Time Division Multiplexing, Statistical Time Division Multiplexing, Switching Networks, Circuit-Switching Networks, Circuit-Switching Concepts, Control Signaling, Soft switch Architecture, Packet-Switching Principles, X.25, and Frame Relay. (8L)

Module V

- Asynchronous Transfer Model Protocol Architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories, ATM Adaptation Layer. Routing in Switched Networks Routing in Circuit-Switching Networks, Routing in Packet-Switching Networks, Least-Cost Algorithms. (8L)

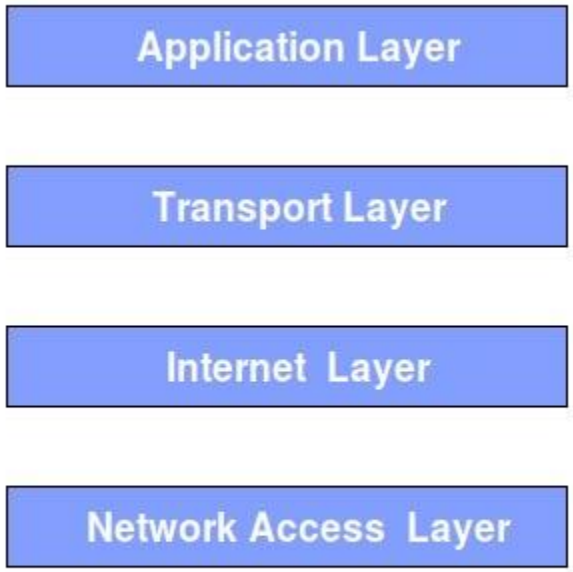
Text Book: Stallings W., Data and Computer Communications, 10th Edn., Pearson Education, PHI, New Delhi, 2014.(T1)

Reference Book: Forouzan B. A., Data Communications and Networking, 5thEdn. TMH, New Delhi, 2017.(R1)

TCP/IP Model

- Almost all operating systems in use today include a TCP/IP implementation
- TCP/IP protocol suite consists of a set of communication protocols for packet switching networks
- It is named after two of its most popular protocols- TCP and IP
  1. TCP- Transmission Control Protocol
  2. IP- Internet Protocol

TCP/IP Architecture



TCP/IP Architecture

- **Application Layer**
  - Defines protocols used by applications to exchange data through the network
  - HTTP, FTP, Telnet, SMTP

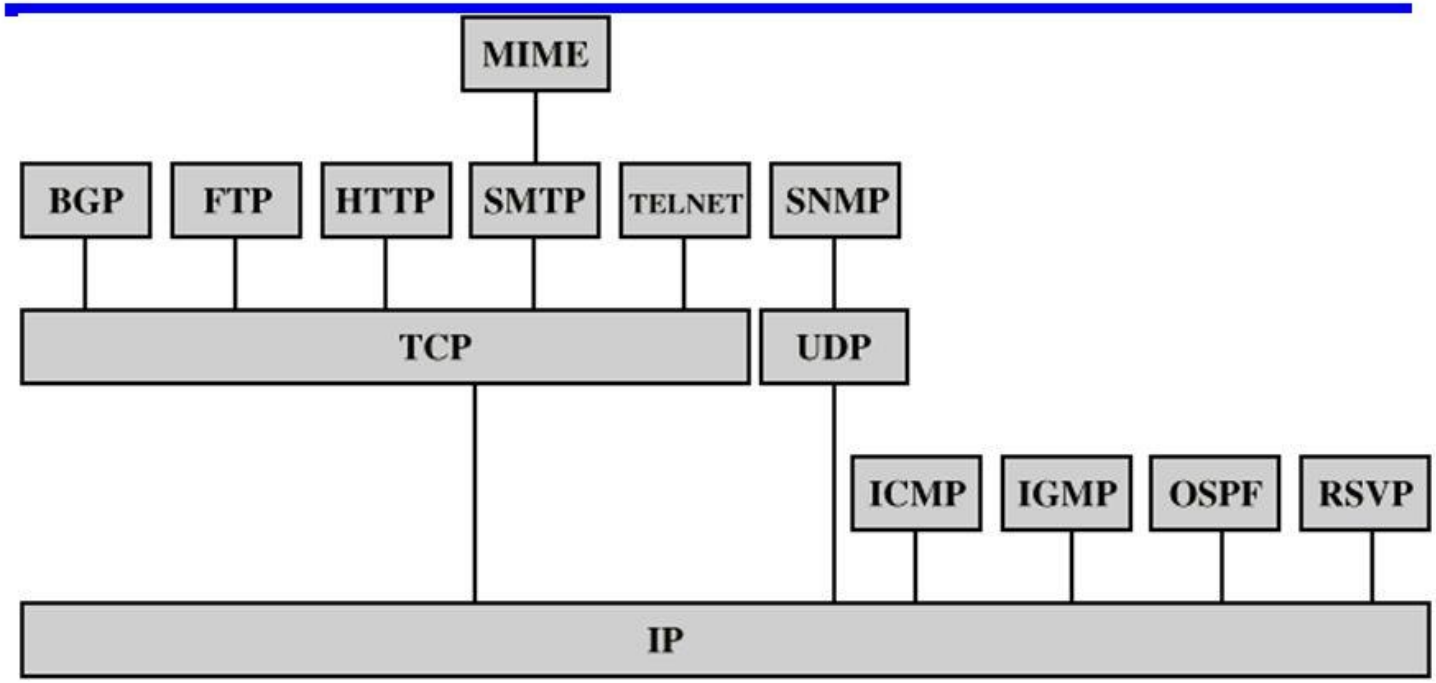
- **Transport Layer**
  - Provides two types of services, Connection-less and connection-oriented
  - Accepts data from the application layer, encapsulates into segments and passes to the lower layer
  - TCP and UDP

TCP/IP Architecture

- **Internet Layer**
  - Moves the data segments across networks to reach the destination network by encapsulating it into packets
  - Provides addressing and path determination functionalities
  - IP, ICMP

- **Network Access Layer**
  - Sends data to the next hop in the path
  - Defines protocols and hardware for network access
  - Protocols depends upon the type of physical network being used

Some Protocols in TCP/IP Suite



BGP = Border Gateway Protocol
FTP = File Transfer Protocol
HTTP = Hypertext Transfer Protocol
ICMP = Internet Control Message Protocol
IGMP = Internet Group Management Protocol
IP = Internet Protocol
MIME = Multi-Purpose Internet Mail Extension
OSPF = Open Shortest Path First
RSVP = Resource ReSerVation Protocol
SMTP = Simple Mail Transfer Protocol
SNMP = Simple Network Management Protocol
TCP = Transmission Control Protocol
UDP = User Datagram Protocol

Protocol Data Unit (PDU)

- Data created at the Application layer is called a **message**.
- The data unit created at the Transport layer, which encapsulates application layer message, is called **a segment** if it comes from the Transport layer's TCP protocol. If the data package comes from the Transport layer's **User Datagram Protocol (UDP)** protocol, it is called a **datagram**.
- The data unit at the Internet layer, which encapsulates the Transport layer segment, is called a **datagram**.
- The data unit at the Network Access layer, which encapsulates the datagram, is called a **frame**.

Address Identifiers

- Logical Address Identifiers
  - Port Numbers (16 bits) identify application processes in a host
  - IP Addresses (32 bits) specifies network id and host id
- Physical Address Identifier
  - MAC address (48 bits) of network interface card uniquely identifies a host in a network

Data Encapsulation

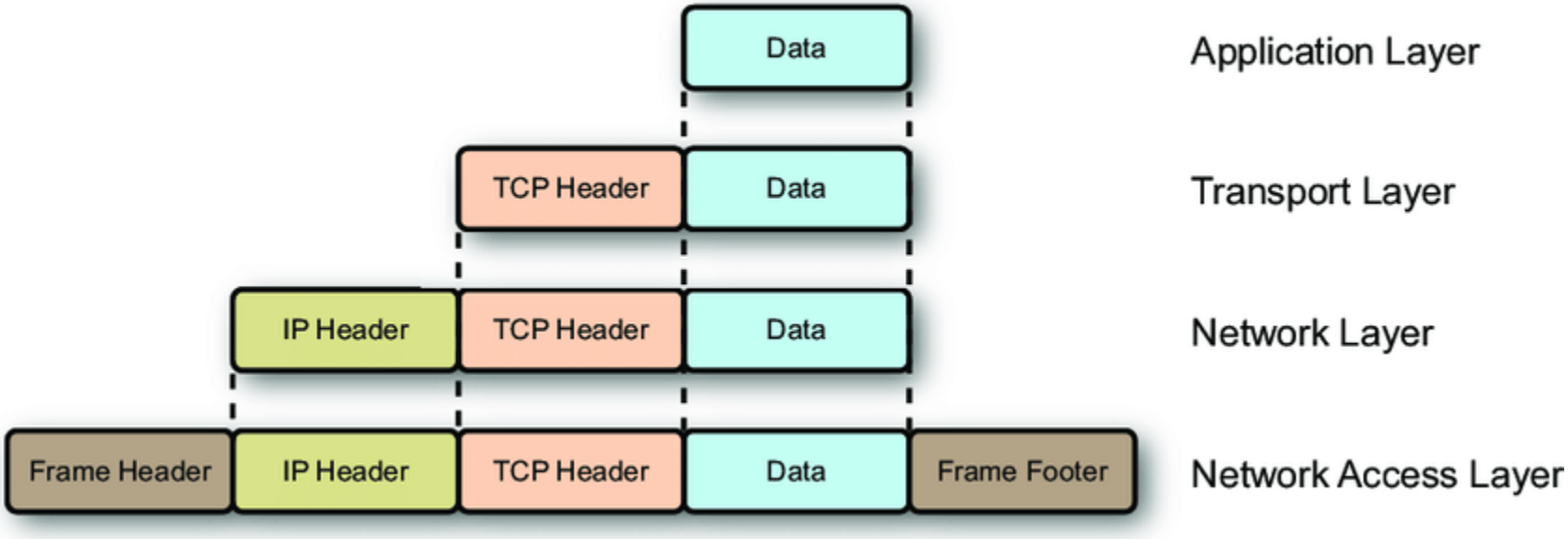
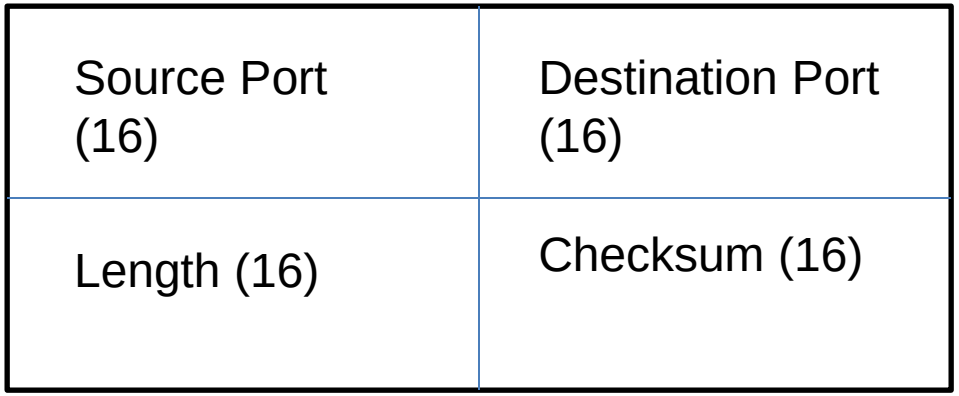


Image Source: researchgate.net

TCP Header

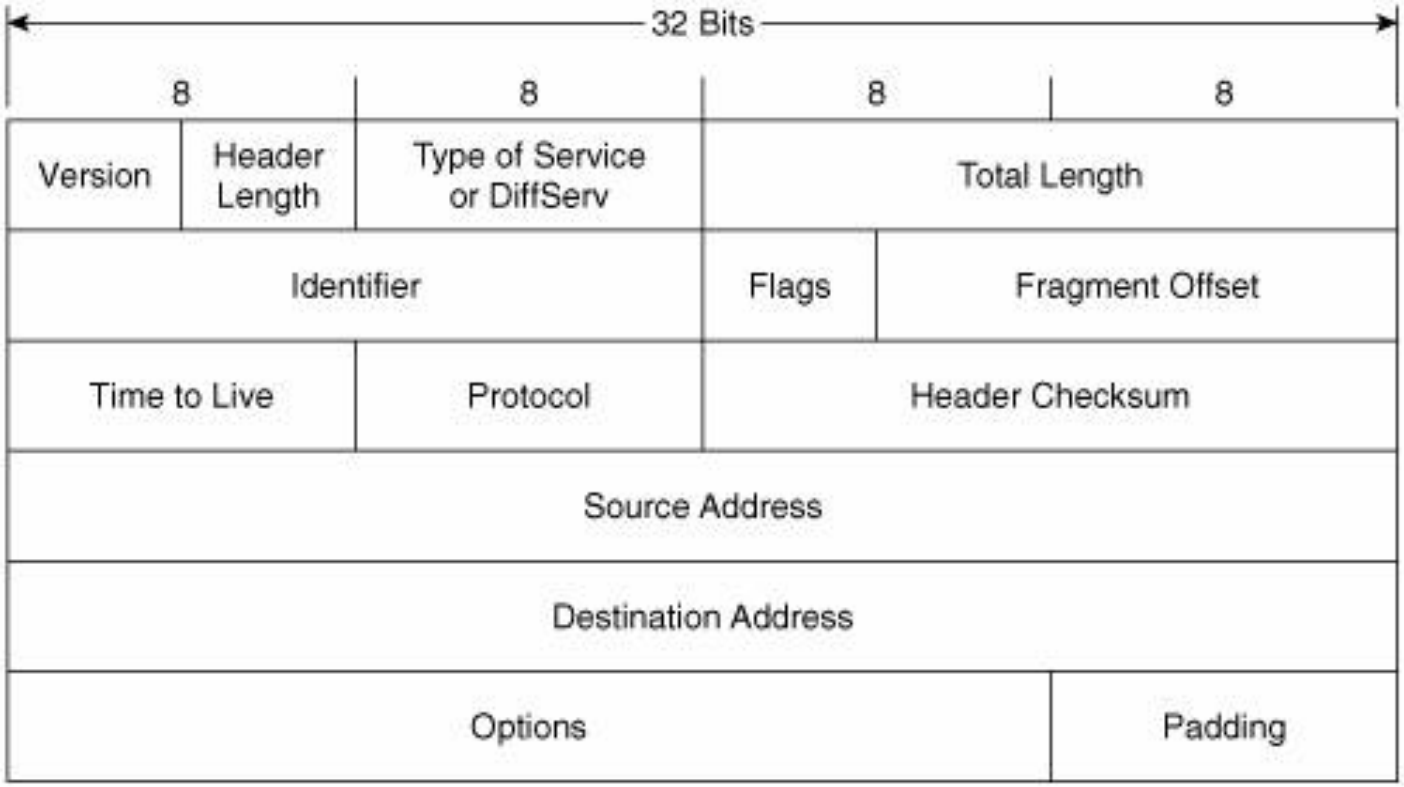
<table>
<tr><td colspan="3">Source Port (16)</td><td>Destination Port (16)</td></tr>
<tr><td colspan="4">Sequence Number (32)</td></tr>
<tr><td colspan="4">Acknowledgement Number (32)</td></tr>
<tr><td>Data offset</td><td>Reserved (6)</td><td>Flags (6)</td><td>Window (16)</td></tr>
<tr><td colspan="3">Checksum (16)</td><td>Urgent (16)</td></tr>
<tr><td colspan="4">Options and Padding</td></tr>
</table>

UDP Header



- TCP Communication
  - Slow but reliable
  - Emails, Web browsing
- UDP Communication
  - Fast but unreliable, uses best effort
  - VoIP, Music streaming

IPv4 Header


32 Bits
8
8
8
8
Version
Header Length
Type of Service or DiffServ
Total Length
Identifier
Flags
Fragment Offset
Time to Live
Protocol
Header Checksum
Source Address
Destination Address
Options
Padding

Switching Network

Provides switching facility to move data from one node to another through the interconnection network

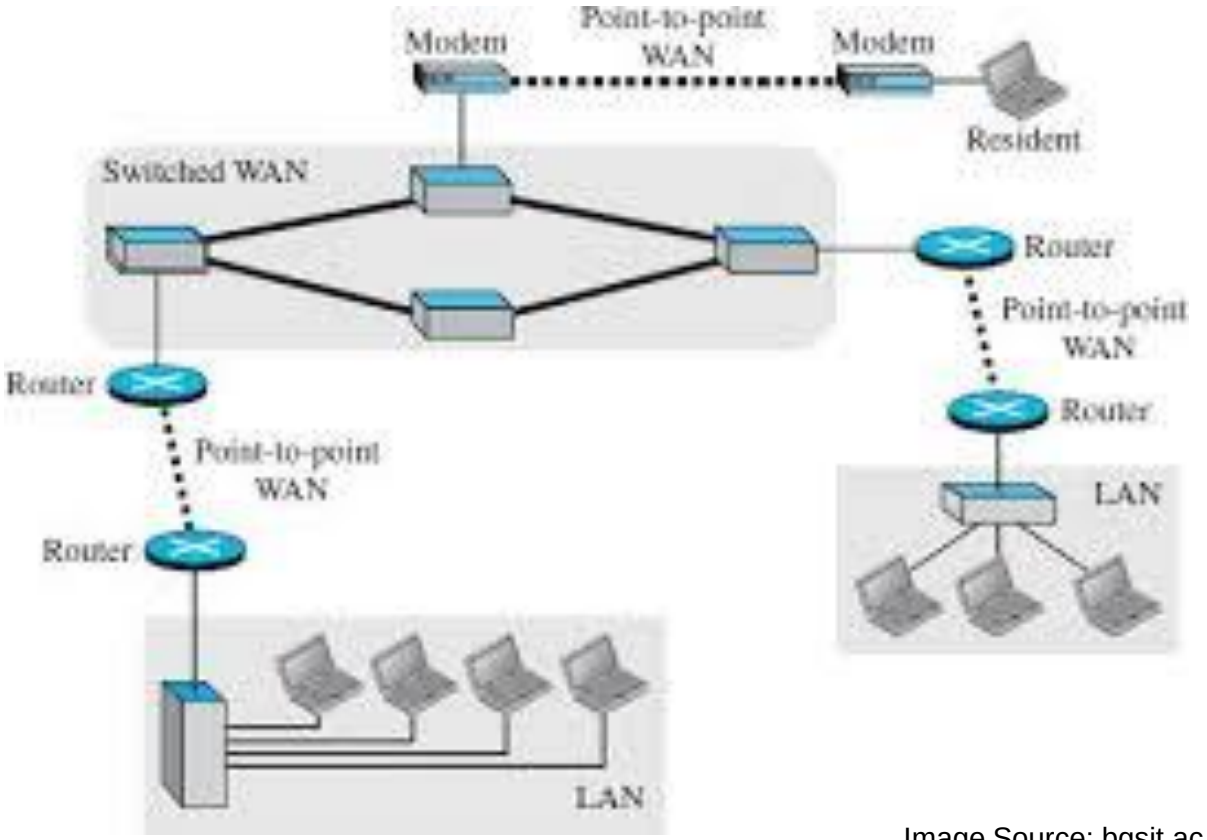


Image Source: bgsit.ac.in

Switching Techniques

- Circuit Switching
- Packet Switching
  - Datagram Approach
  - Virtual Circuit Switching

Circuit Switching

- When connection is established, a dedicated path is set up between two stations
- Path is a connected sequence of physical links
- On each link a logical channel is dedicated to the connection for the its lifetime
- Circuit switching is done at physical layer

Example

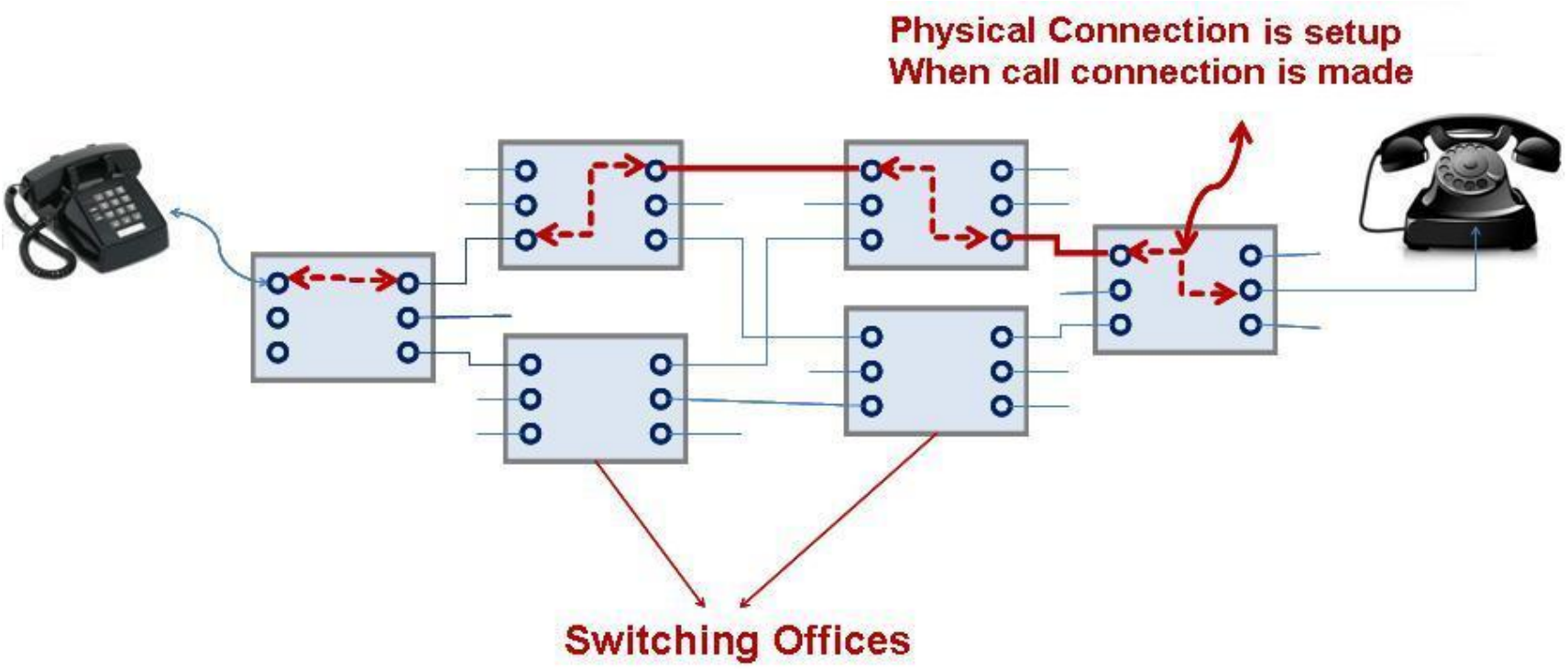


Image Source: apposite-tech.com

Packet Switching

- Data is transmitted as a sequence of chunks called packets
- Path is not dedicated to any connection
- Helps in efficient utilization of bandwidth

Datagram Approach

- Datagram approach of packet switching is used to at the network layer
- No fixed path
- At each node, next node is decided for forwarding the packet towards destination
- IP protocol uses datagram approach

Example

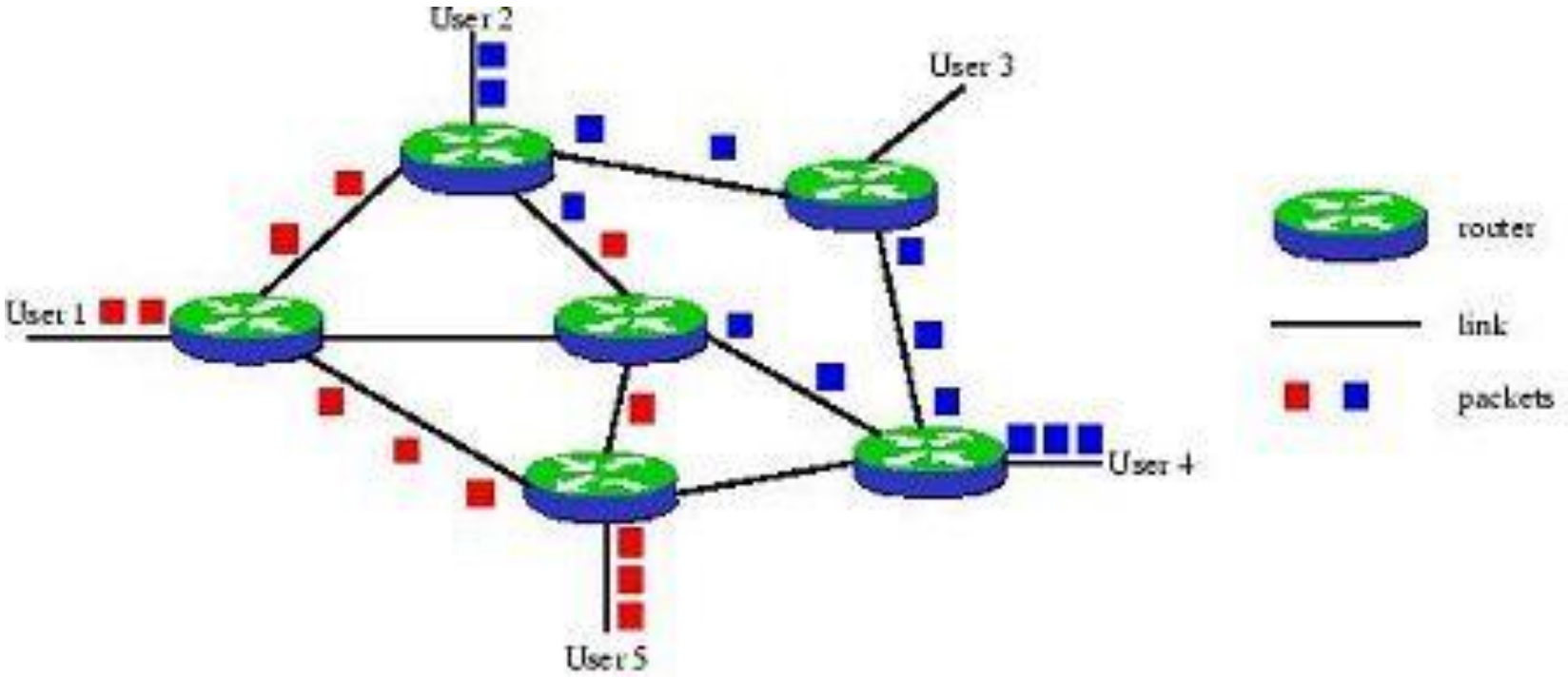


Image Source: ecomputernotes.com

Virtual Circuit Switching

- Path is fixed
- When connection is established, a path is set up for the connection
- All packets of that connection will take the same path
- Path is not dedicated to the connection
- Frame Relay and ATM networks

Example

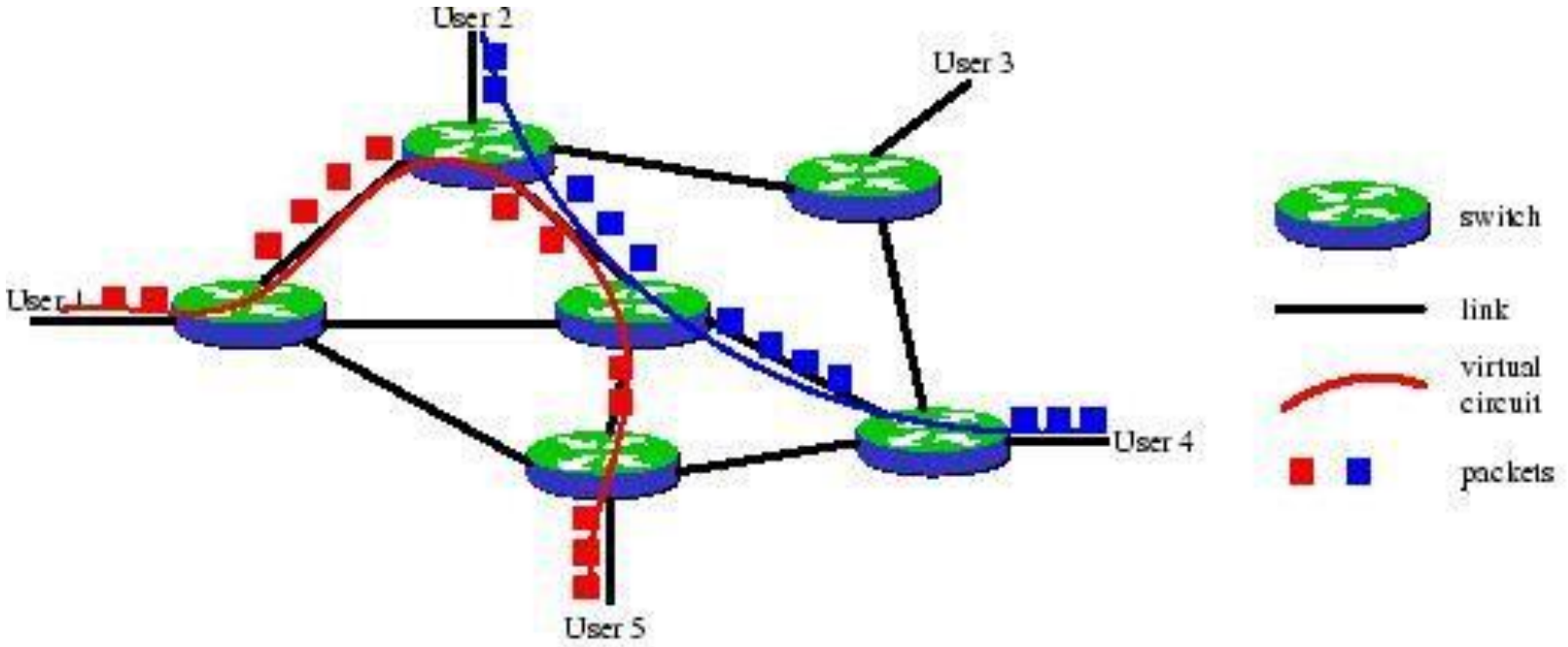


Image Source: ecomputernotes.com