Network Fundamental

(Day-1)

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Network

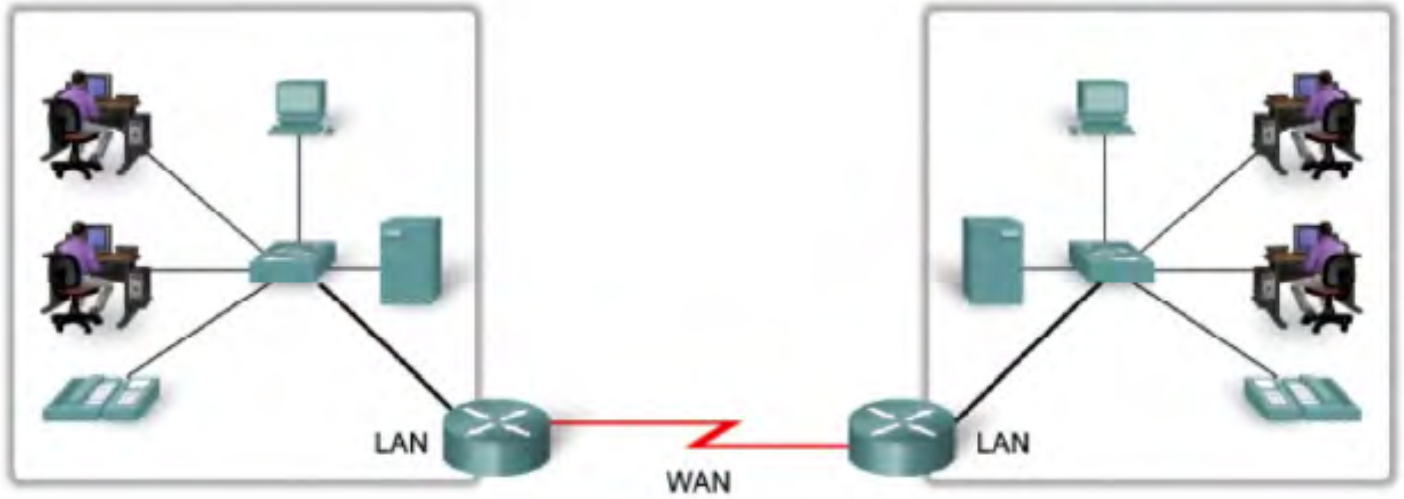
A network can be as small as two computers that are directly connected to each other or as large as the Internet with millions of devices.

Network devices

- Host Devices
- Servers
- NIC
- Communication Medium
- Router
- Switch
- Firewall
- Wireless Accesspoint
- Voice Devices

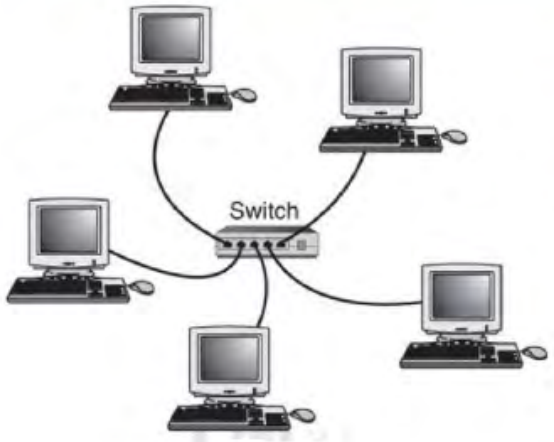
Router

Device connecting two or more LAN



Switch

Provides centralized location to connect devices with in the LAN.

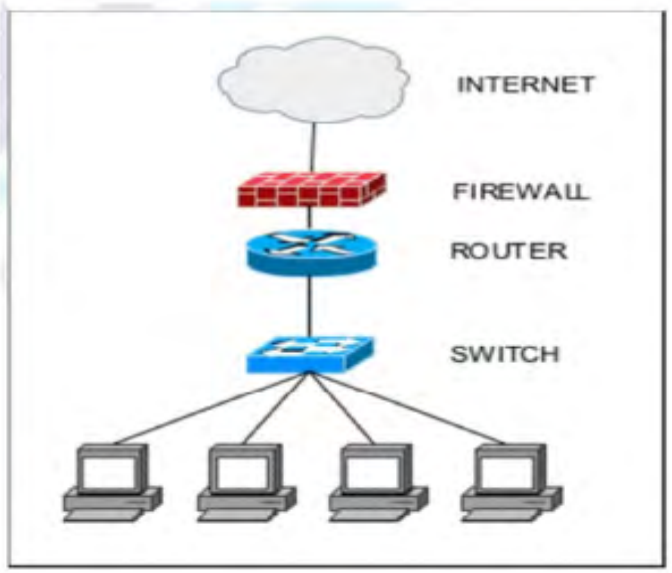


Switch

Rj45 Cable

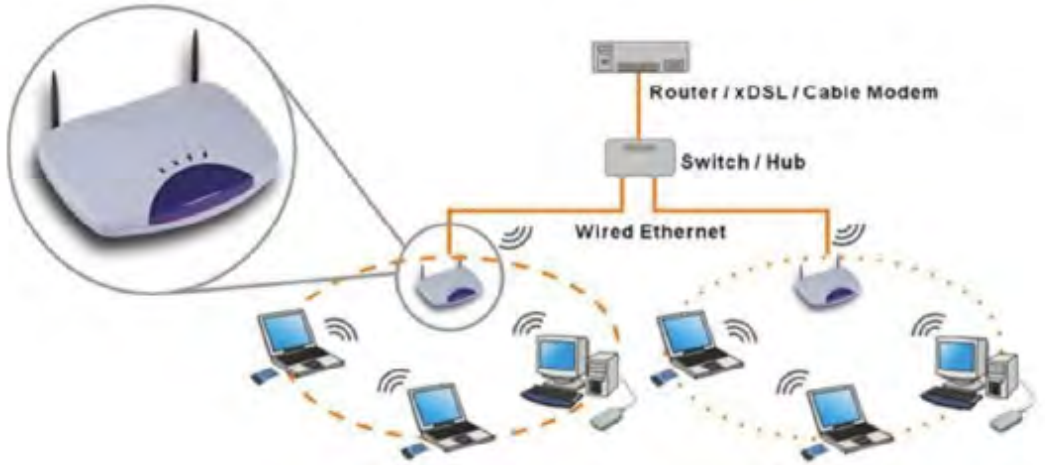
Firewall

- protects a network from unauthorized access
- controls incoming and outgoing network traffic based on a set of rules.



Wireless Access Point

- Provides centralized location to connect devices with in the LAN.
- Without wire (using RF signals)



Wireless Access Controller

- Provides centralized management of all access points in the networks.
- make it easier to manage large wireless scale deployments.
  - Example : Airports, Shopping Malls

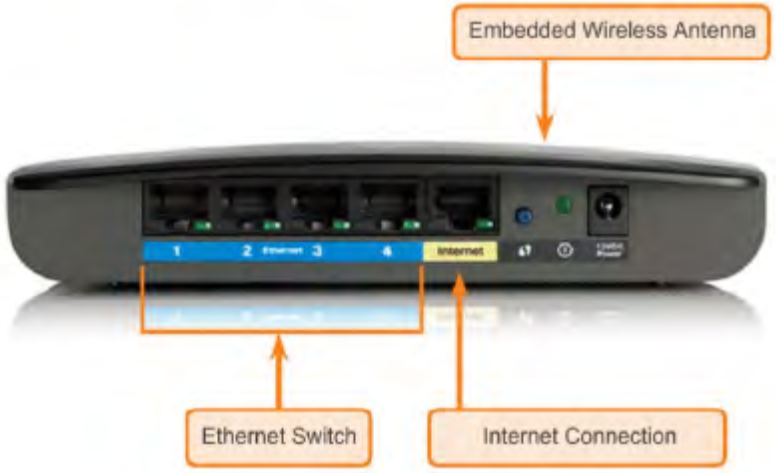
- More in depth on this in cisco you have CCNA CCNP CCIE Wireless track.

VoIP

A **VoIP** phone uses Voice over IP for placing and transmitting telephone calls over an IP network, such as the Internet, instead of the traditional public switched telephone network (PSTN).

Home Network

- Inbuilt Switch , Router, wireless AP
- Applicable for small home/office networks



Protocol

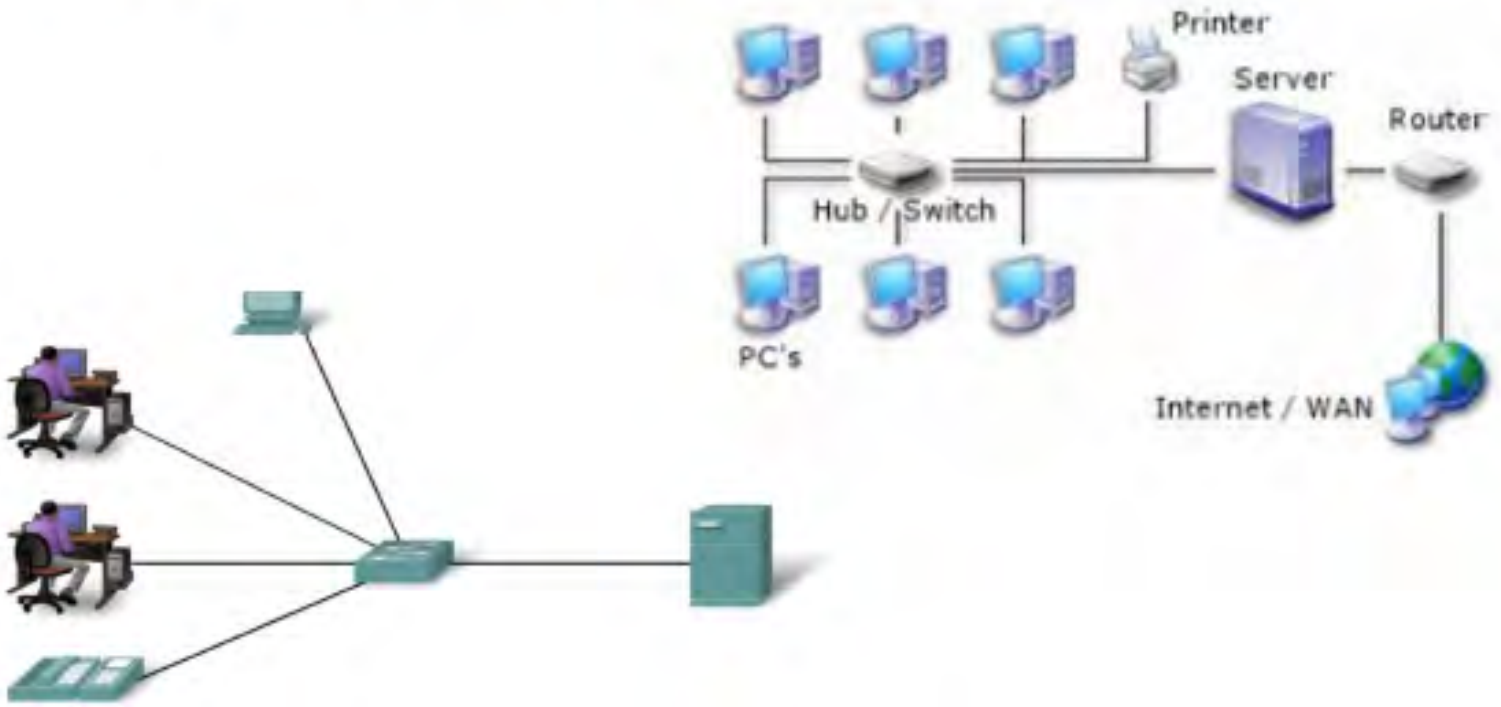
set of rules to follow to have proper communication.

Network protocols

- TCP/IP (DoD)
- IPx/SPx (Novell)
- Appletalk (Apple)
- Netbios (Microsoft)
- OSI (ISO)

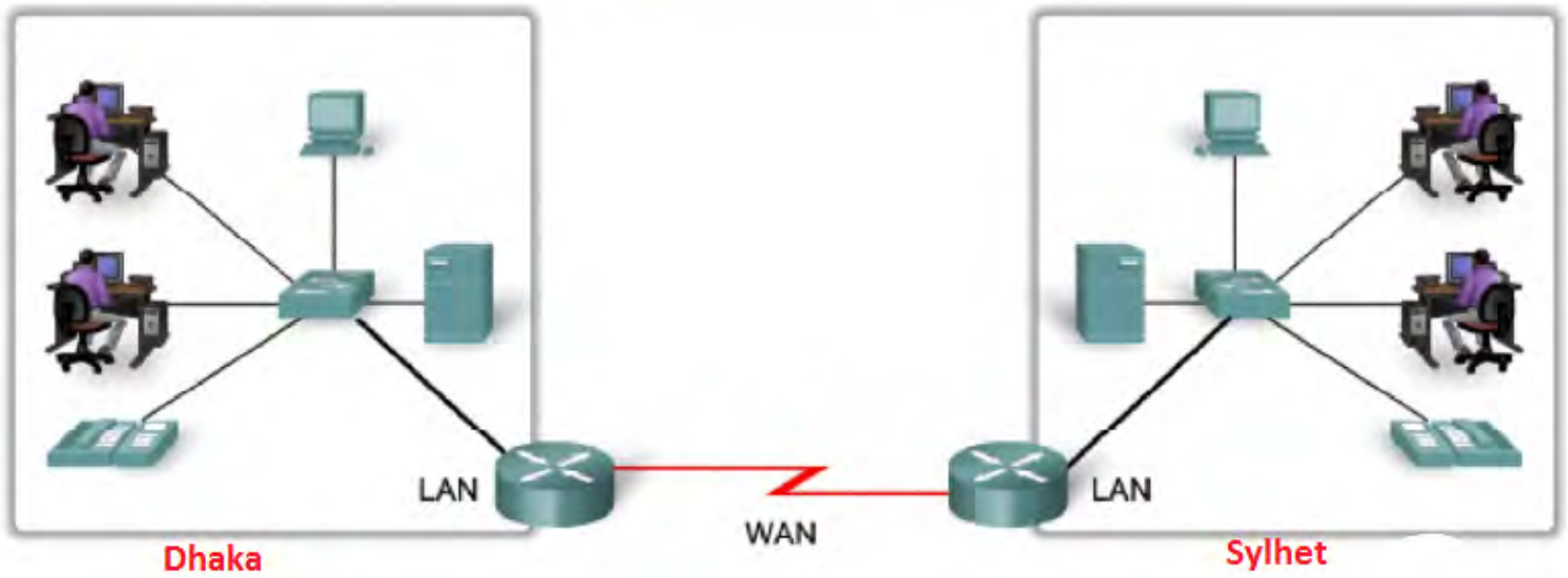
LAN

Set of devices connected with the same location (office/building)



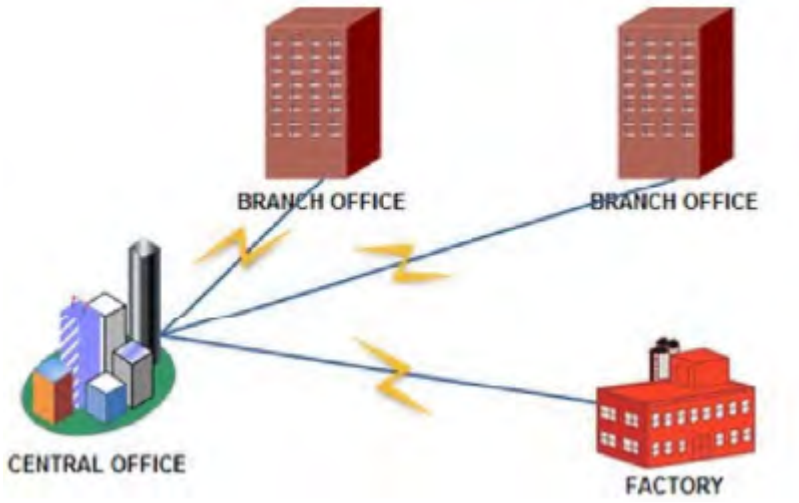
WAN

- Set of devices connected in two or more different locations.
- Two or more LAN.



MAN

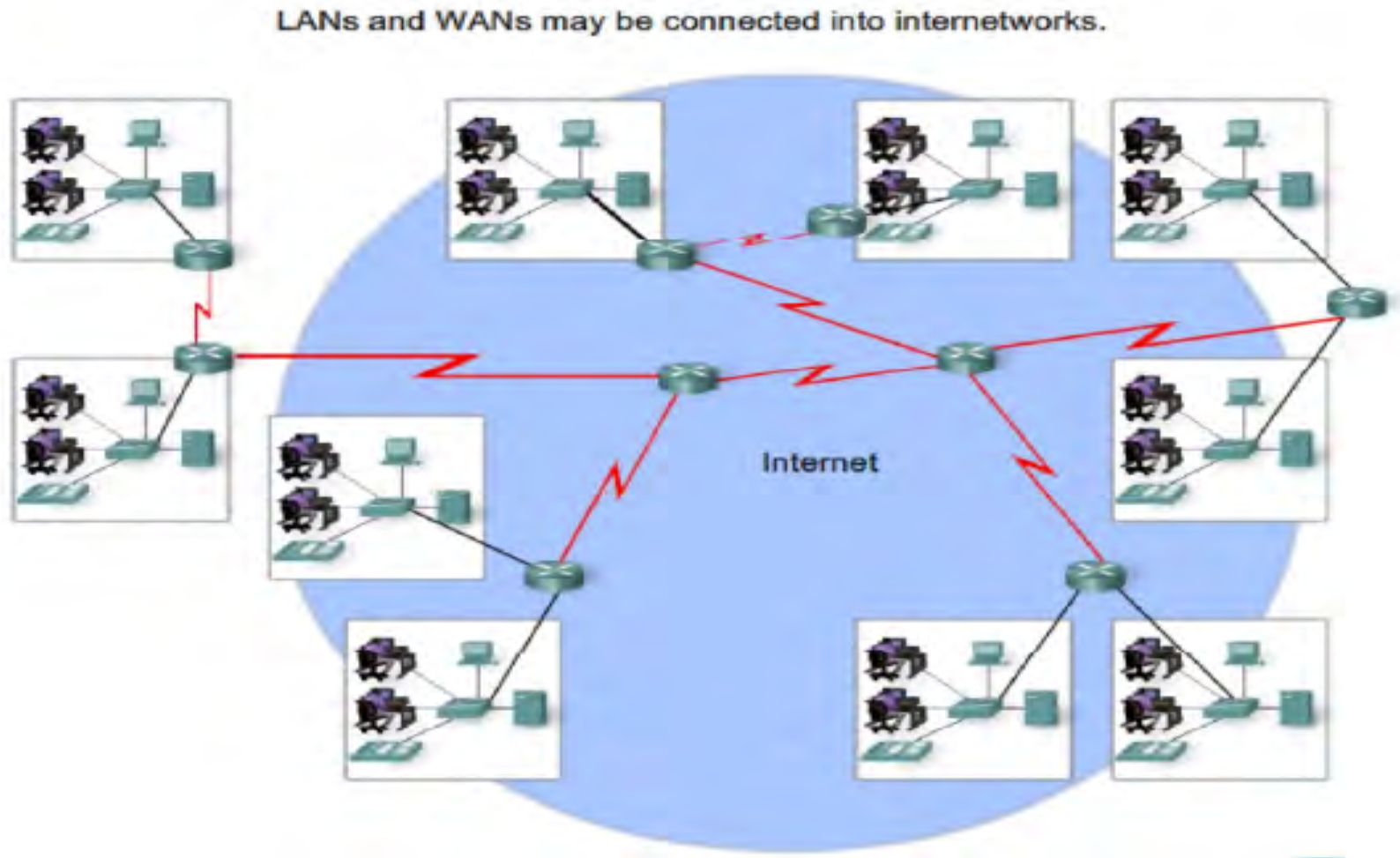
Set of devices connected in city limits



PAN

two or more computer systems with in 4 to 6 meters.

Internet

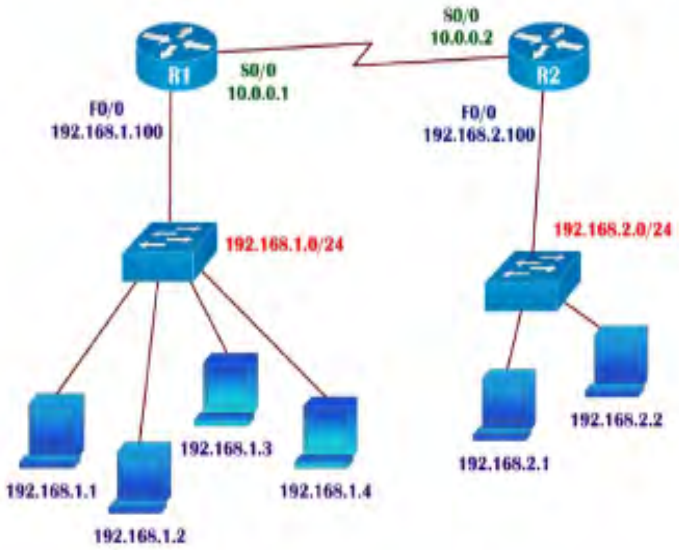

LANs and WANs may be connected into internetworks.
Internet

What is TCP/IP?

- TCP/IP is a standard protocol used between computers and network devices for communication.
- Internet work based on TCP/IP

TCP/IP Addressing

- IP Address is Logical Address given to each and every device in the network.
- IP address used to identify specific device in the network.

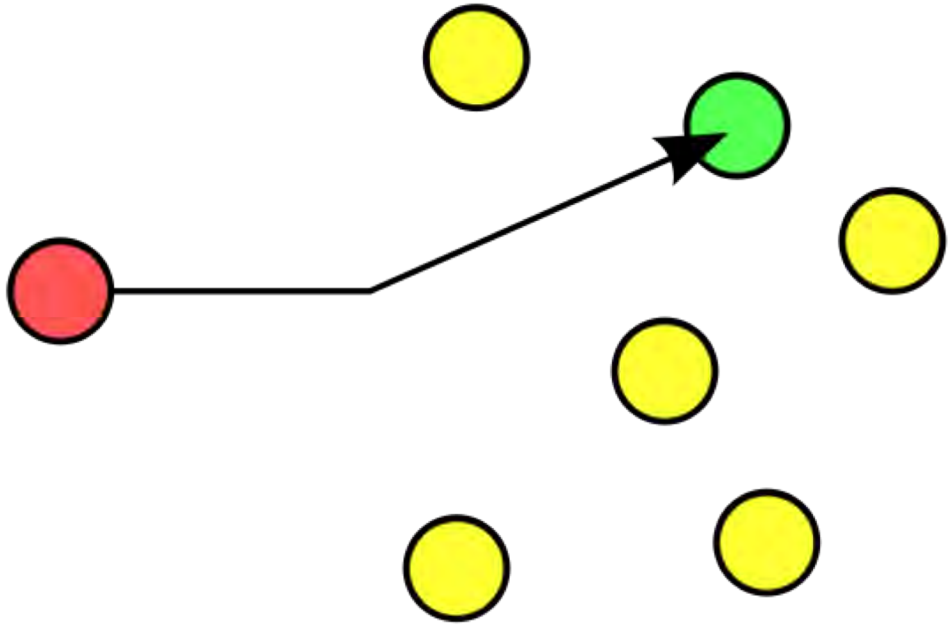


Types of Communication

- In an IPv4 network hosts can communicate one of three different ways-
    - Unicast
    - Broadcast
    - Multicast

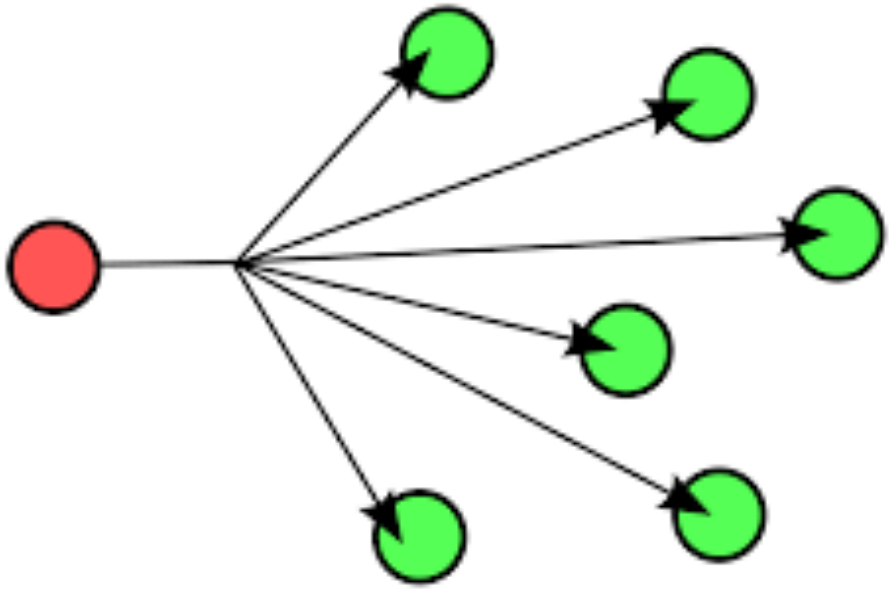
Unicast

- Process of sending a packet from one host to an individual host.



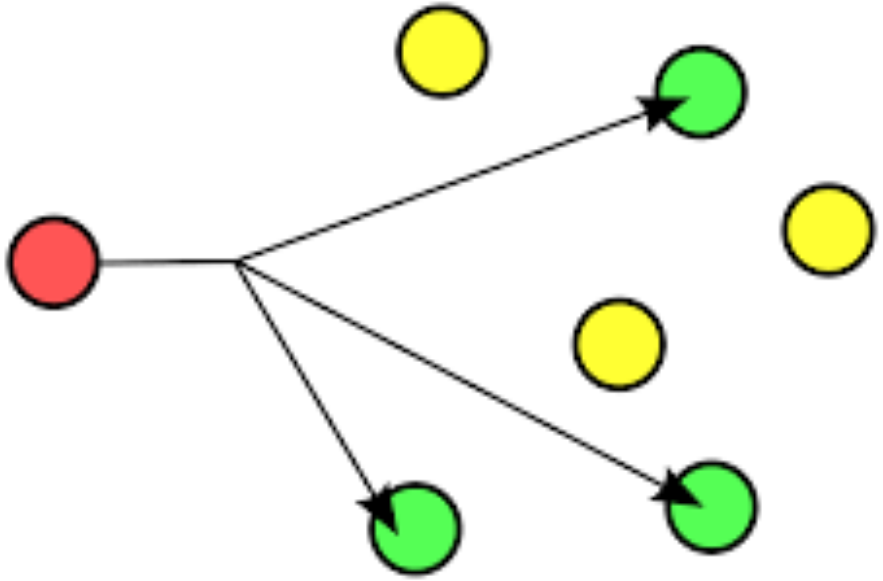
Broadcast

- The process of sending packet one to all hosts in the Network.



Multicast

- The process of sending packet from one host to a selected group of hosts, Possibly in different Network

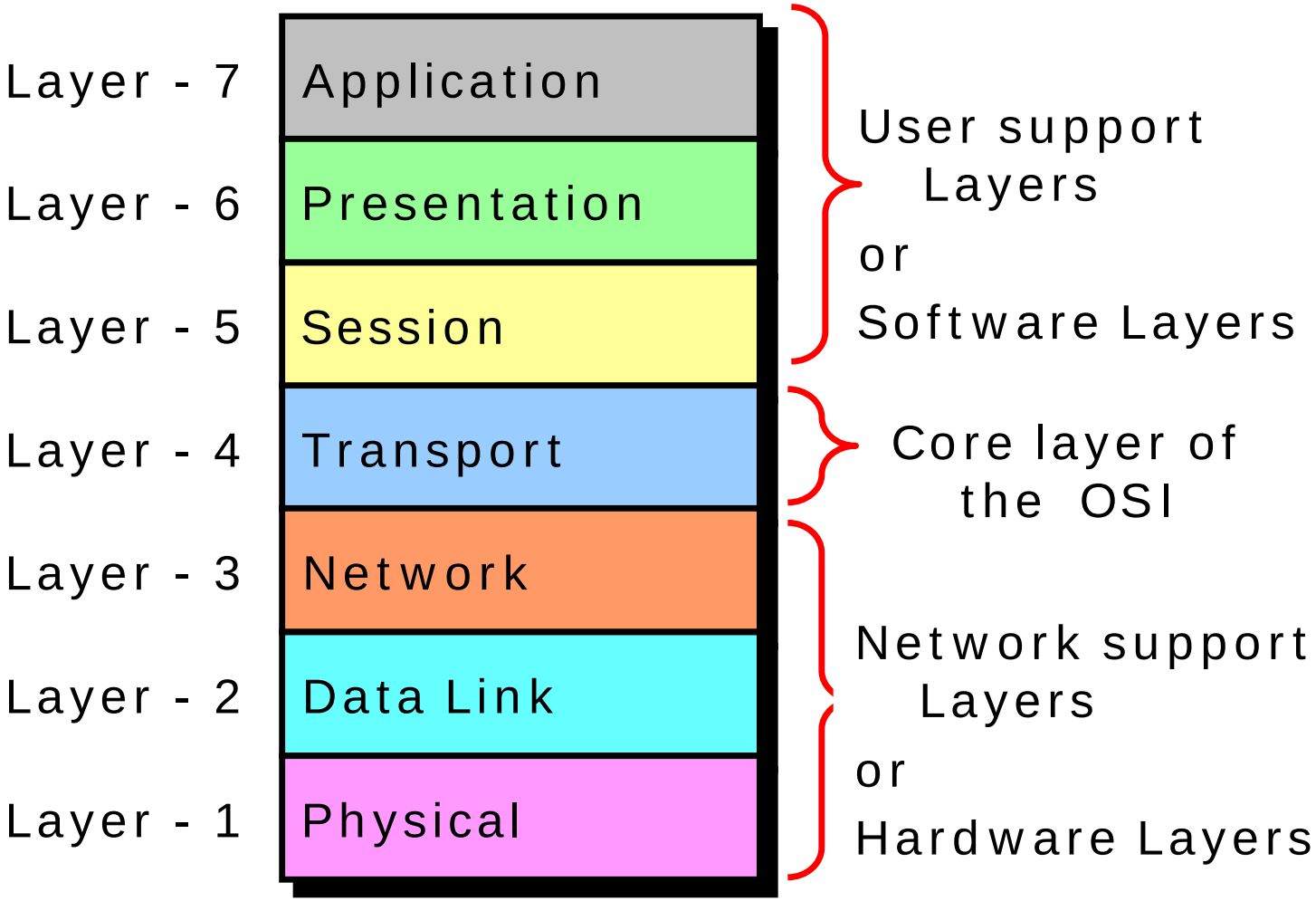


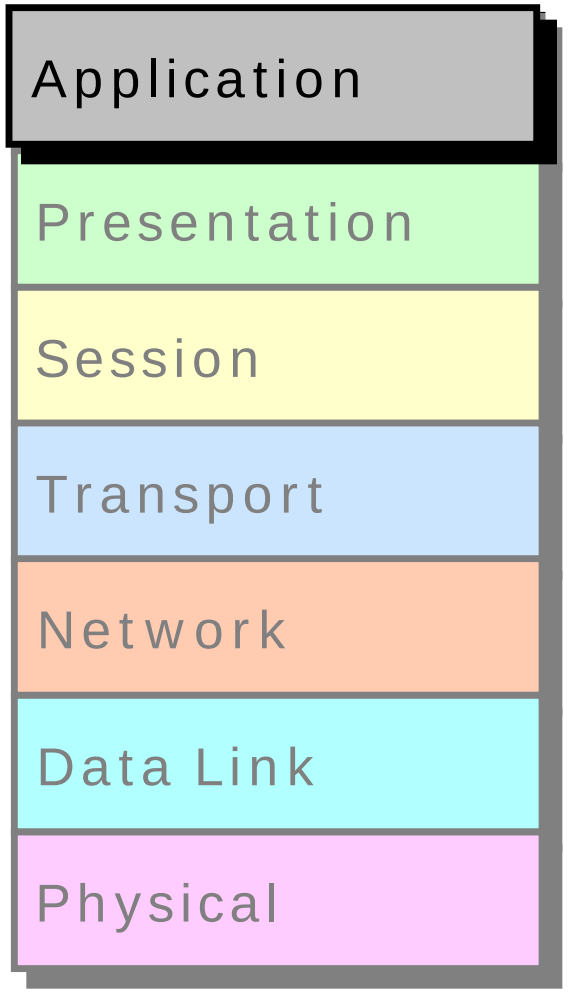
Media Types

1. Copper Cables (UTP & Co-axial)
2. Fiber Optic Cables
3. Wireless (RFsignal)

OSI Model

- OSI was developed by the International Organization for Standardization (ISO) and introduced in 1984.
- It is a layered architecture (consists of seven layers).
- Each layer defines a set of functions which takes part in data communication.

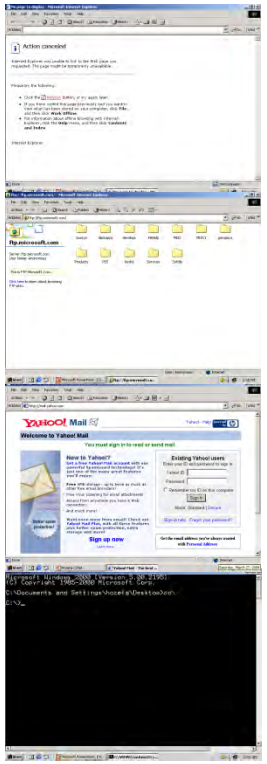

Layer - 7
Application
Layer - 6
Presentation
Layer - 5
Session
Layer - 4
Transport
Layer - 3
Network
Layer - 2
Data Link
Layer - 1
Physical
User support Layers
or
Software Layers
Core layer of the OSI
Network support Layers
or
Hardware Layers

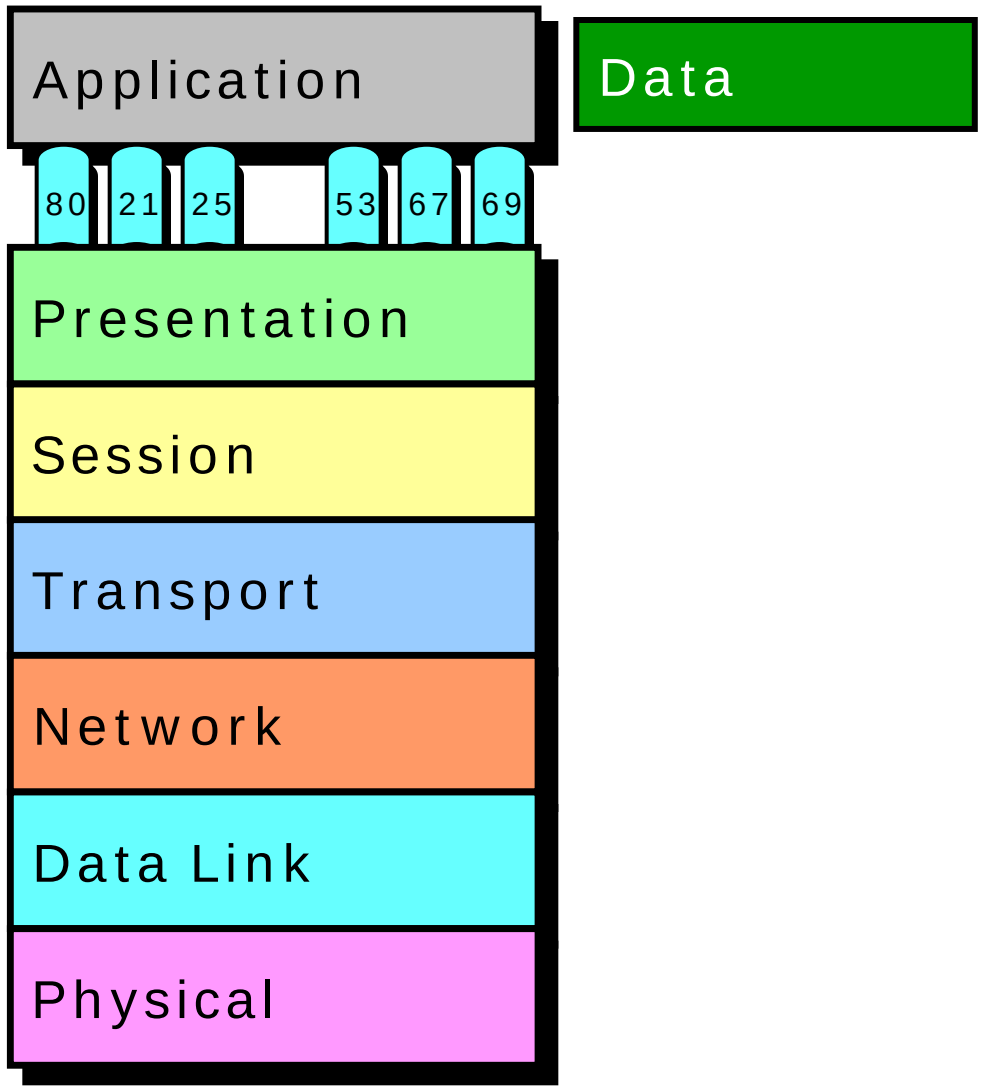


Application Layer is responsible for providing an interface for the users to interact with application services or Networking Services .

Ex: Web browser, Telnet etc.

Service	Port No.
HTTP	80
FTP	21
SMTP	25
TELNET	23
TFTP	69




Application
Data
80
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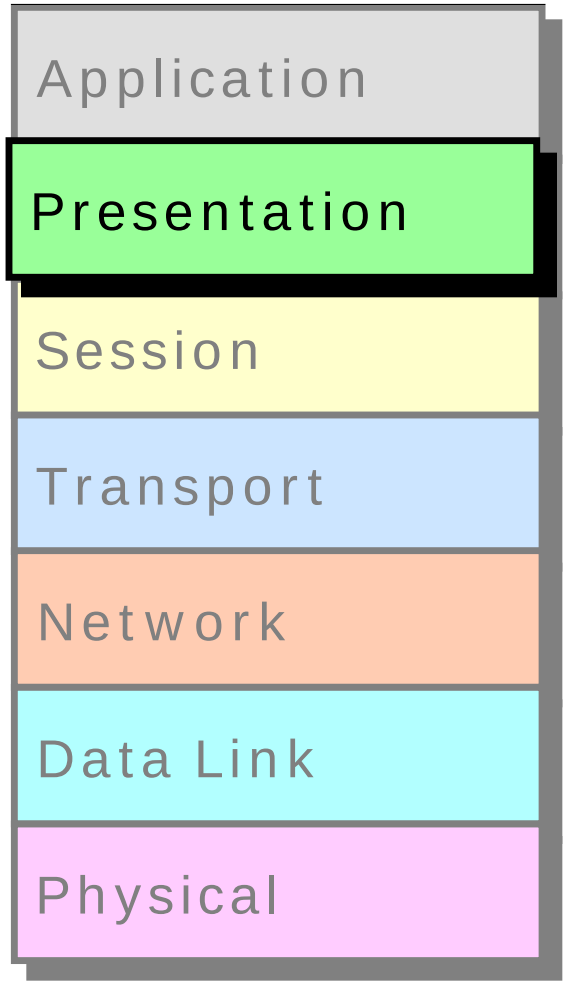
67
69
Presentation
Session
Transport
Network
Data Link
Physical



Presentation Layer It is responsible for defining a standard format to the data.

It deals with data presentation.

The major functions described at this layer are..

Encoding – Decoding

Ex: ASCII, EBCDIC (Text)

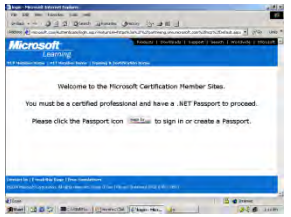
JPEG,GIF,TIFF (Graphics)

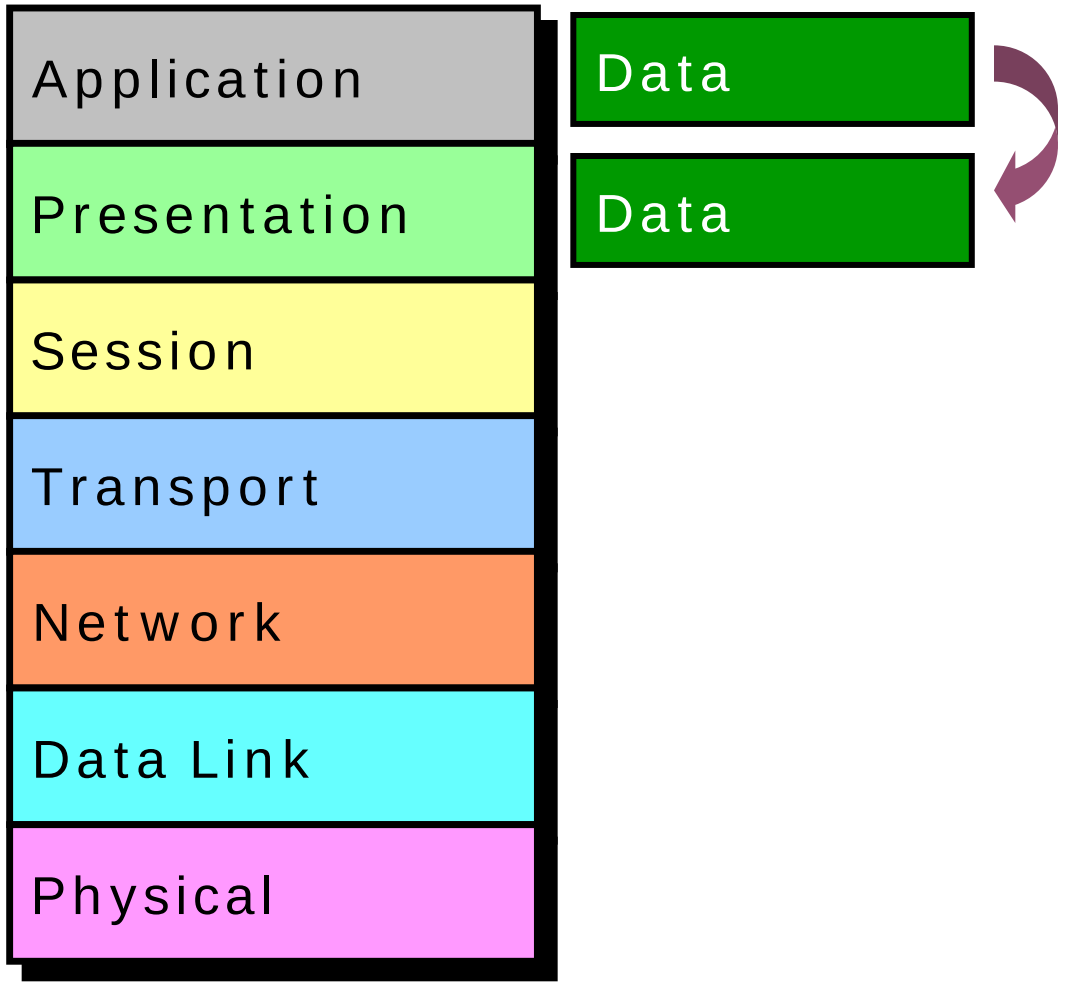
MIDI,WAV (Voice)

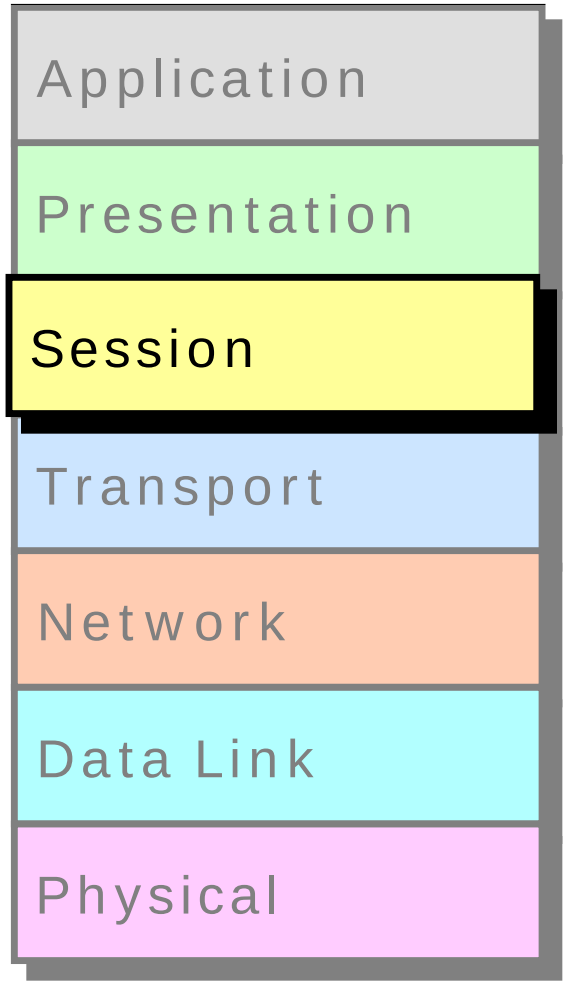
MPEG,DAT,AVI (Video)

Encryption – Decryption

Compression – Decompression




Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data



Session Layer

It is responsible for establishing, maintaining and terminating the sessions.

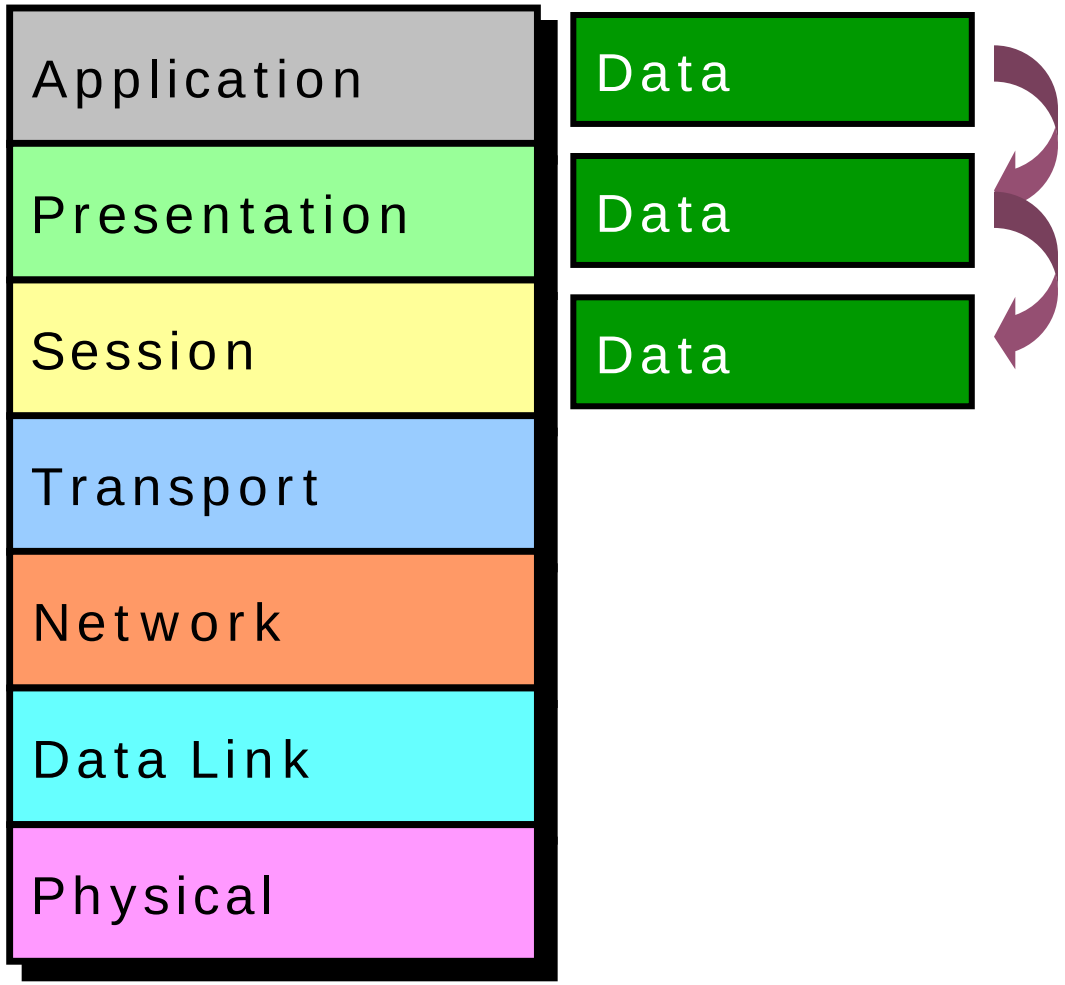
Session ID is used to identify a session or interaction.

Examples :

RPC → Remote Procedural Call

SQL → Structured Query Language

ASP → AppleTalk Session protocol


Application
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Data Link
Physical
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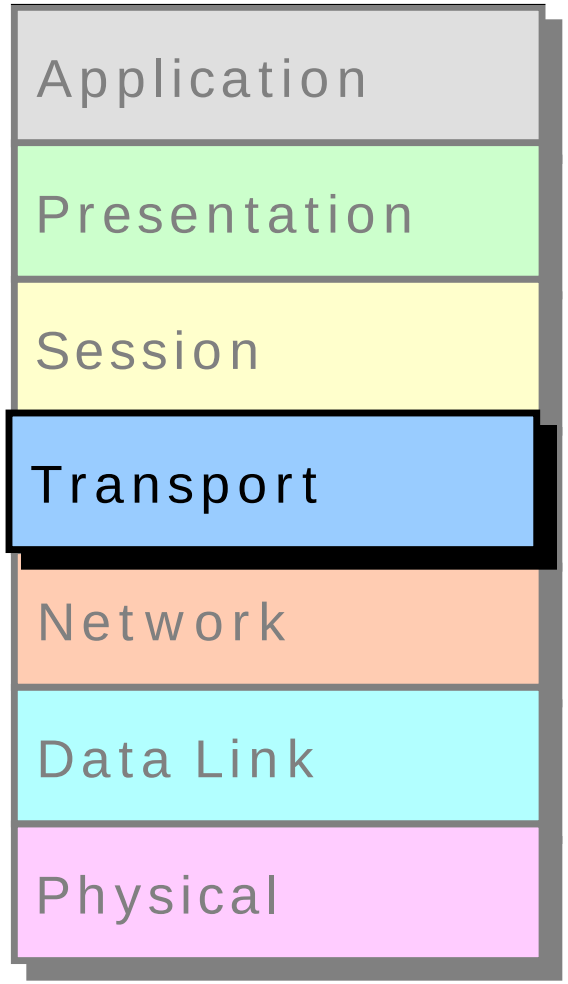


Transport Layer

It provides data delivery mechanism between the applications in the network.

The major functions described at the Transport Layer are..

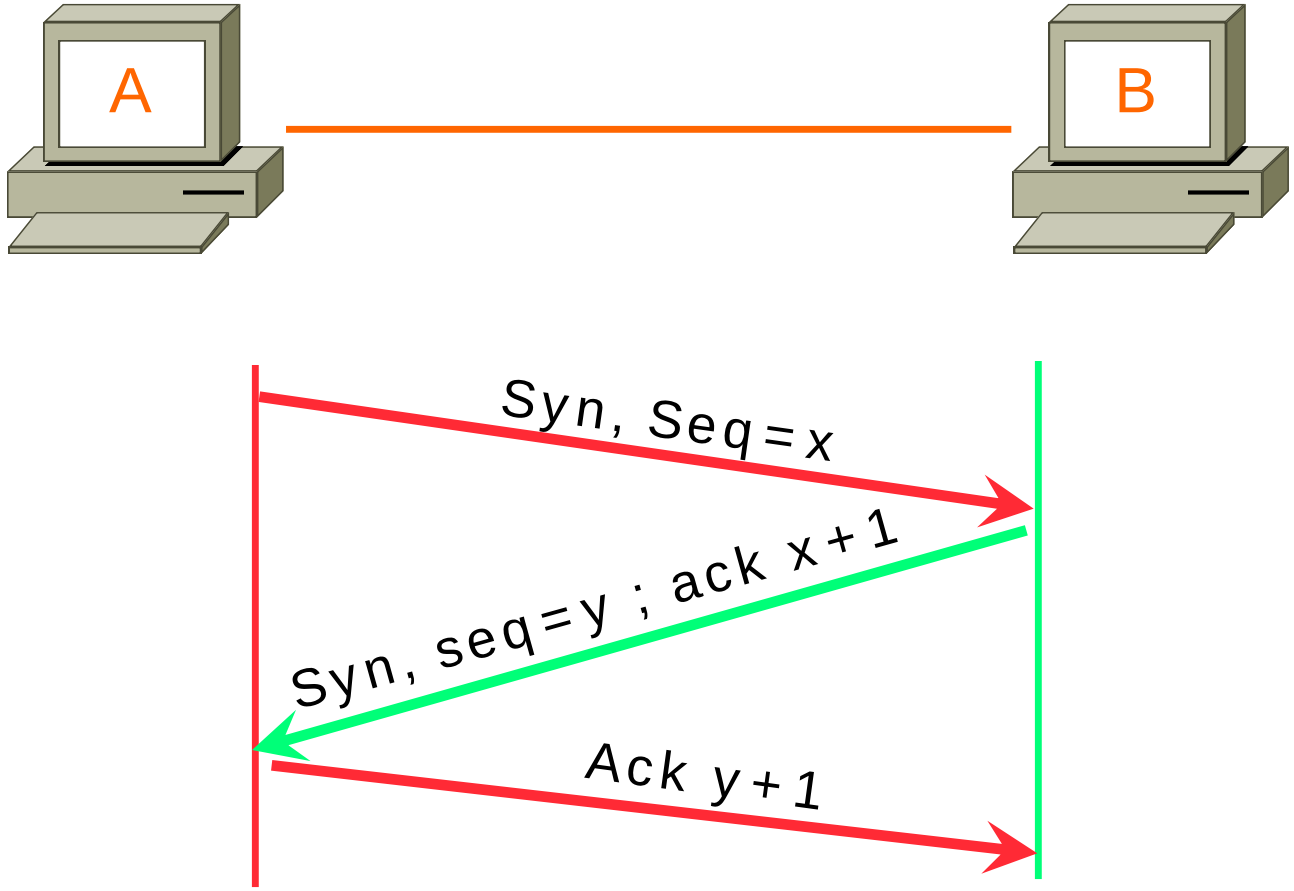
- Identifying Service
- Multiplexing & De-multiplexing
- Segmentation
- Sequencing & Reassembling
- Error Correction
- Flow Control

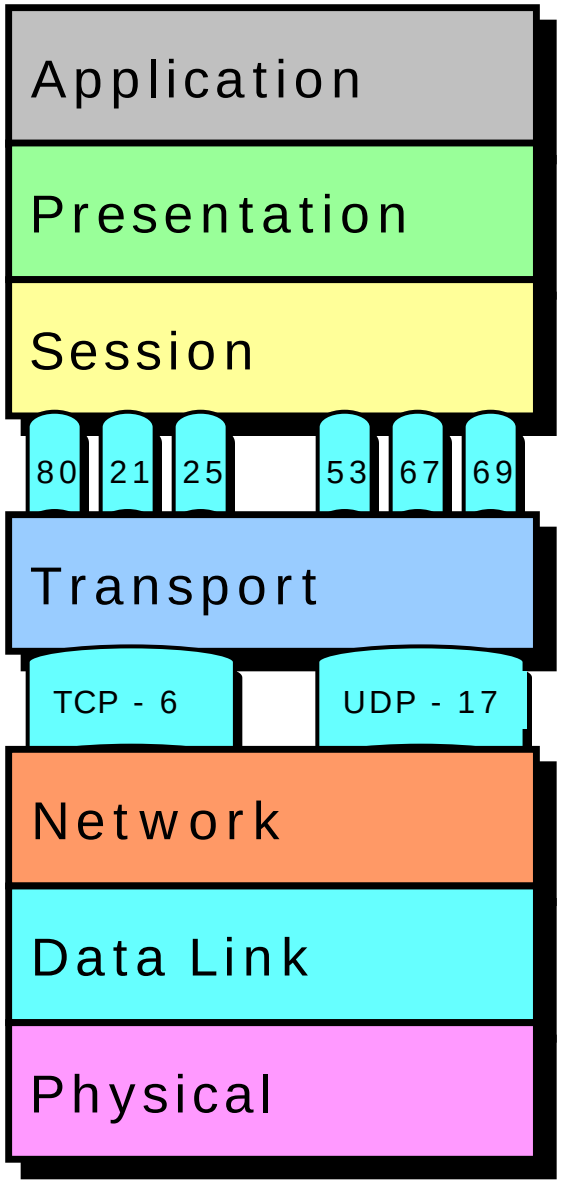
- Identification of Services is done using Port Numbers.
- Port is a logical communication Channel

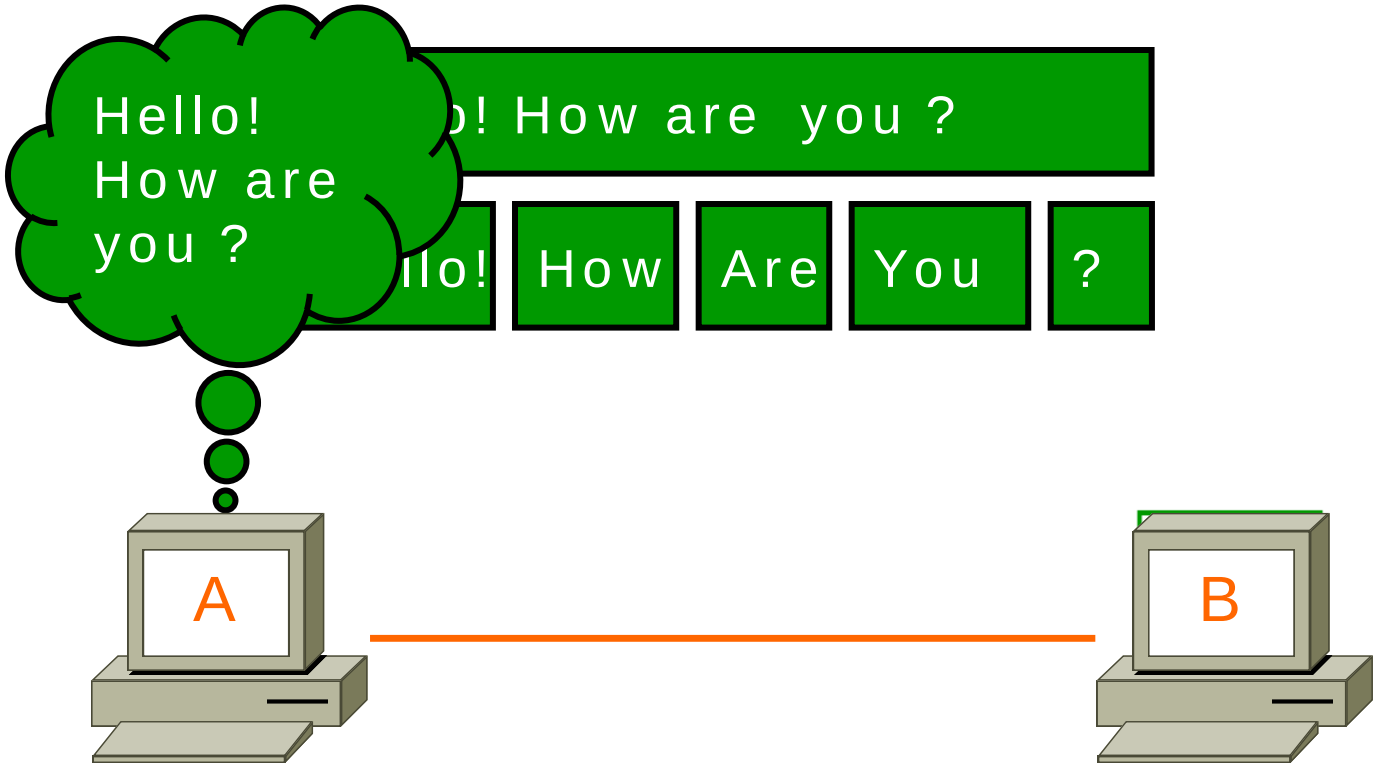
Total No. Ports	0 – 65535
Server Ports	1 - 1023
Client Ports	1024 – 65535

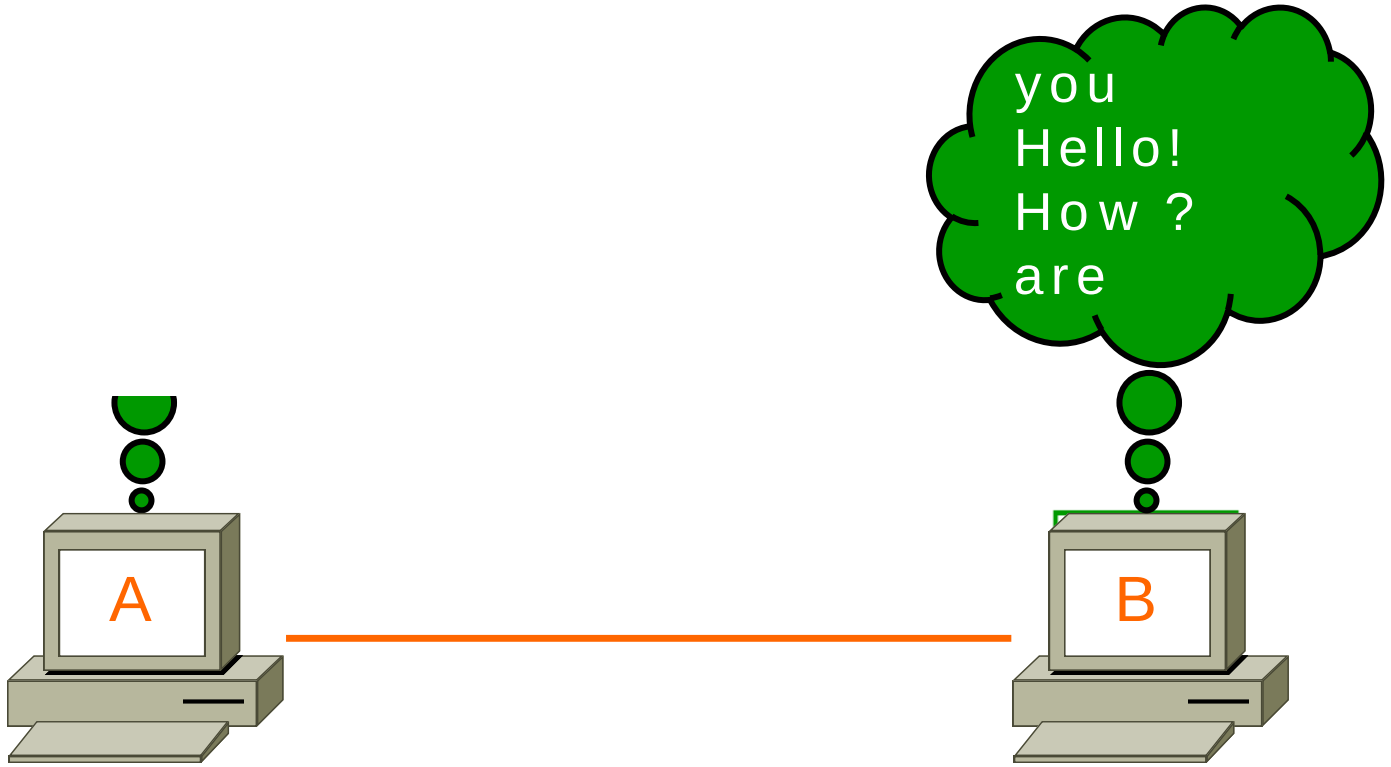
- The protocols which takes care of Data Transportation at Transport layer are...TCP,UDP

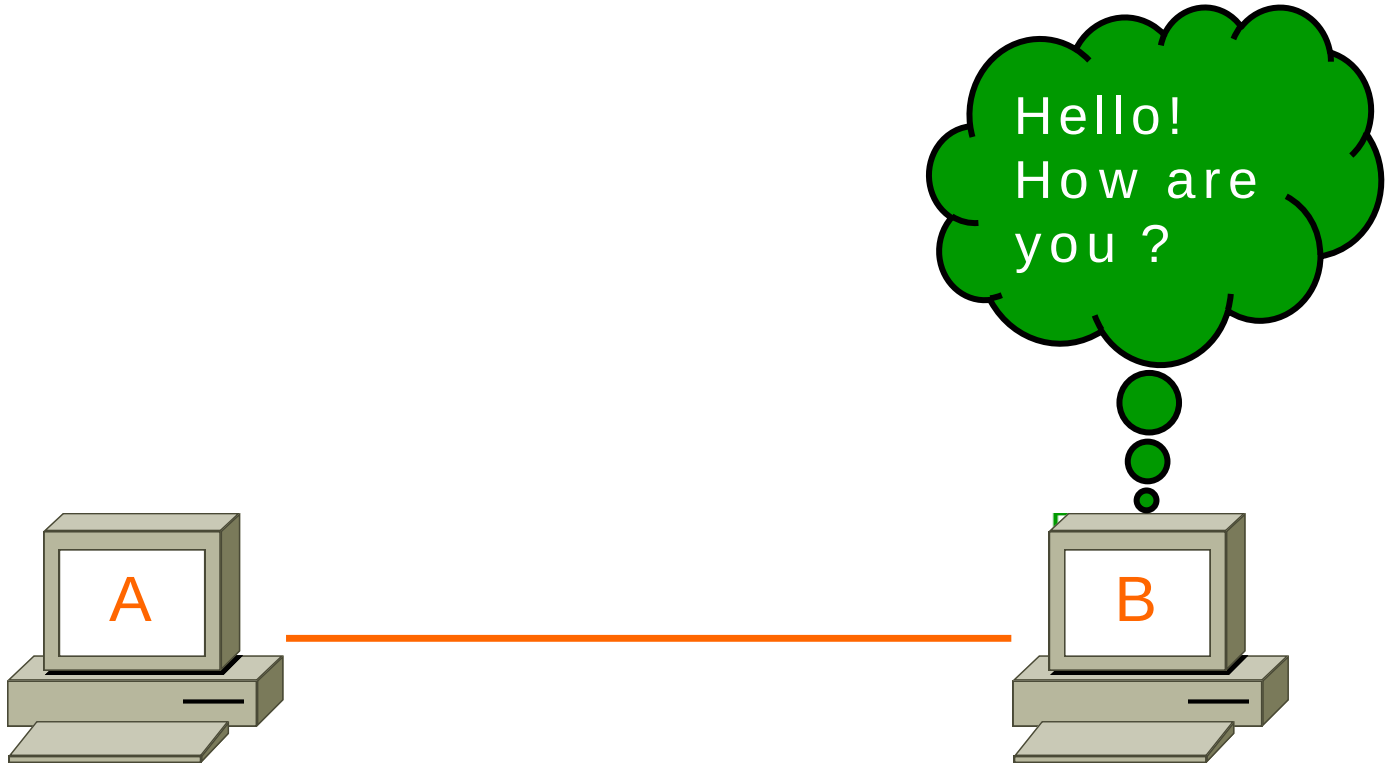
TCP	UDP
• Transmission Control Protocol • Connection Oriented • Supports Ack's • Reliable communication • Slower data Transportation • Protocol No is 6 Eg: HTTP, FTP, SMTP	• User Datagram Protocol • Connection Less • No support for Ack's • Unreliable communication • Faster data Transportation • Protocol No is 17 Eg: DNS, DHCP, TFTP

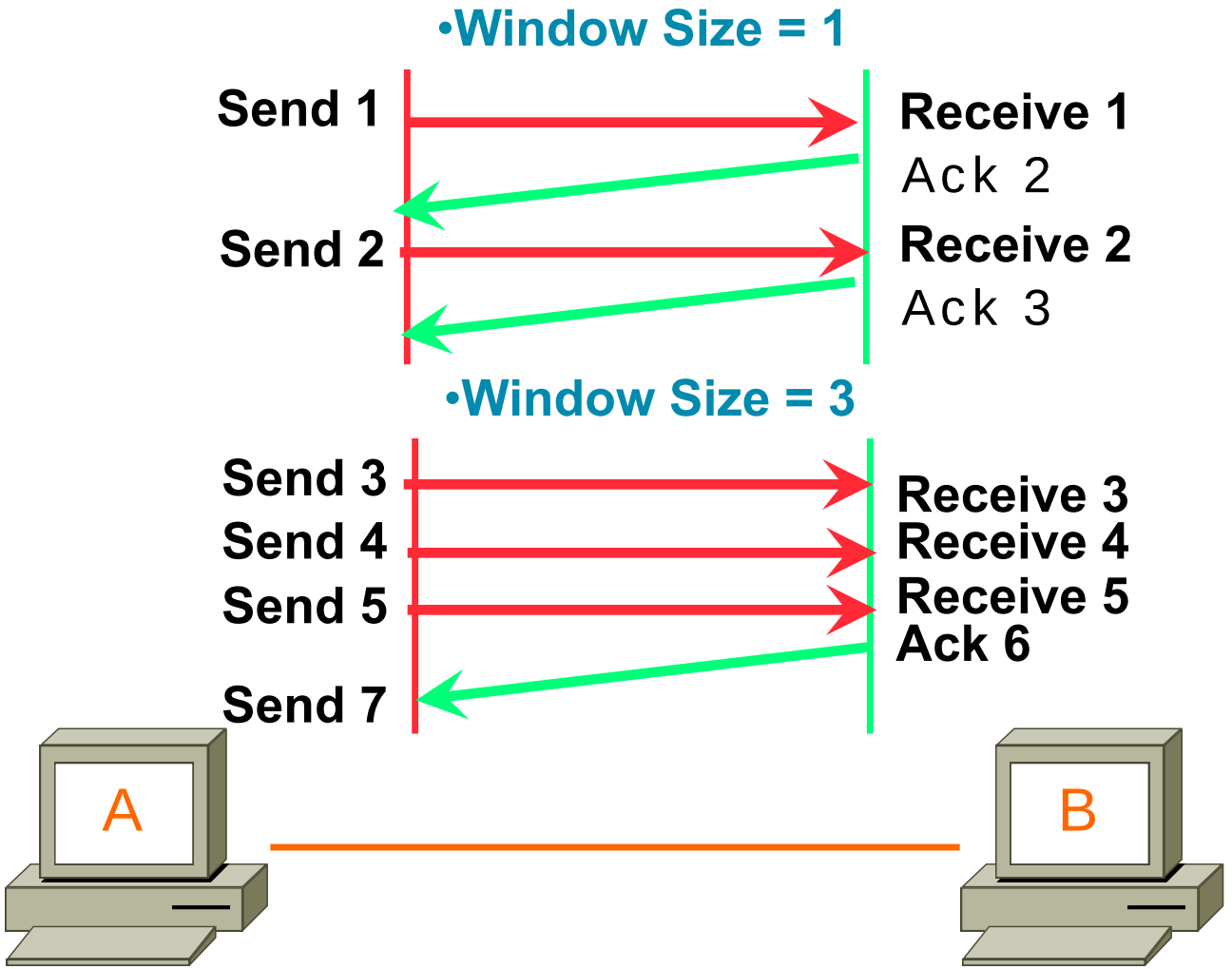

A
B
Syn, Seq=x
Syn, seq=y ; ack x+1
Ack y+1

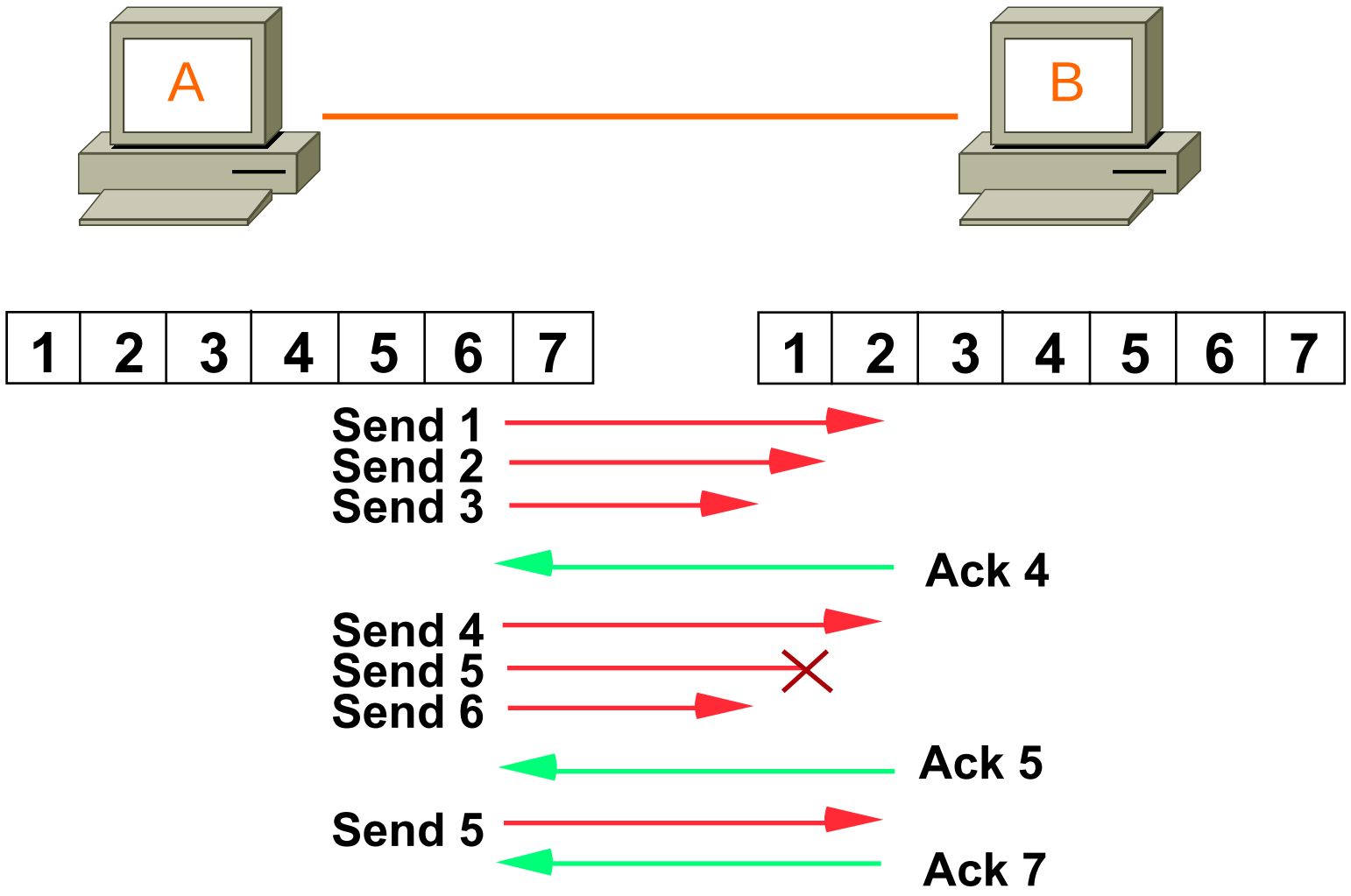

Application
Presentation
Session
80
21
25
53
67
69
Transport
TCP - 6
UDP - 17
Network
Data Link
Physical

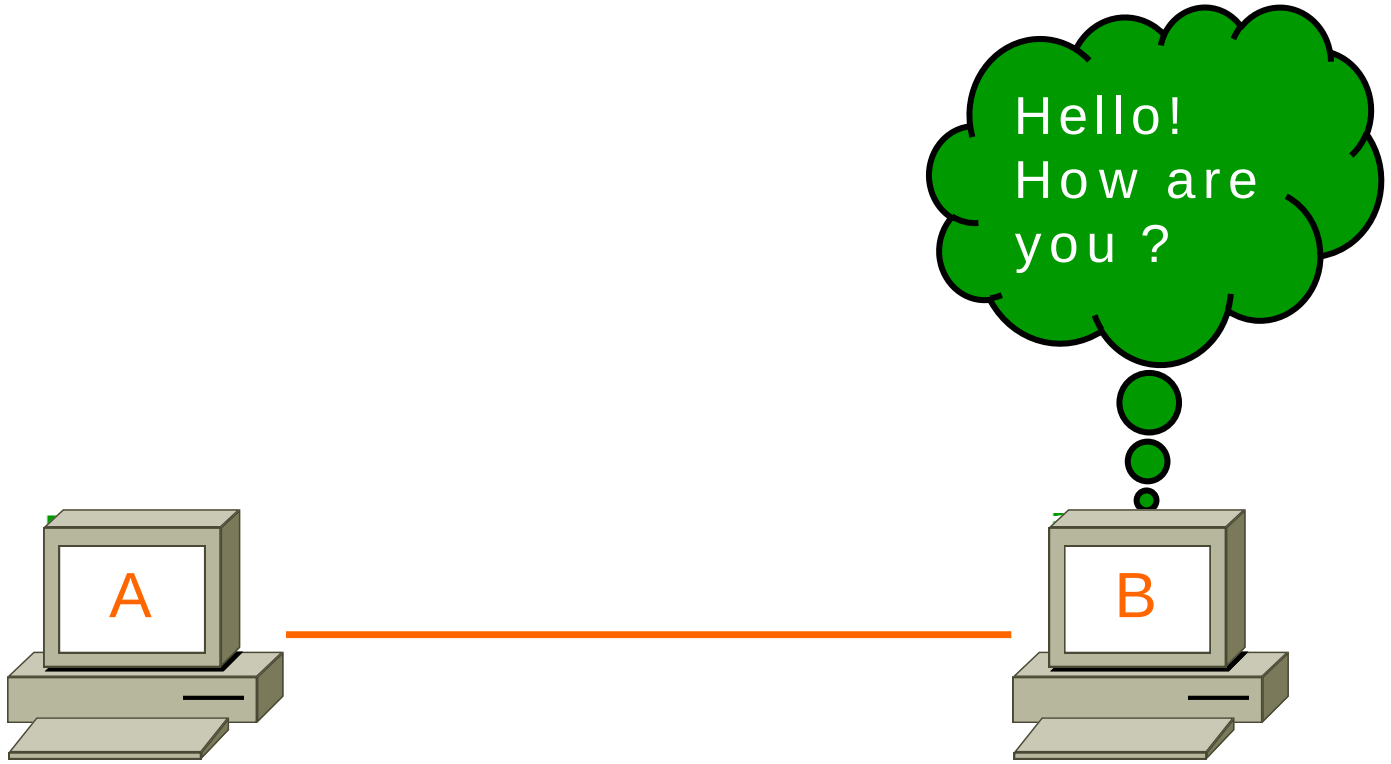

Hello!
How are
you ?
o! How are you ?
llo!
How
Are
You
?
A
B

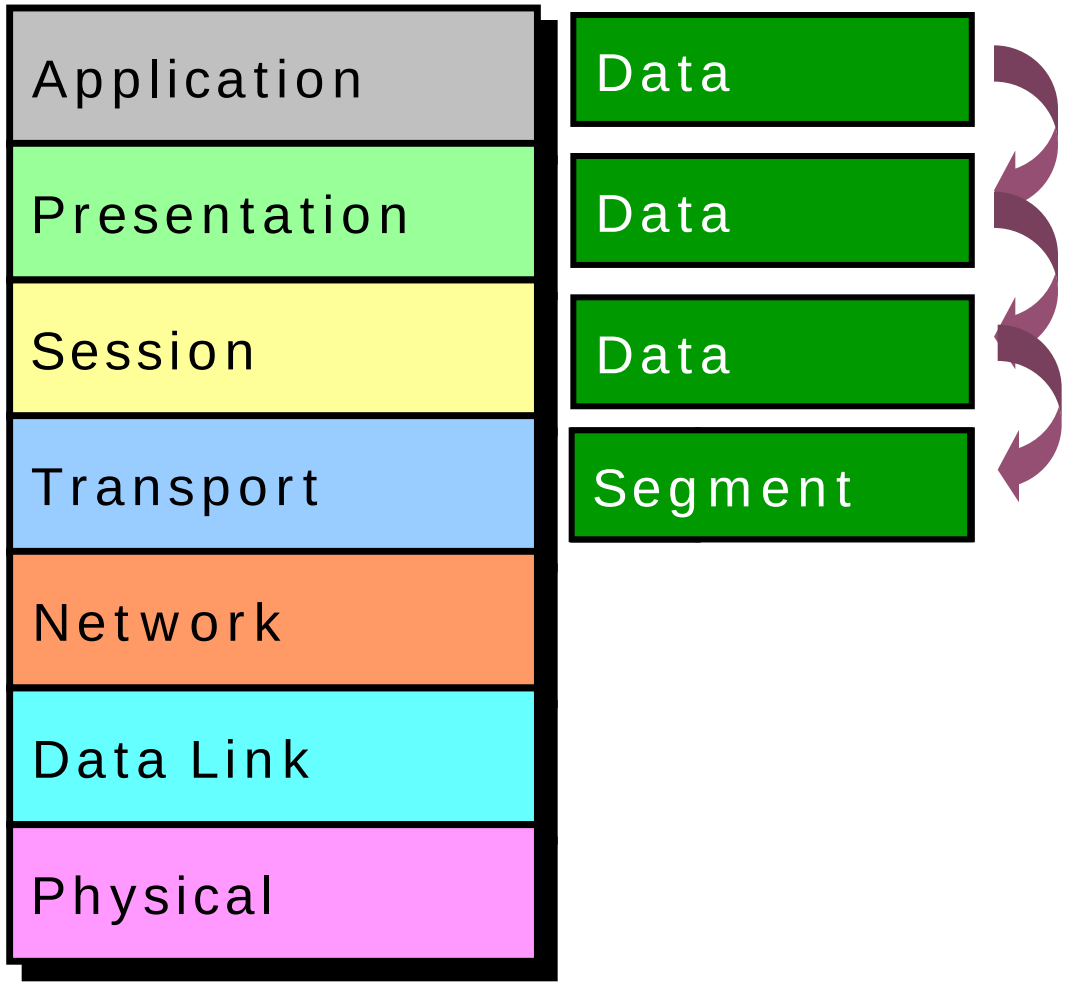

you
Hello!
How ?
are
A
B

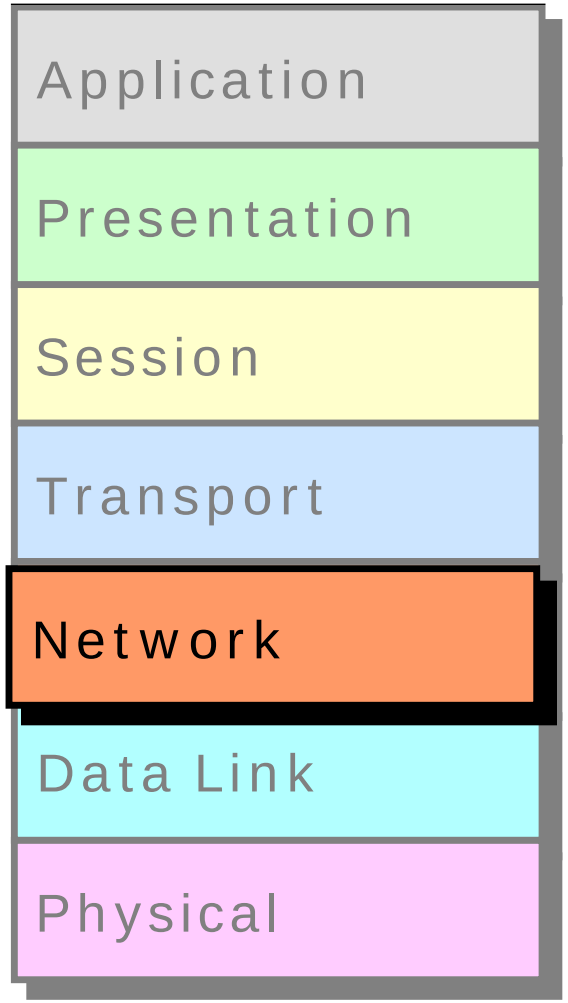

Hello!
How are
you ?
A
B


•Window Size = 1
Send 1
Receive 1
Ack 2
Send 2
Receive 2
Ack 3
•Window Size = 3
Send 3
Send 4
Send 5
Send 7
Receive 3
Receive 4
Receive 5
Ack 6
A
B


A
B
1 2 3 4 5 6 7
1 2 3 4 5 6 7
Send 1
Send 2
Send 3
Ack 4
Send 4
Send 5
Send 6
Ack 5
Send 5
Ack 7


Hello!
How are
you ?
A
B


Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data
Data
Segment



Network Layer

It provides Logical addressing & Path determination (Routing) in this layer.

The protocols that work in this layer are:

Routed Protocols:

IP, IPX, AppleTalk.. Etc

Routed protocols used to carry user data between hosts.

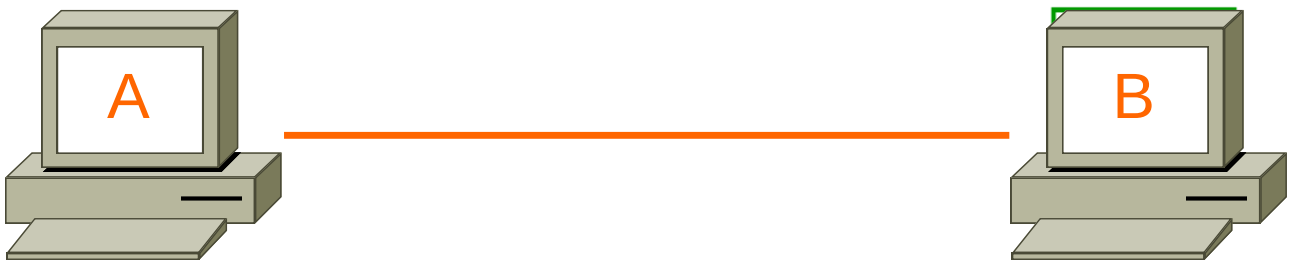
Routing Protocols:

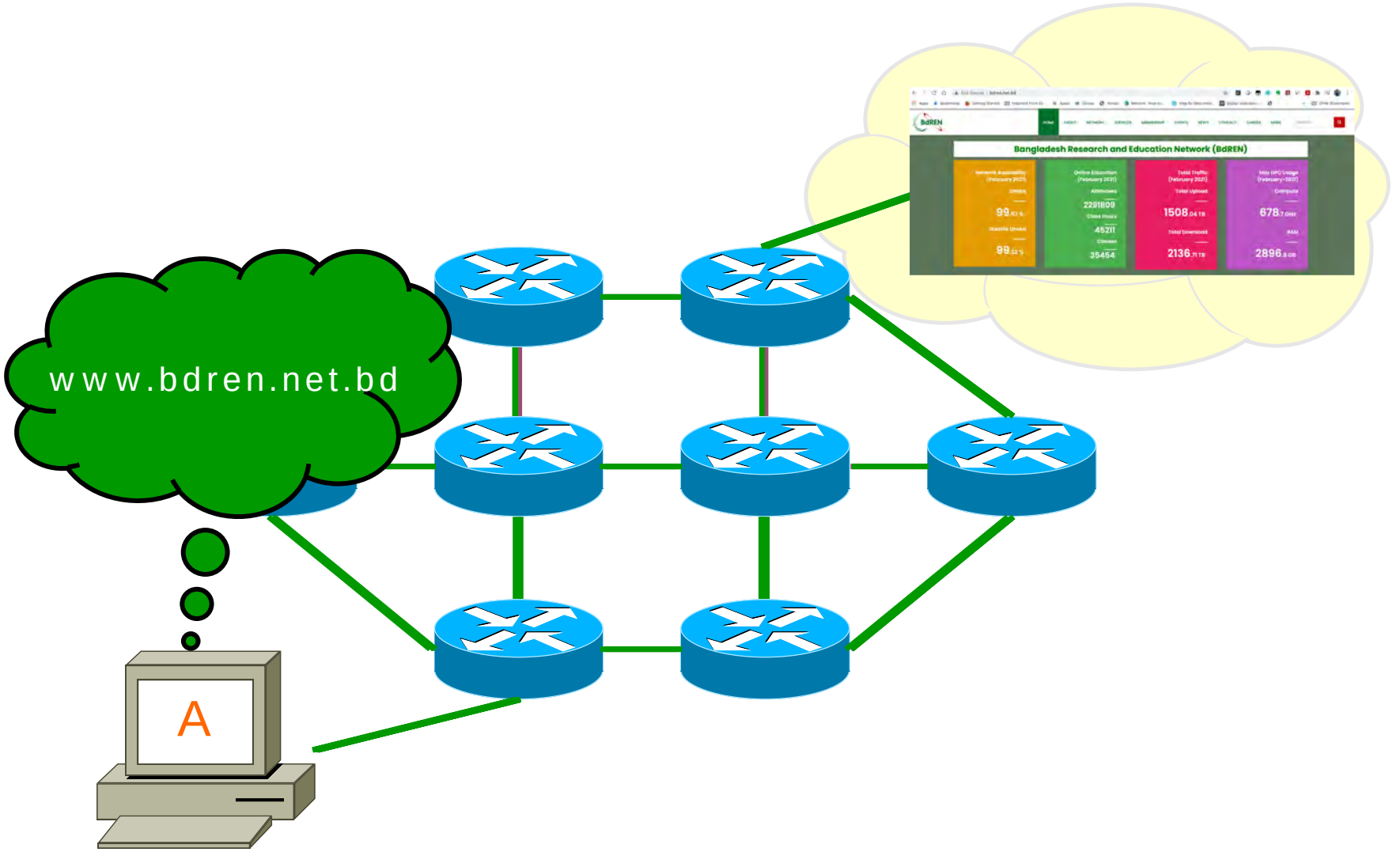
RIP, OSPF.. Etc

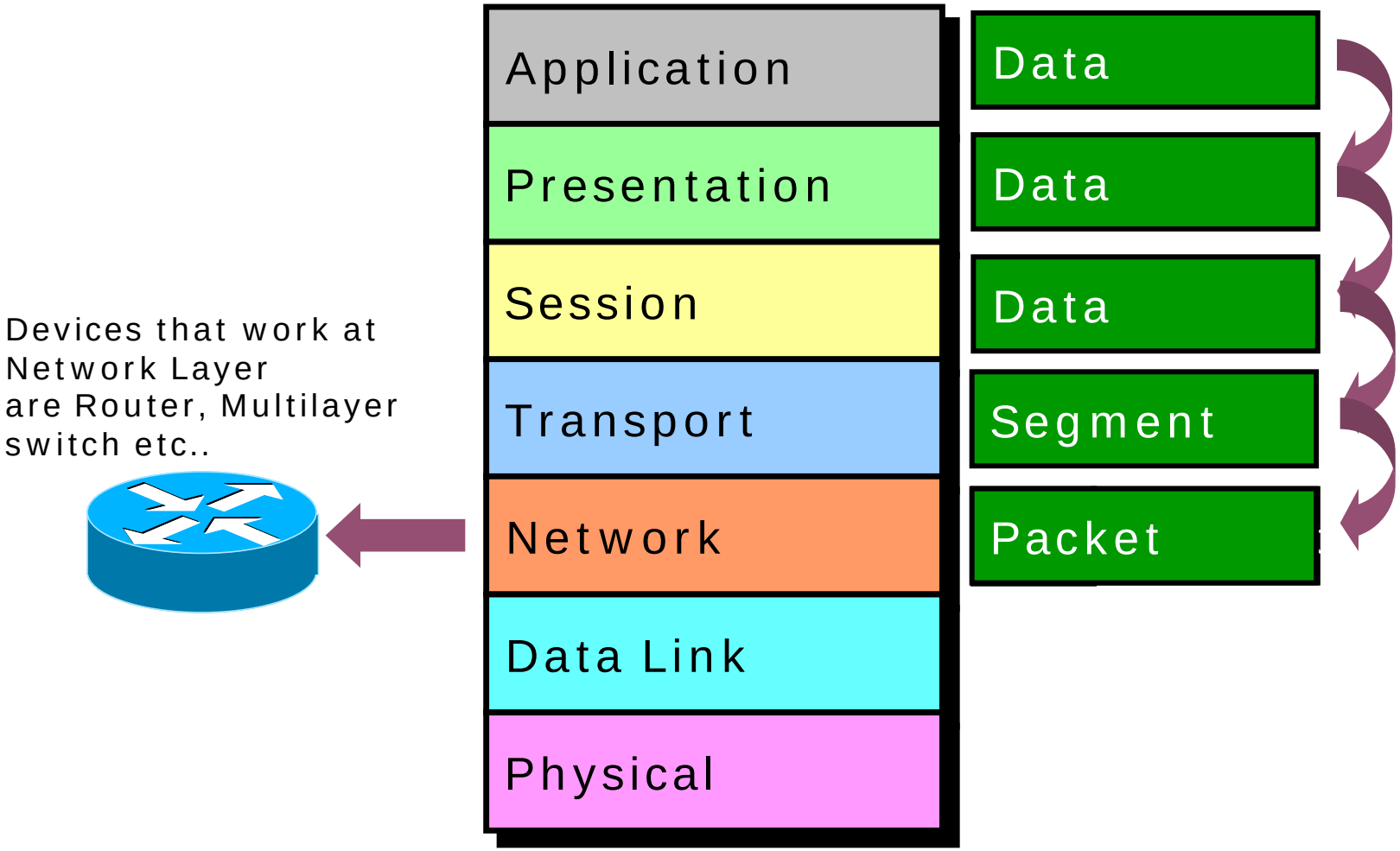
Routing protocols performs Path determination (Routing).

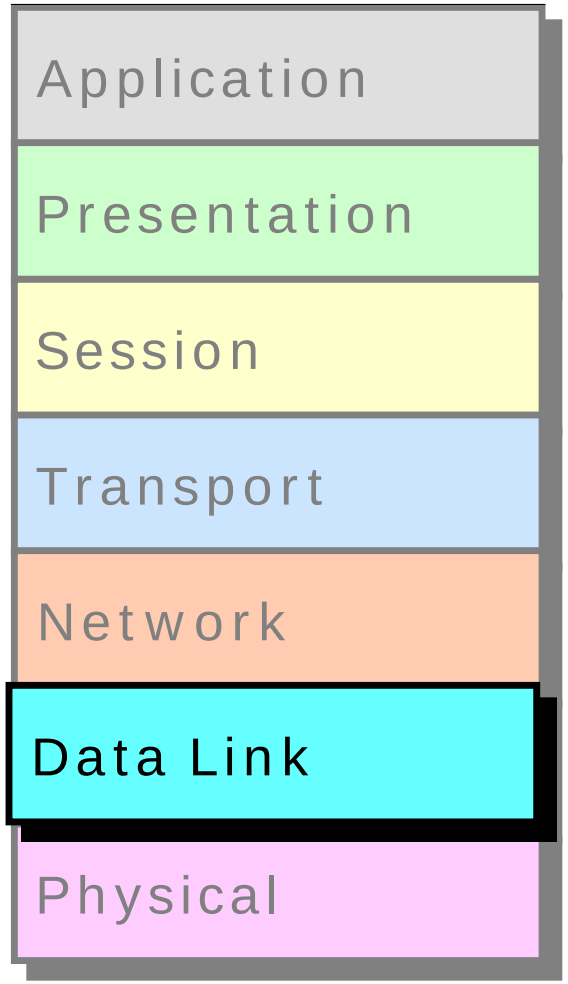
Transport

Network




www.bdren.net.bd
A
Bangladesh Research and Education Network (BdREN)


Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data
Data
Segment
Packet
Devices that work at
Network Layer
are Router, Multilayer
switch etc..



Datalink Layer

It has 2 sub layers

- MAC (Media Access Control) It provides reliable transit of data across a physical link.

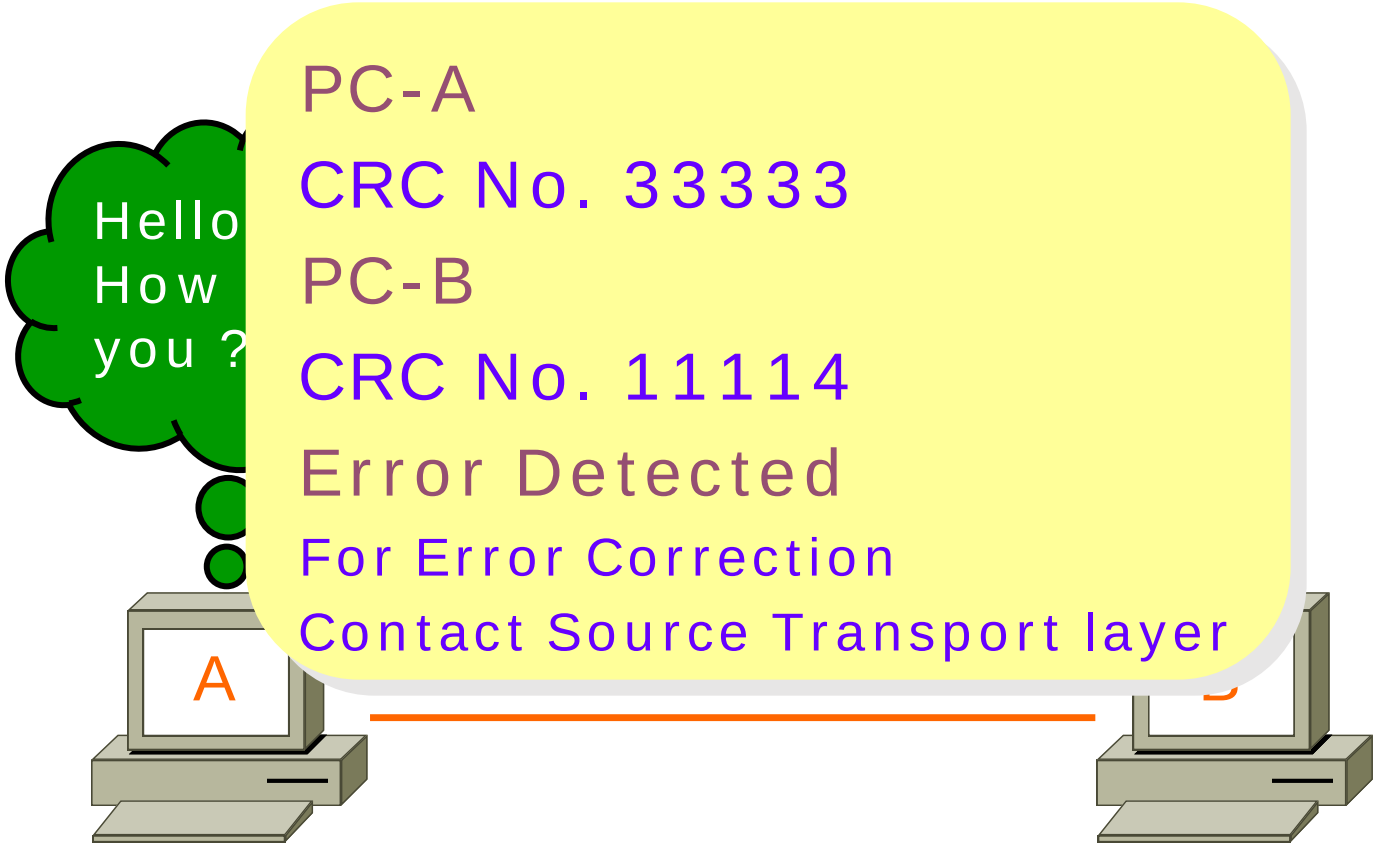
  It also provides ERROR DETECTION using CRC (Cyclic Redundancy Check) and ordered delivery of Frames.

  Ex: Ethernet, Token ring...etc

- LLC (Logical Link Control)

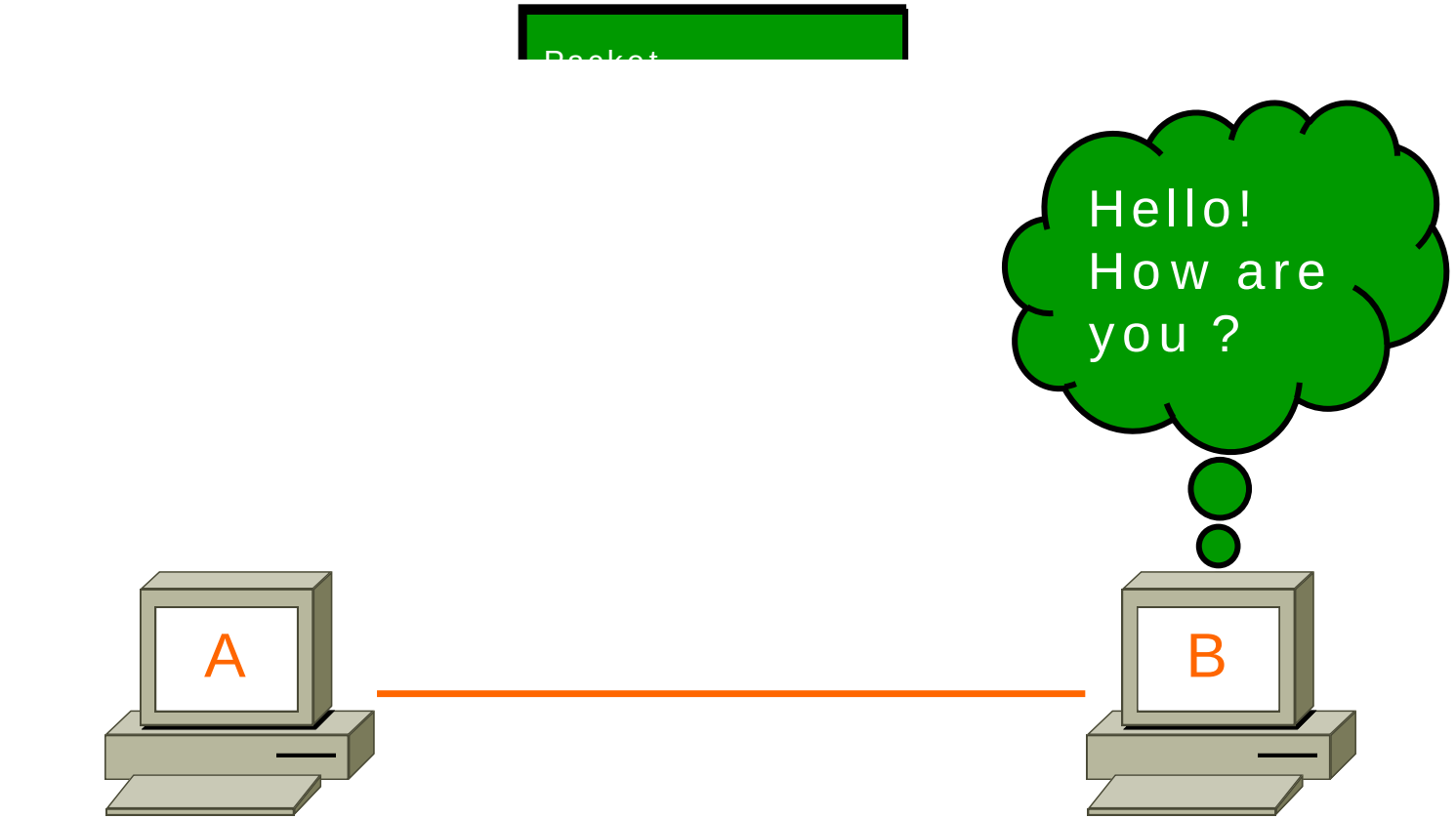
  It provides communication with Network layer.

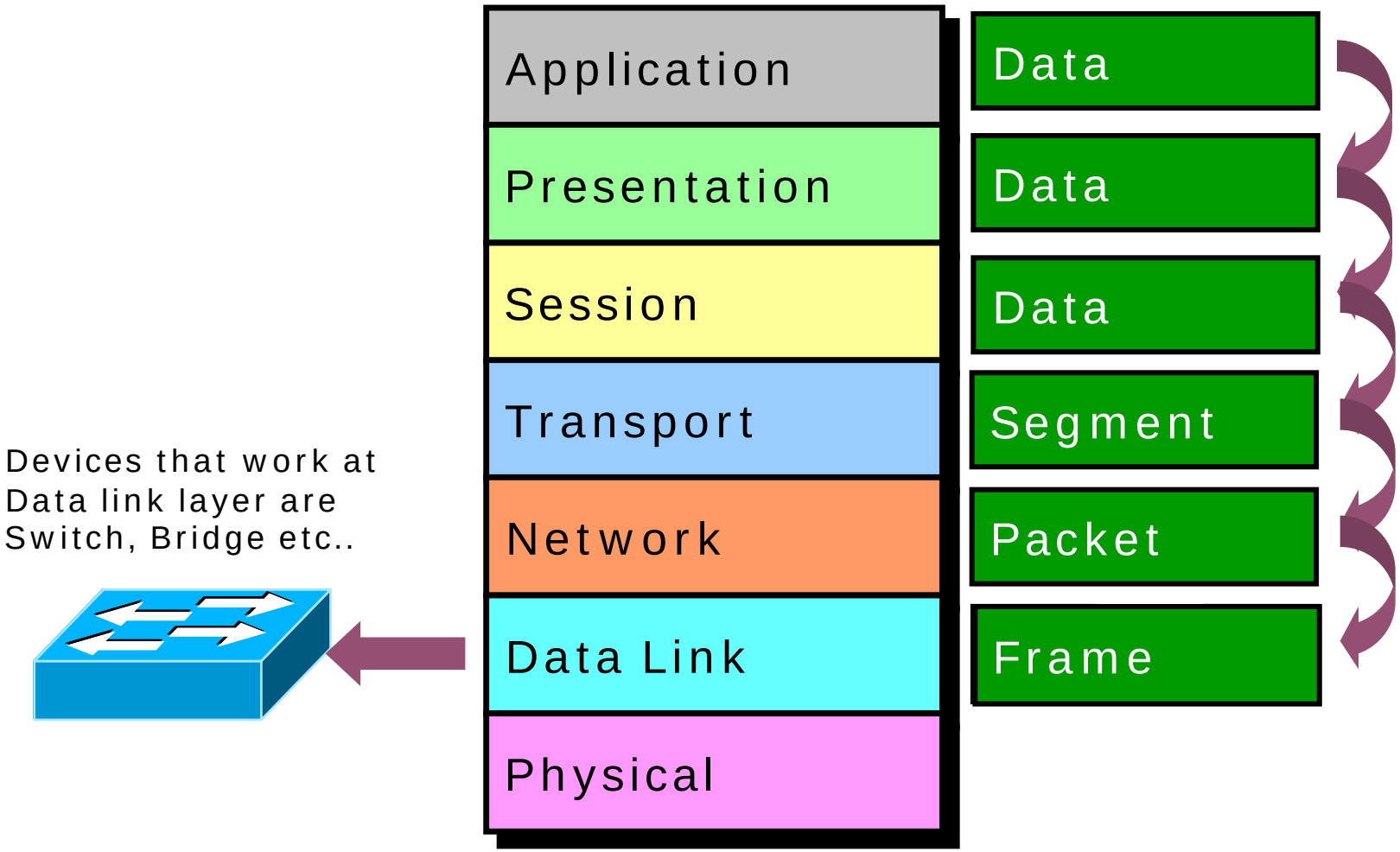
  Negotiates with Network Layer using SAP & SNAP protocols

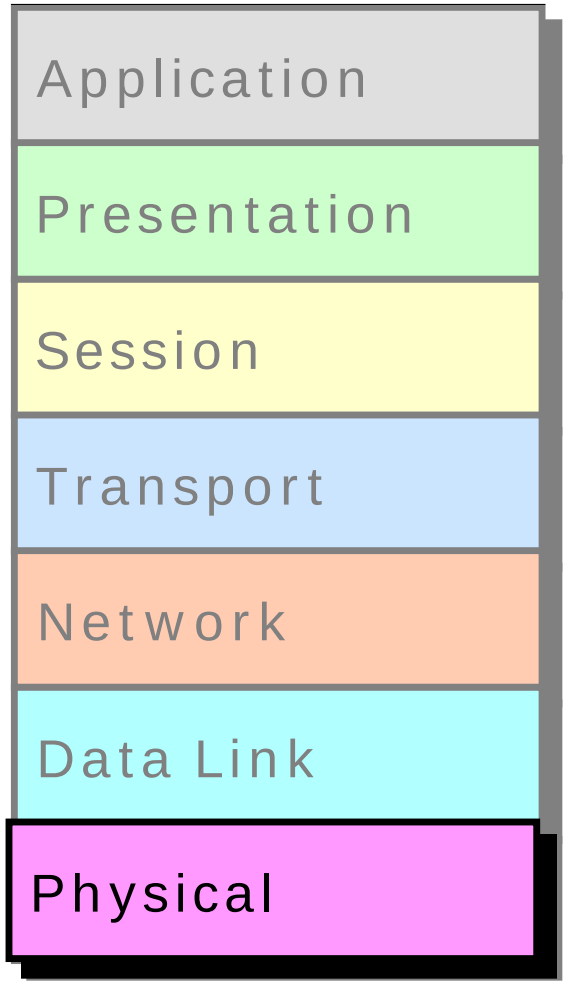


192.168.1.1
00-20-18-C0-07-71

192.168.1.2
00-20-18-C0-07-72


Hello!
How are
you ?
A
B
192.168.1.1
00-20-18-C0-07-71
192.168.1.2
00-20-18-C0-07-72


Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data
Data
Segment
Packet
Frame
Devices that work at
Data link layer are
Switch, Bridge etc..



Physical Layer

It defines the electrical, Mechanical & functional specifications for communication between the Network devices.

The functions described at this layer are..

Encoding/decoding:

It is the process of converting the binary data into signals based on the type of the media.

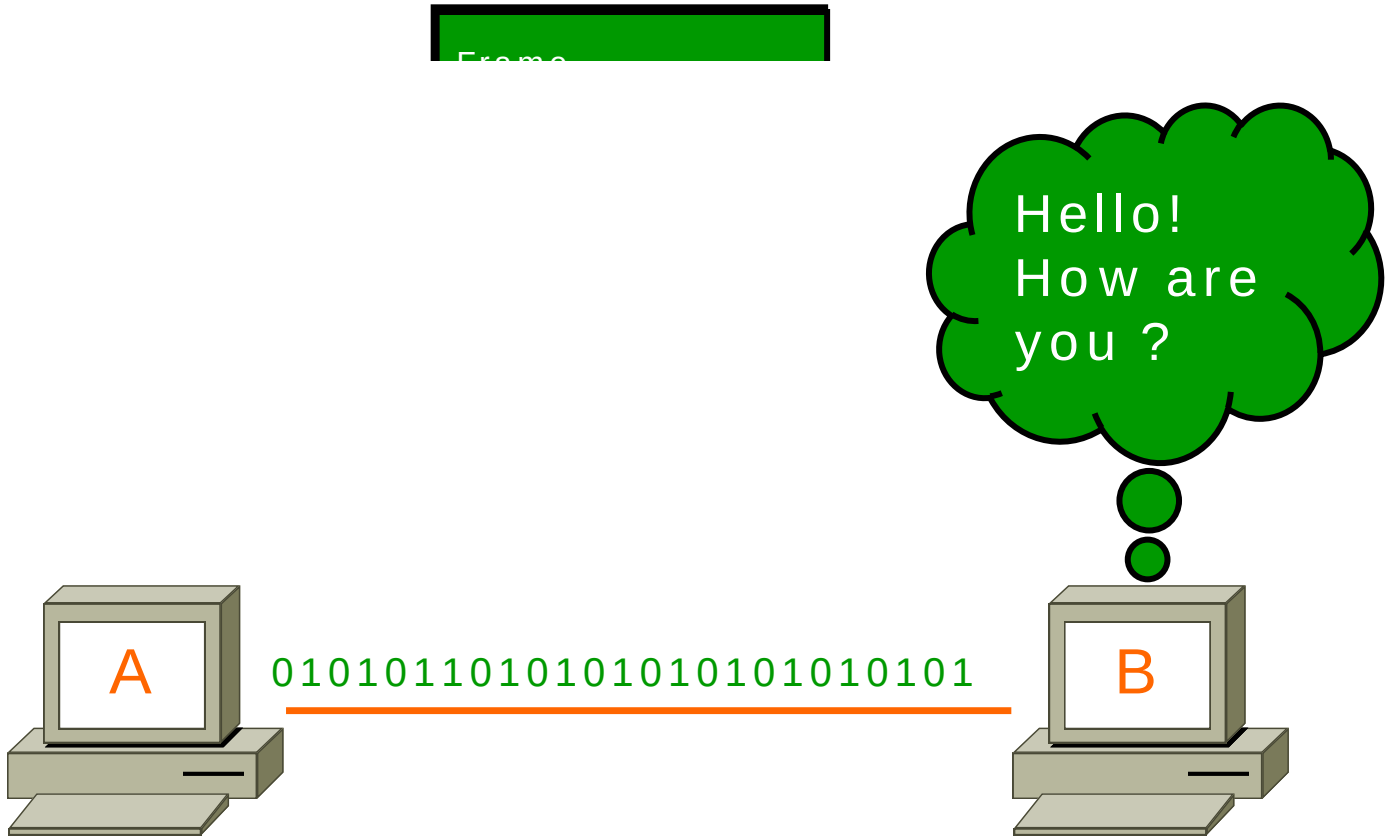
- Copper media : Electrical signals of different voltages
- Fiber media : Light pulses of different wavelengths
- Wireless media: Radio frequency waves

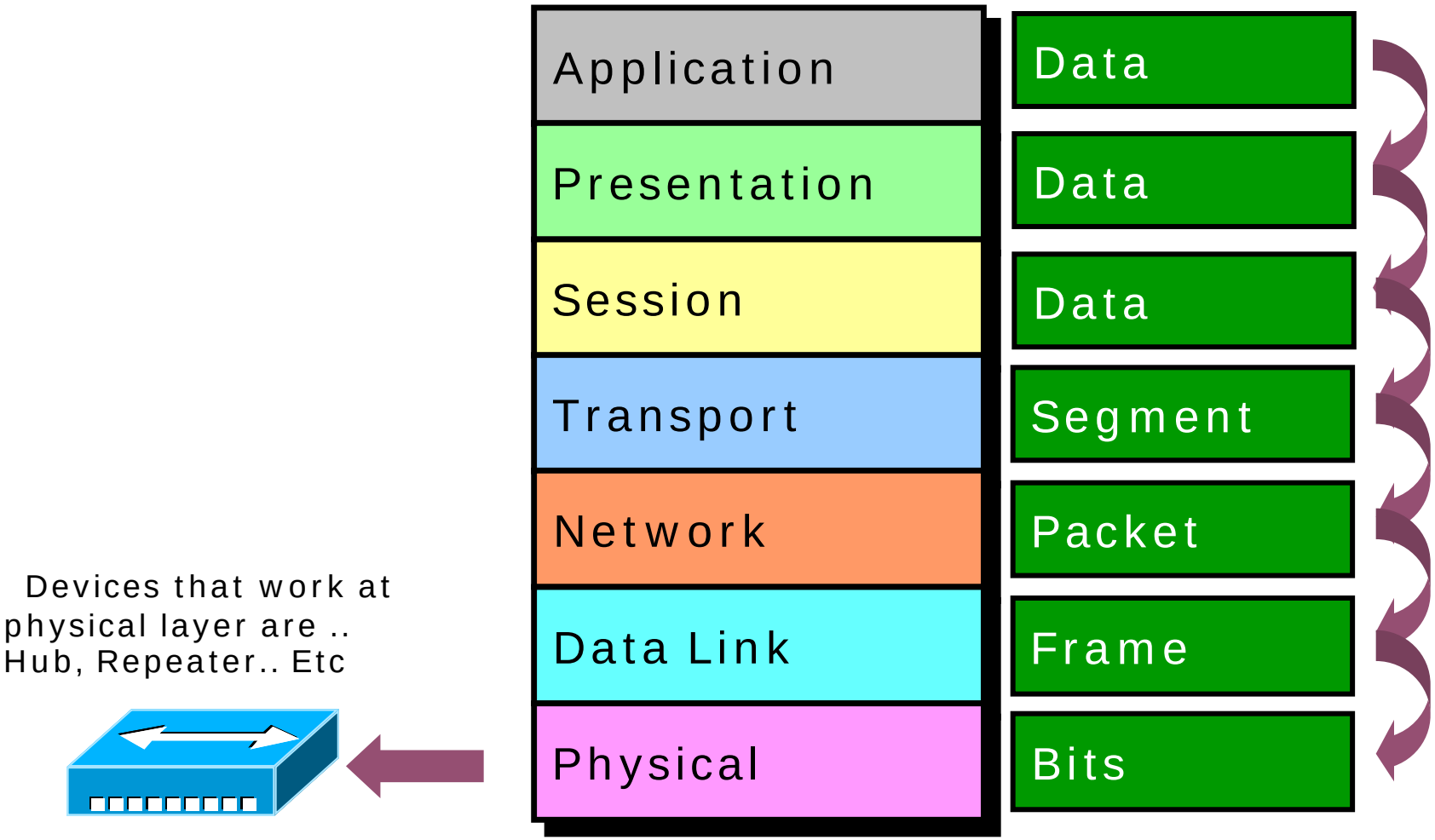
Mode of transmision of signals:

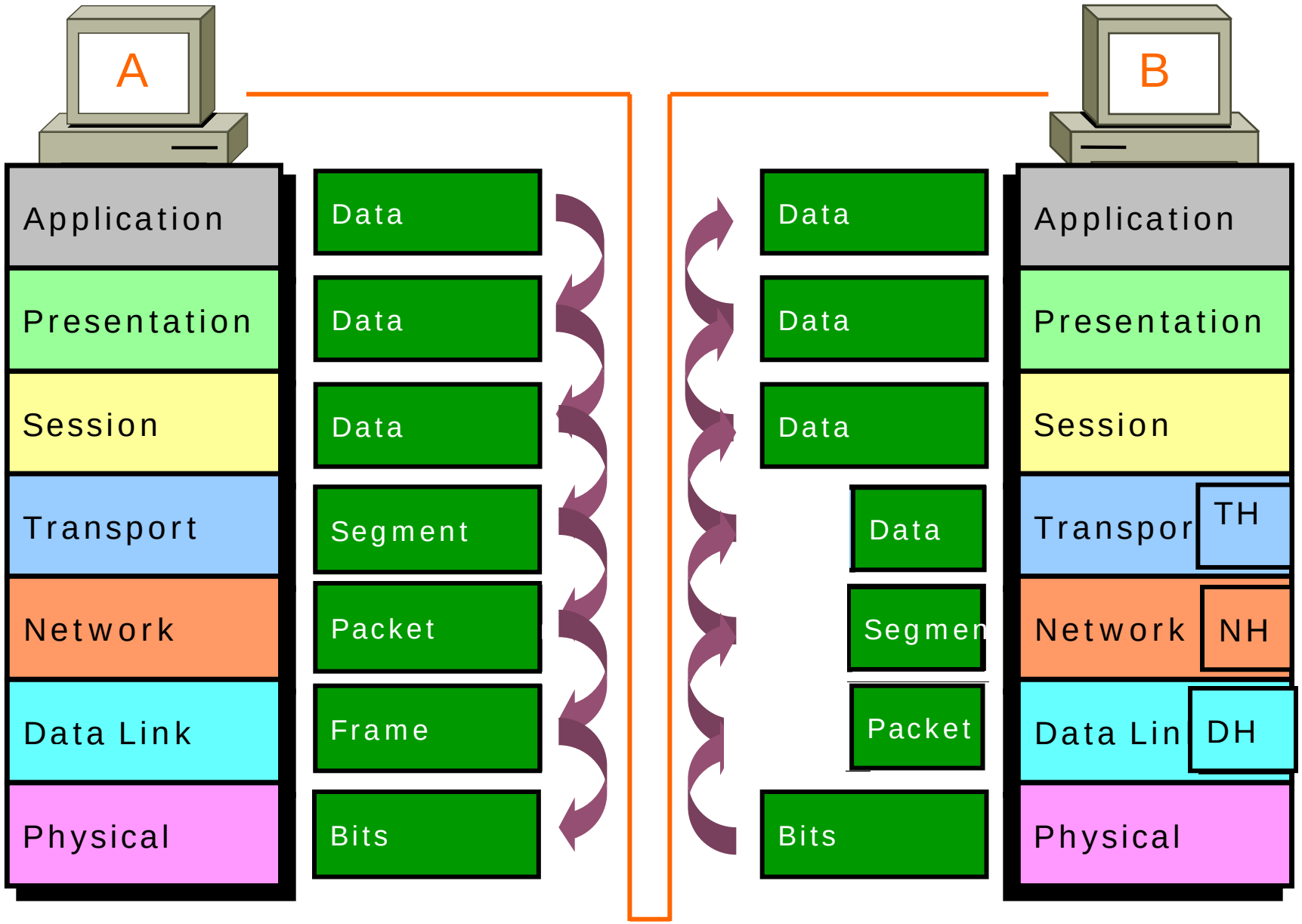
Signal Communication happens in three different modes

Simplex, Half-duplex, Full-duplex

Protocols works at physical layer: 10BaseT, 100BaseT, V.35, RS-232..etc


Hello!
How are
you ?
A
01010110101010101010101
B


Application
Presentation
Session
Transport
Network
Data Link
Physical
Data
Data
Data
Segment
Packet
Frame
Bits
Devices that work at physical layer are .. Hub, Repeater.. Etc


A
B
Application
Presentation
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Transport
Network
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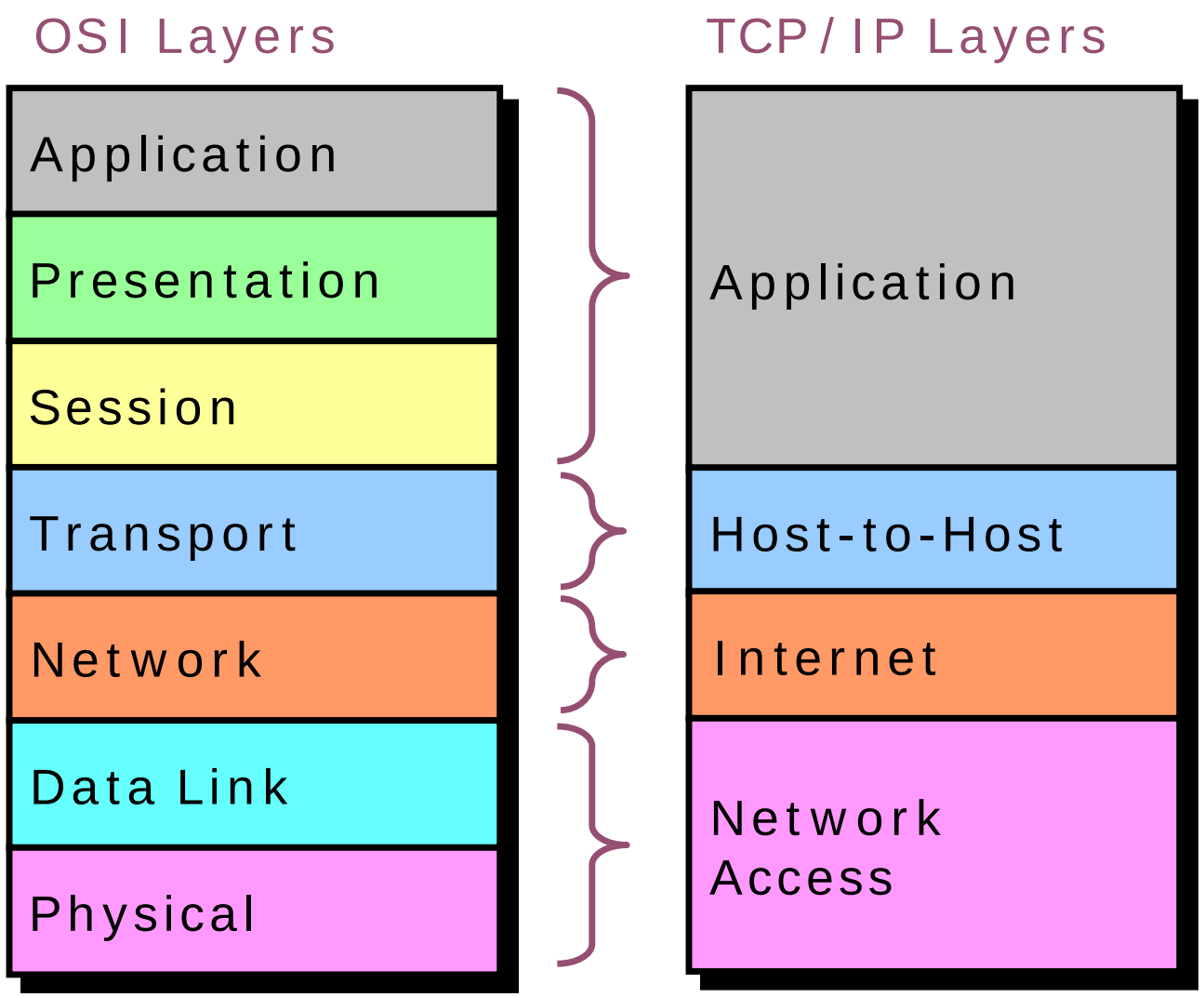

OSI Layers
TCP / IP Layers
Application
Presentation
Session
Transport
Network
Data Link
Physical
Application
Host-to-Host
Internet
Network Access

IP (Internet Protocol) Version 4

IPv4 Address Classification

Address Class	Value in First Octet	Classful Mask (dotted decimal)	Classful Mask (prefix notation)
A	1 - 126	255.0.0.0	/8
B	128 - 191	255.255.0.0	/16
C	192 - 223	255.255.255.0	/24
D	224 - 239	N/A	N/A
E	240 - 255	N/A	N/A

Network and Host Portion

- IP address is Divided into two portion
  - Class A N.H.H.H
  - Class B N.N.H.H
  - Class C N.N.N.H

  - Host: A Specific Device in the Network
  - Network: set of Devices

Network and Broadcast Address

- Network ID
  - First IP of the range
  - All ZERO’s in the host portion
  - Reserved for identifying complete Network .

• Class A	N.H.H.H	10.X.X.X	10.0.0.0
• Class B	N.N.H.H	172.16.X.X	172.16.0.0
• Class C	N.N.N.H	192.168.1.X	192.168.1.0

Network and Broadcast Address

- Broadcast ID
  - Last IP of the range
  - All ONE’s in the host portion
  - Used to send broadcast to all with in the same Network .

• Class A	N.H.H.H	10.X.X.X	10.255.255.255
• Class B	N.N.H.H	172.16.X.X	172.16.255.255
• Class C	N.N.N.H	192.168.1.X	192.168.1.255

- Valid IP
  - Valid IP address lie between the Network Address and Broadcast Address
  - Only Valid IP Address are assigned to hosts/clients

- Subnet-mask
  - Subnet Mask differentiates the Network and Host Portion .
  - 1 represent network
  - O represent hosts

Reserved Address

- Class D 224.X.X.X – 239.X.X.X
- Class E 240.X.X.X – 255.X.X.X
- Network ID and Broadcast ID
- 0.X.X.X not valid
- 127.X.X.X for loopback address (testing TCP/IP)

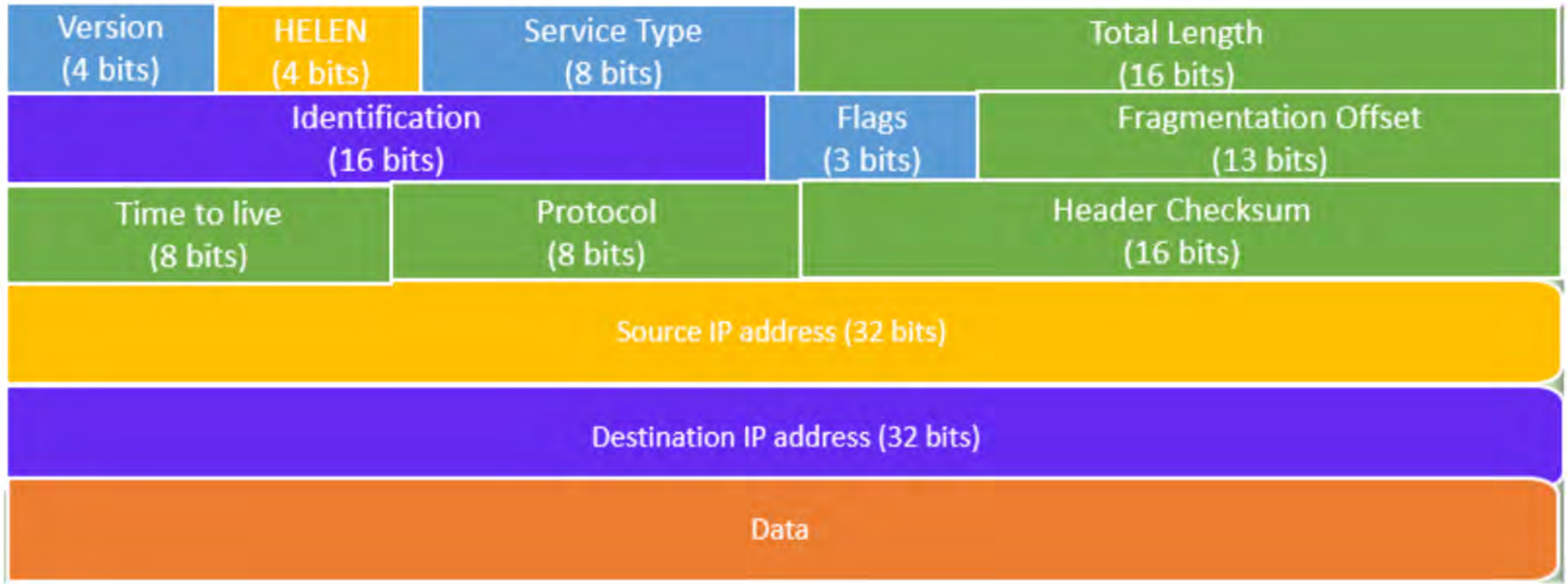
Public IP	Private IP
Used on Public network (INTERNET)	Used with the LAN or within the organization
Recognized on internet	Not recognized on internet
Given by the Service Provider (from IANA)	Given by the Administrator
Globally Unique	Unique within the network or organization
Pay to Service provider (or IANA)	Free
Registered	Unregistered IP

Private IP Address

- There are certain address in each class of IP address that are reserved for Private Networks. These address are called private address

    - Class A 10.0.0.0 to 10.255.255.255 (10.X.X.X)
    - Class B 172.16.0.0 to 172.31.255.255
    - Class C 192.168.0.0 to 192.168.255.255 (192.168.X.X)

IPv4 Header


Version
(4 bits)
HELEN
(4 bits)
Service Type
(8 bits)
Total Length
(16 bits)
Identification
(16 bits)
Flags
(3 bits)
Fragmentation Offset
(13 bits)
Time to live
(8 bits)
Protocol
(8 bits)
Header Checksum
(16 bits)
Source IP address (32 bits)
Destination IP address (32 bits)
Data

IPv6 Header


Version
4 bits
Traffic class
8 bits
Flow label
20 bits
Payload length
16 bits
Next header
8 bits
Hop limit
8 bits
Source address
128 bits
Destination address
128 bits