Computer Networks Fundamentals

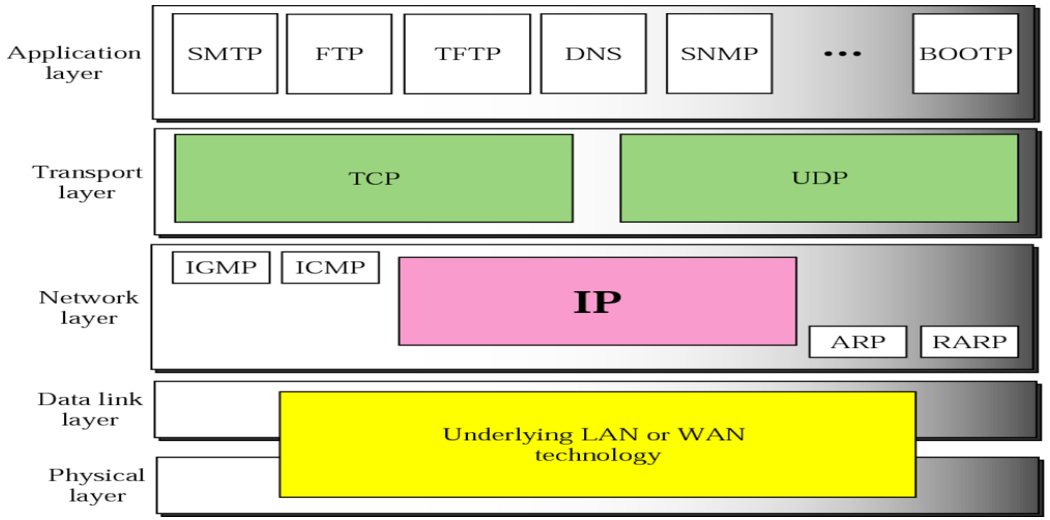
Basic Network Elements (Software)

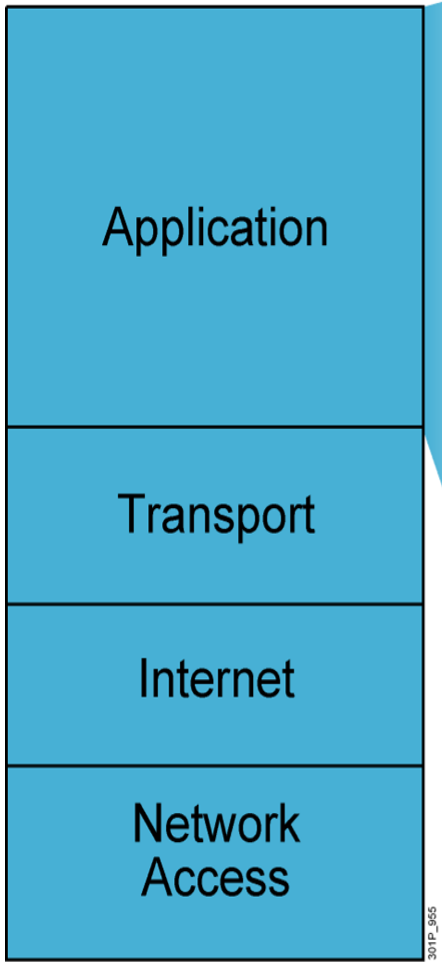
TCP/IP Protocol Suite

Basic Network Elements (Software)

TCP/IP Protocol Architecture

- Application Layer
  - Communication between processes or applications





Application Layer Protocols

- File transfer
  - FTP
  - TFTP
  - Network File System
- E-mail
  - Simple Mail Transfer Protocol
- Remote login
  - Telnet
  - rlogin
- Network management
  - Simple Network Management Protocol
- Name management
  - Domain Name System

Basic Network Elements (Software)

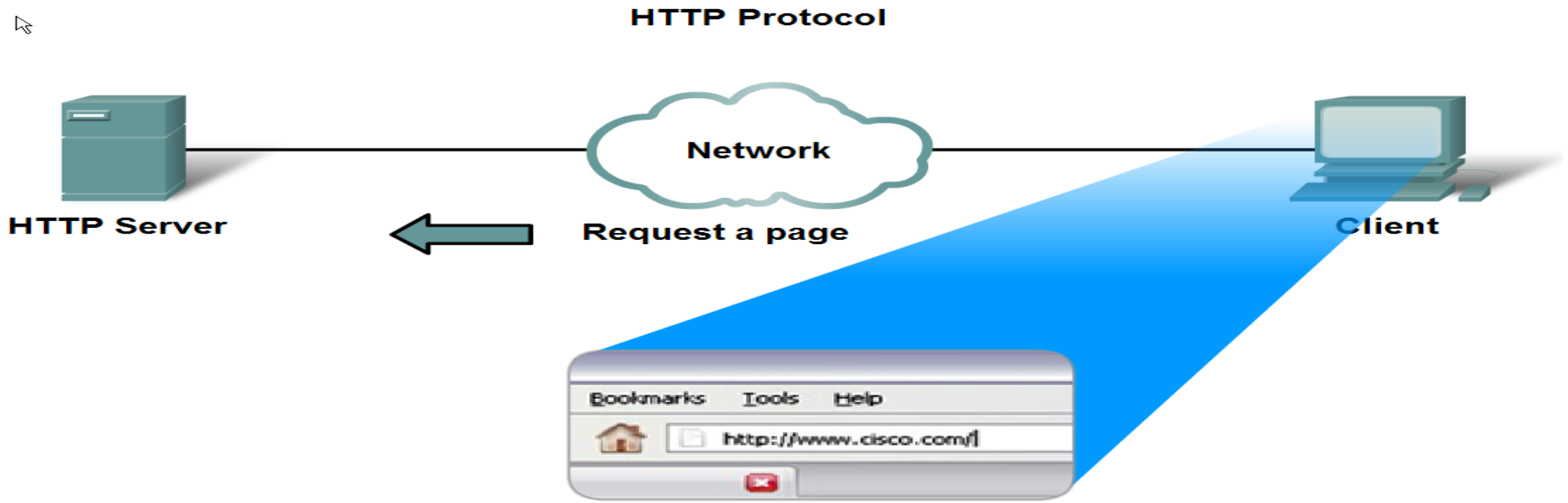
Internet Services (Client/Web Server)

- The World Wide Web: HTTP
- Naming Service: DNS
- File Transfer: FTP
- Telnet Service
- Electronic Mail service: IMAP, POP3, SMTP

Basic Network Elements (Software)

HTTP Protocol

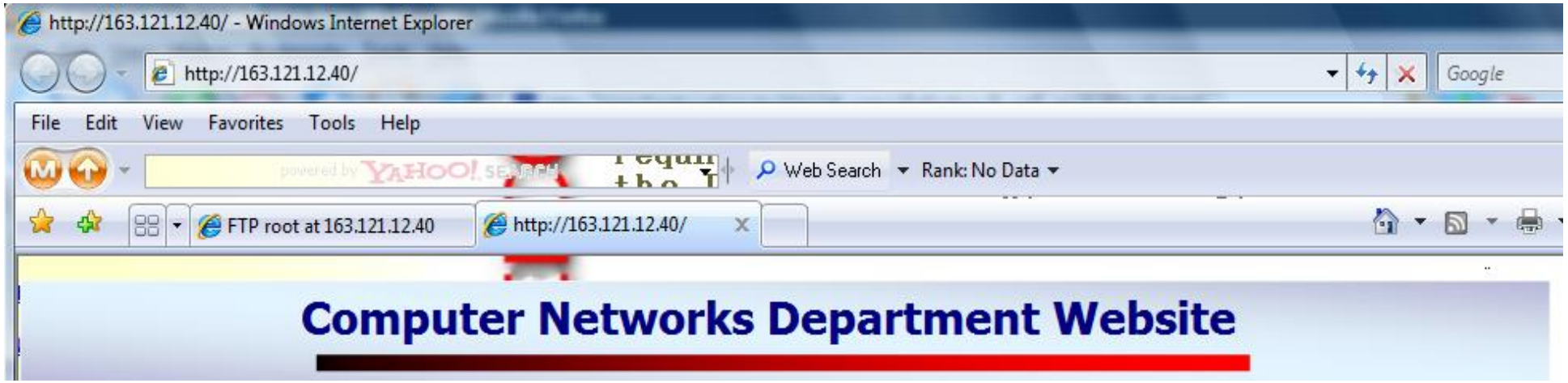
- Hyper Text Transfer Protocol
- Supports the delivery of web pages to the client



Basic Network Elements (Software)

Browser as a web client

- Use Internet Browser as WEB client.



- Application specified in the TCP/IP suite
- A way to translate human-readable names into IP addresses

Basic Network Elements (Software)

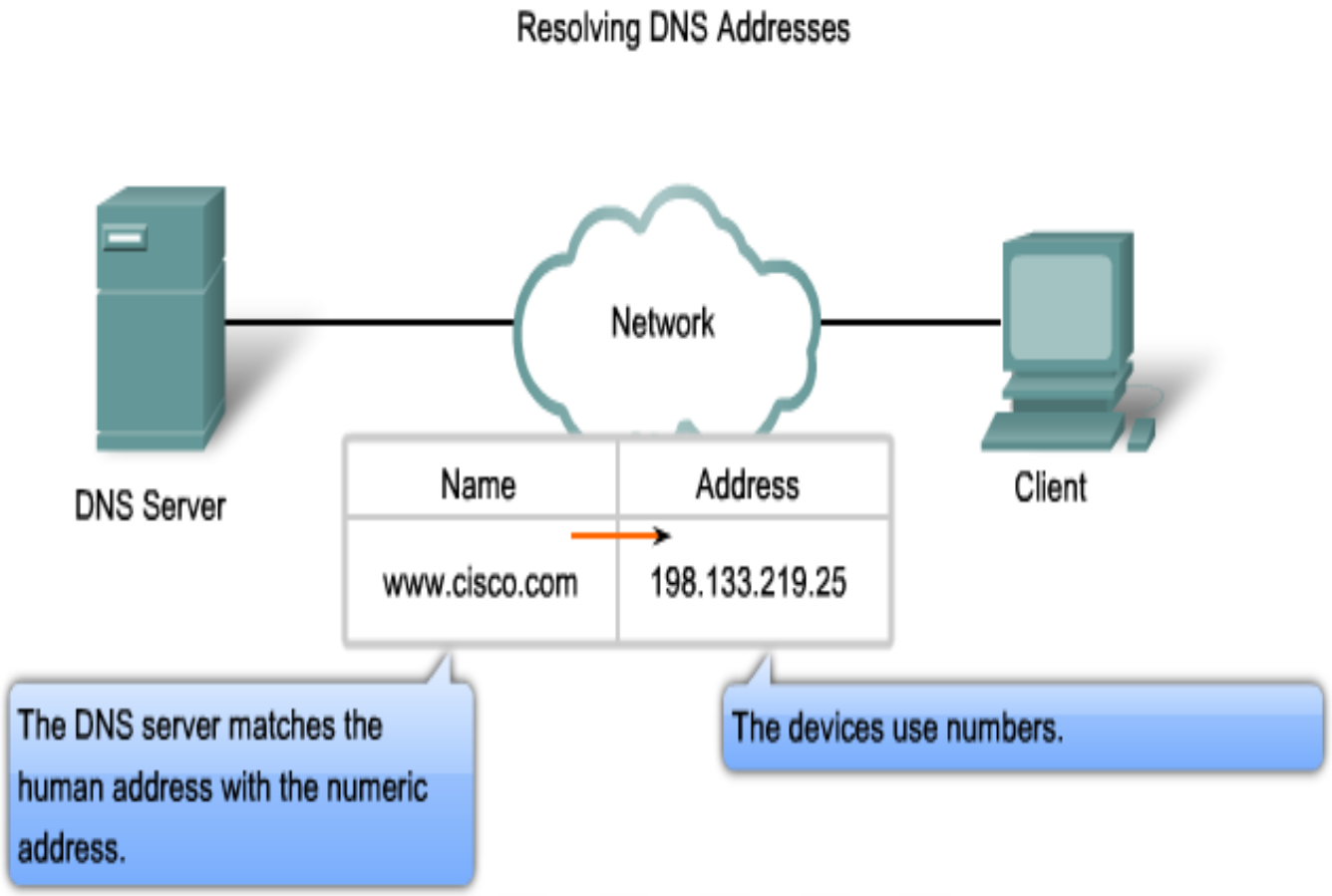
URL

- URL is **Universal Resource Locator**
- Protocol : HTTP or FTP

Basic Network Elements (Software)

DNS

- Domain Name Servers
  - Application specified in the TCP/IP suite
  - A way to translate human-readable names into IP addresses



Basic Network Elements (Software)

How DNS works?

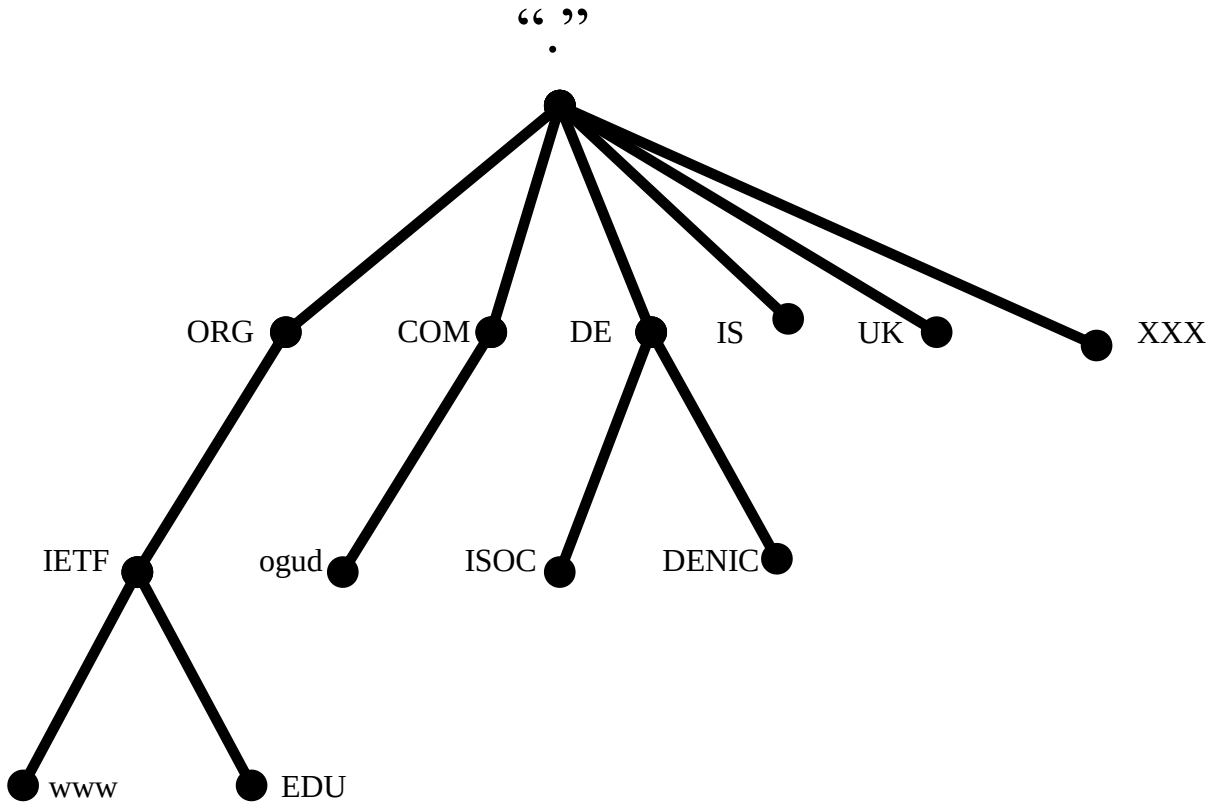
- At the beginning they use Hosts file
- It maps the IP addresses to host names
- It is found at "*C:\Windows\System32\drivers\etc*"
- Then they make DNS Server to centralize the Domain Name Servers.
- Servers are used to convert the addresses we see and read into IP addresses and vice-versa.

Basic Network Elements (Software)

List of Top Level Domains (TLDs)

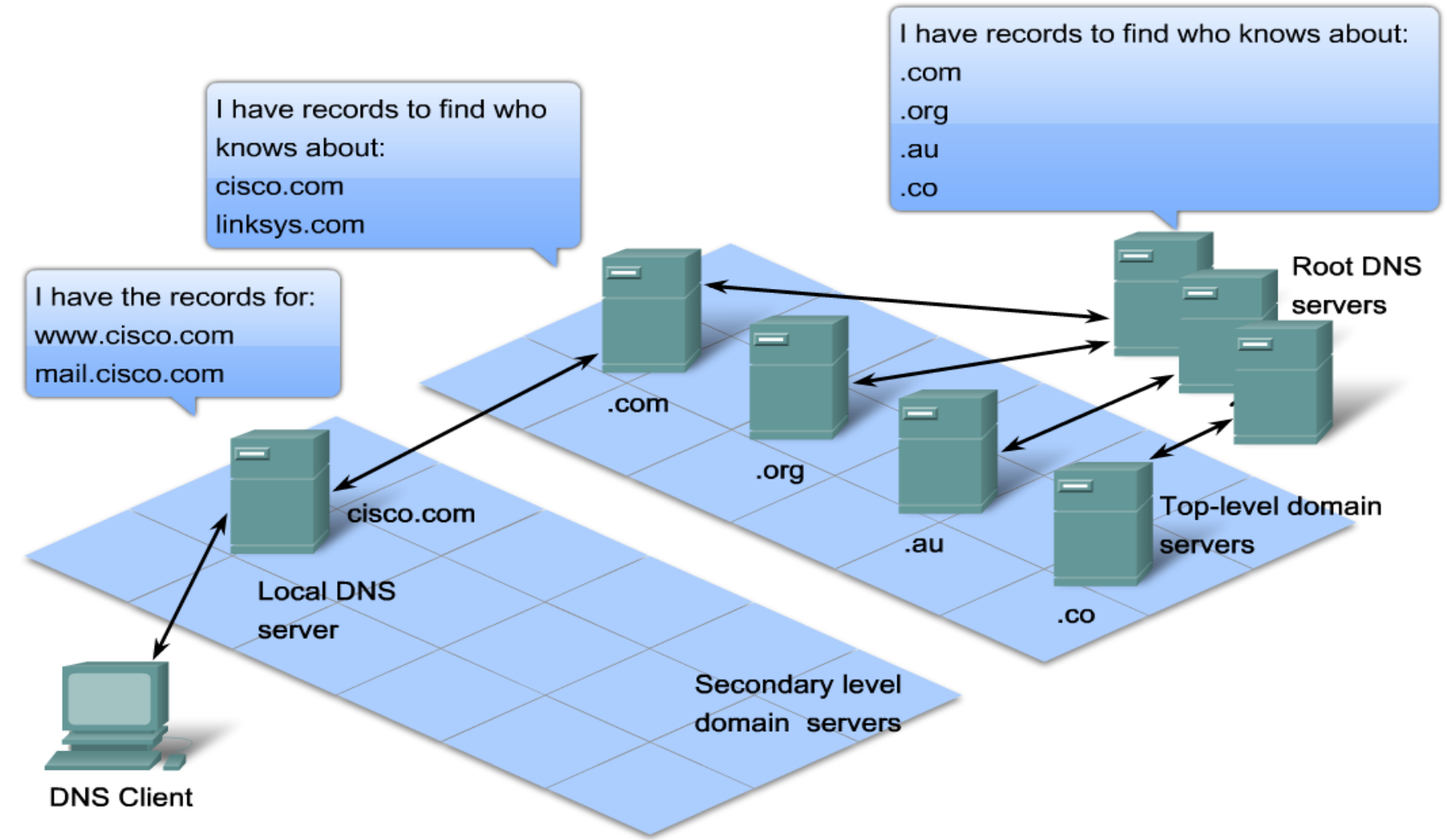
Domain Name	Assigned To
com	Commercial organization
edu	Educational institution
gov	Government organization
mil	Military group
net	Major network support center
org	Organization other than those above
country code	A country

DNS Tree



Basic Network Elements (Software)

DNS Query

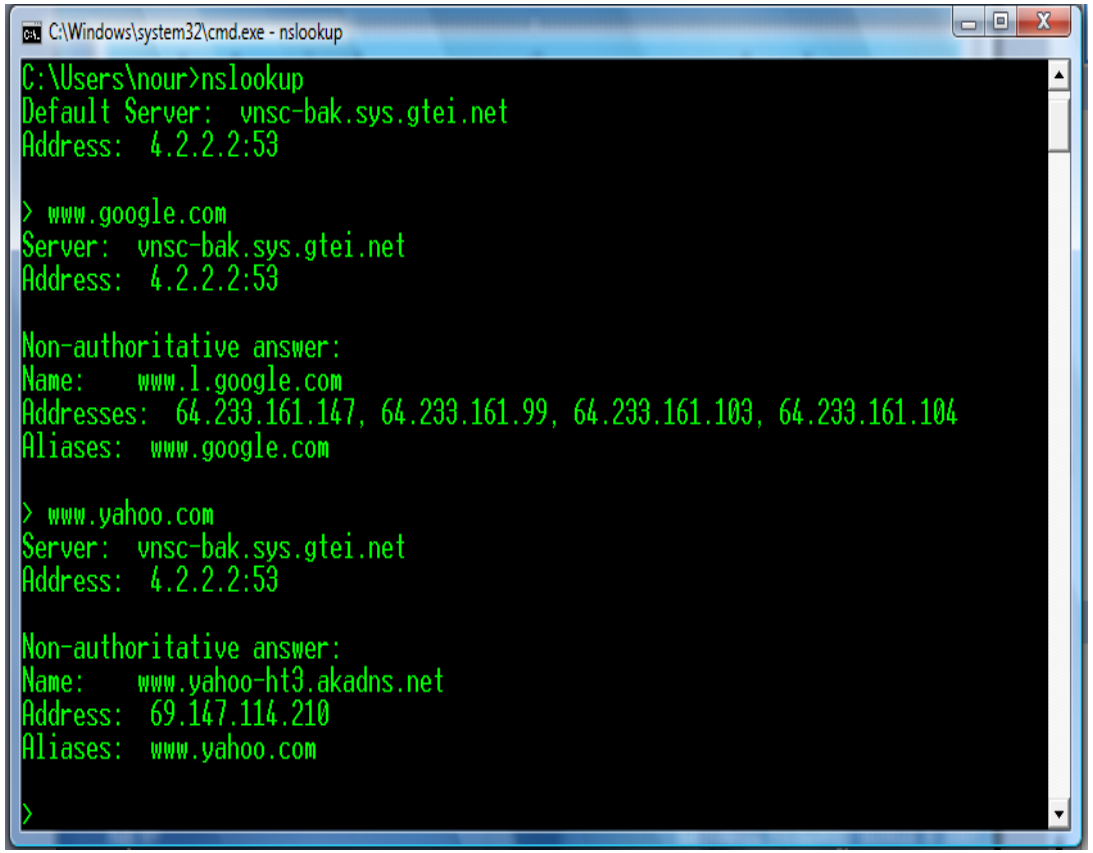


A hierarchy of DNS servers contains the resource records that match names with addresses.

Basic Network Elements (Software) - Lab

Nslookup

- Nslookup is the name of a program that lets you to enter a host name and find out the corresponding IP address



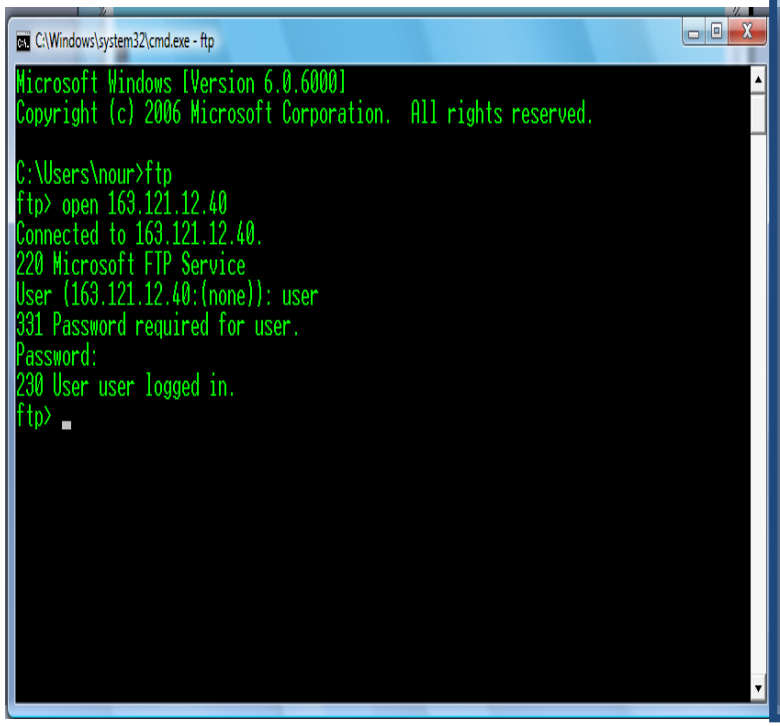
Basic Network Elements (Software) - Lab

FTP

- File Transfer Protocol

FTP Client

- Browser as a FTP client
  - Use Internet Browser as FTP client.
- Using MS Windows built-in FTP client
- Third party programs "*cute FTP*"



open

ls

cd

bin

get

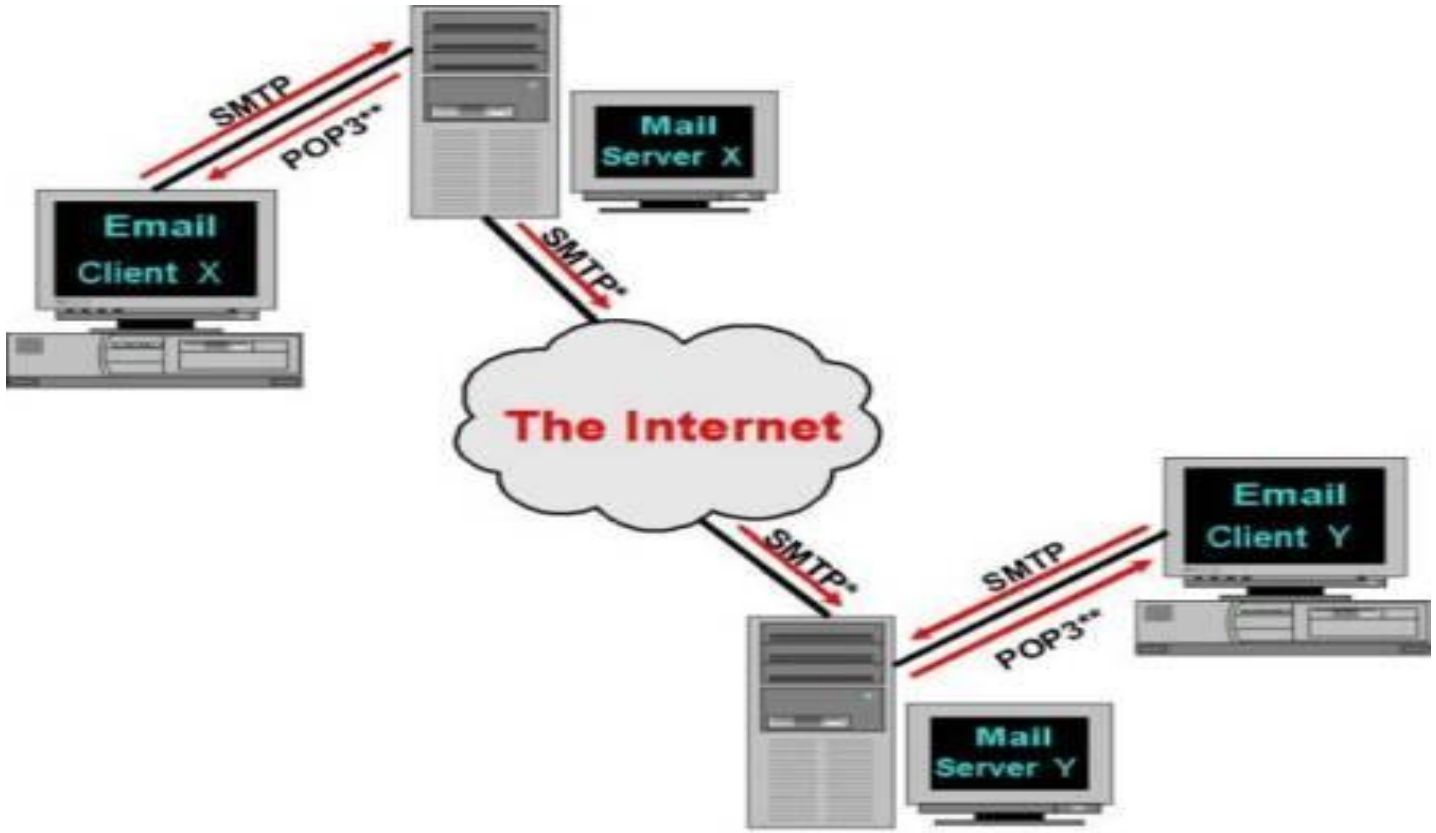
mget

Put

bye

Basic Network Elements (Software) - Lab

Mail Server and Clients



- Mail Clients
  - **Web based**
    - Hotmail
    - gmail
  - **Non web based**
    - Outlook express
    - Microsoft Outlook

Basic Network Elements (Software) - Lab

Mail Protocols

- **SMTP**
  - It is the common language used by the majority of Mail Servers to send messages back and forth to other Mail Servers or Email Clients
- **POP3 "Post Office Protocol version 3"**
  - In order to collect email messages from the Mail Server, the Email Client contacts the Mail Server.
  - Download messages on the hard disk
  - You can work Offline
  - Keep the user's quota on the server
- **IMAP4 "Internet Message Access Protocol version 4"**
  - Retrieve only message header

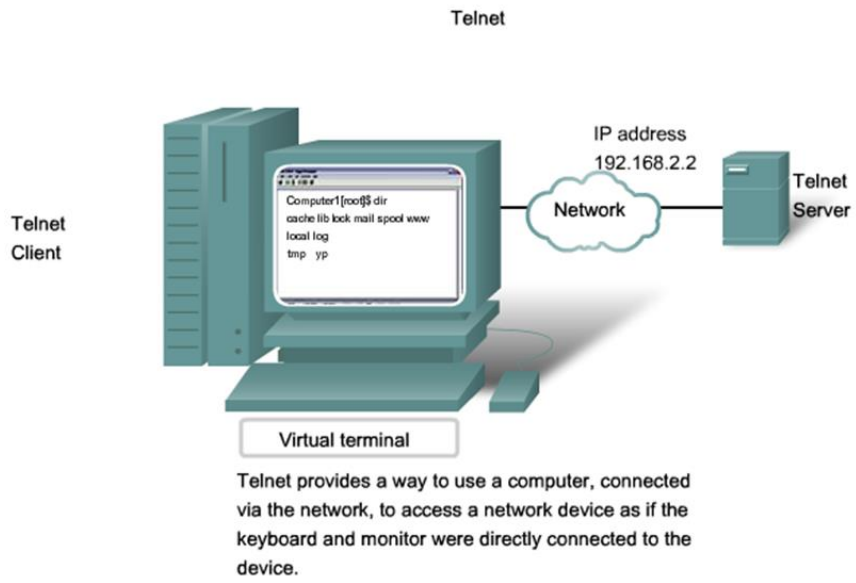
Basic Network Elements (Software) - Lab

Telnet

- Telnet is a user command and an underlying TCP/IP protocol for accessing remote computers.
- Through Telnet, an administrator can access someone else's computer remotely

Telnet client

- Built in MS-Windows Telnet client
- Third party programs



Basic Network Elements (Hardware)

Network Hardware

Devices

Medium

Network Devices (Hardware)

- Computers / Peripherals
  - Any device that can connect to network with NIC
    - Ex: Computer
    - ✓ Mobile
    - ✓ Laptop-
    - ✓ Printers-
    - ✓ Cameras
    - ✓ smart TV
    - ✓ - …..etc

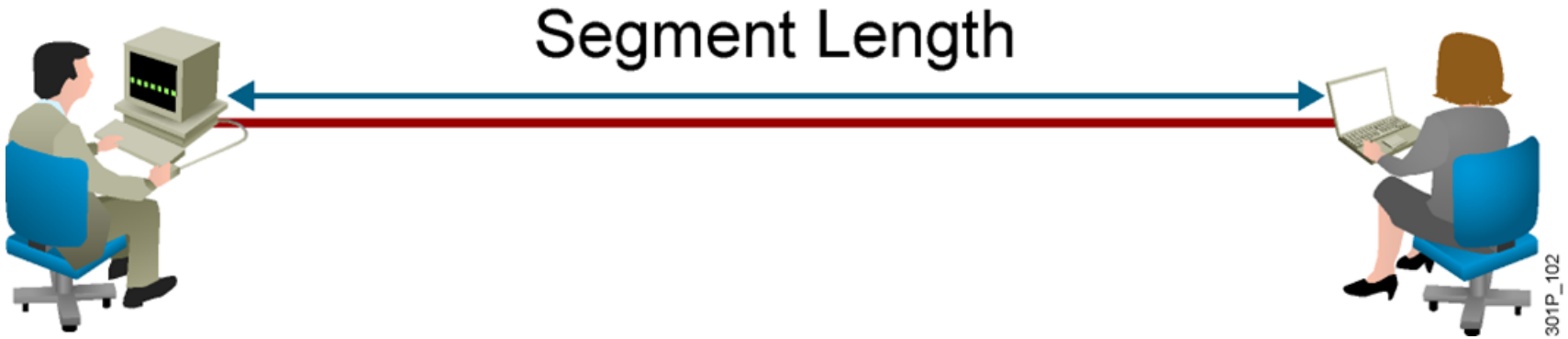
Network Devices (Hardware)

NIC (Network Interface Card)

- Called network interface controller, network adapter or LAN adapter.

- Operate at the physical layer of OSI/RM
- hardware component without a computer cannot be connected over a network cable (interface between the PC and the network)
- Resides in the motherboard of the PC
  - Internal NIC (plugs into the motherboard directly)
  - External NIC (Wireless and USB based)
- Have A physical Address burned on the card called Mac.

LAN Segment Limitations



- Signals degrade with transmission distance.
- Each Ethernet type has a maximum segment length.

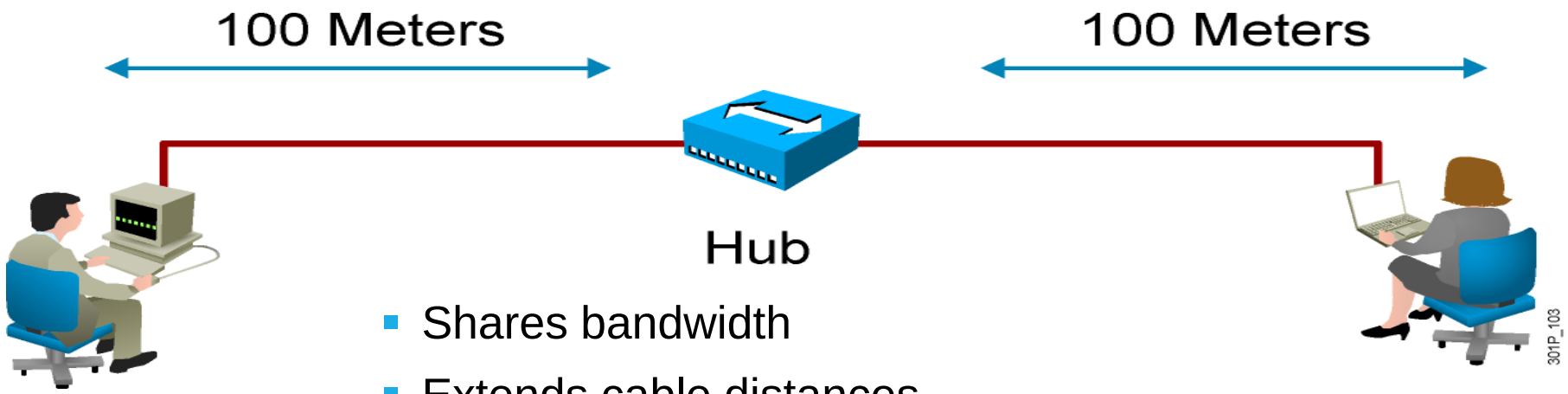
Network Devices (Hardware)

❖Repeater

- Operates at the physical layer.
- Regenerate the signal over the same network before the signal becomes too weak or corrupted
- Only extend the length of the signal to its original strength
- Does not amplify the signal.
- 2 port device.

Network Devices (Hardware)

Extending LAN Segments

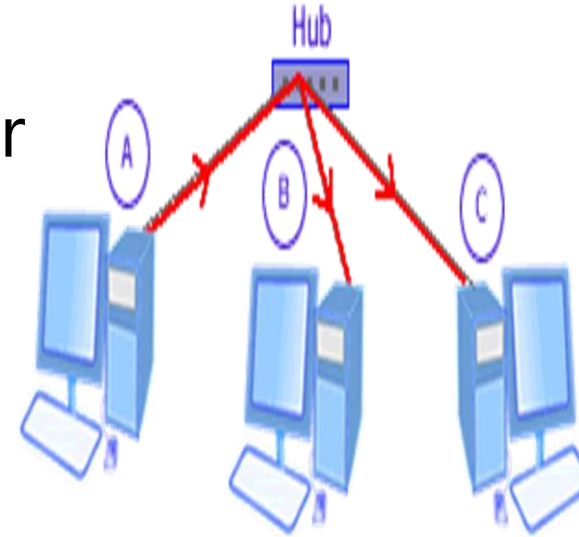


- Shares bandwidth
- Extends cable distances
- Repeats or amplifies signal
- It is layer 1 device
- It work only with bits
- Must work with half duplex communication

Network Devices (Hardware)

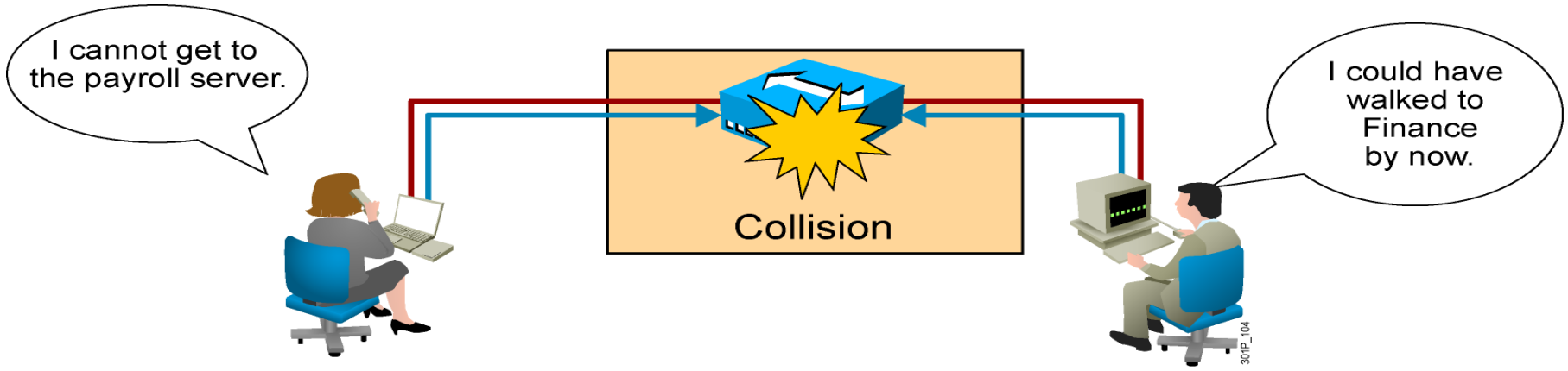
❖Hub

- is a multiport repeater.
- Allow different nodes to communicate with each other
- Hubs cannot filter data, so data packets are sent to all connected devices.
- collision domain of all hosts connected through Hub remains one.
- Do not have intelligence to find out best path for data packets which leads to inefficiencies and wastage.



Network Devices (Hardware)

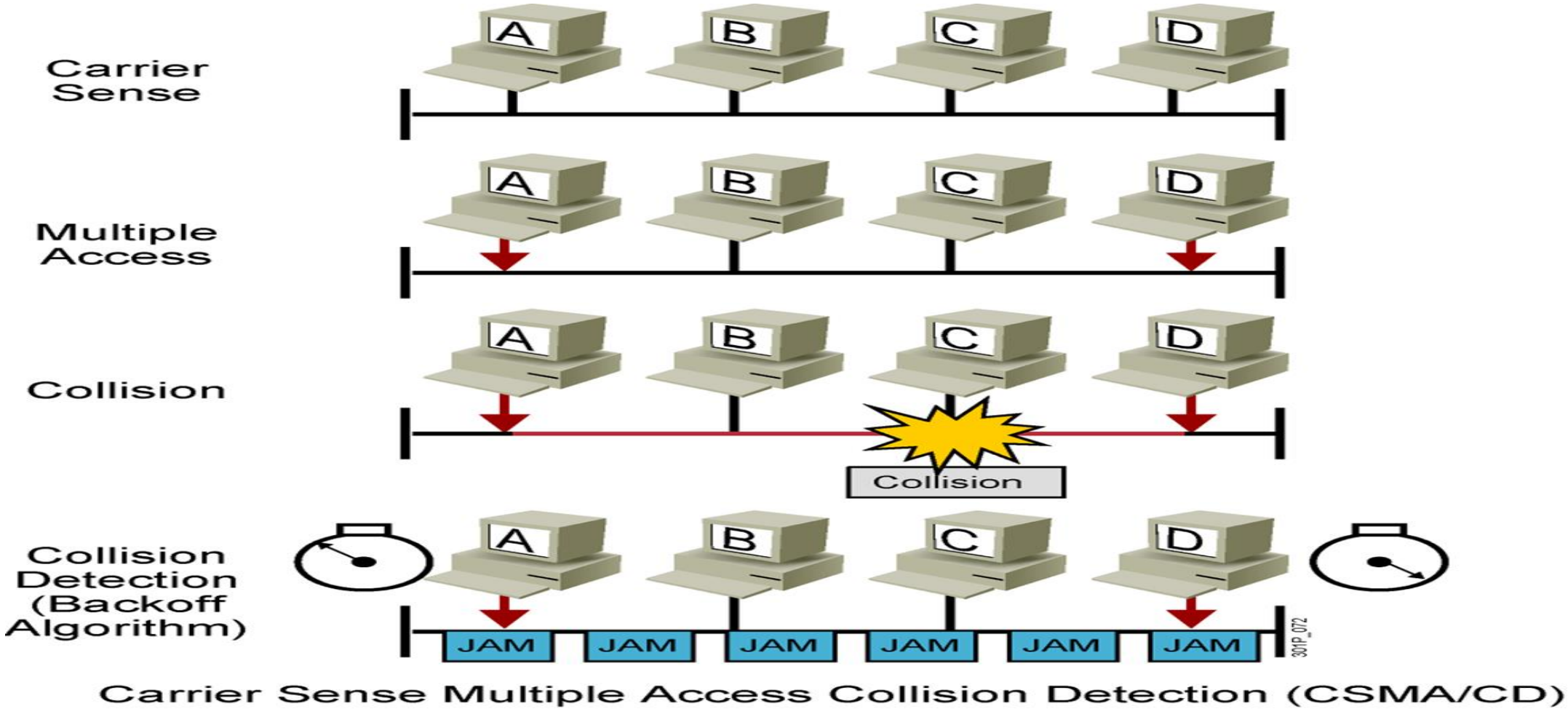
Collisions



- All ports of the hub have the same collision domain and broadcast domain.
- Collisions makes the network very slow and congested

Network Devices (Hardware)

CSMA/CD



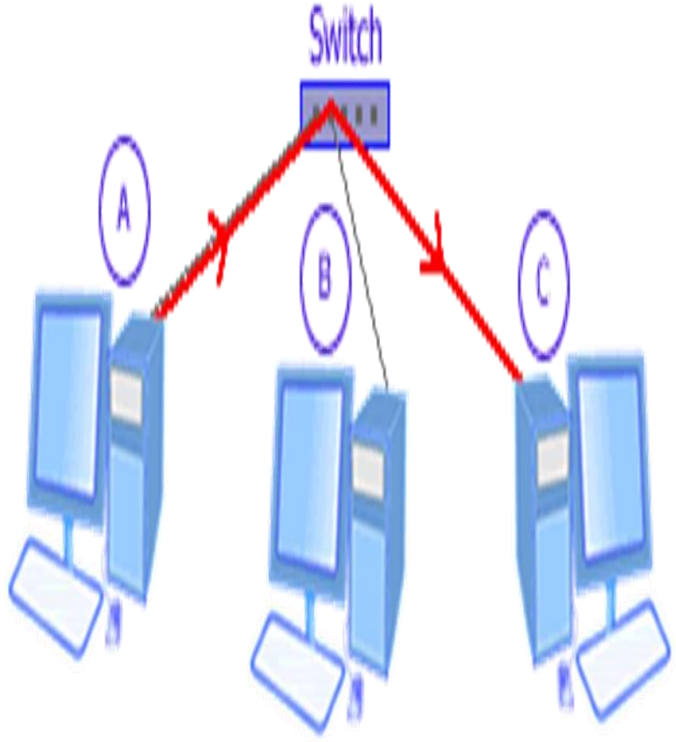
Carrier Sense Multiple Access Collision Detection (CSMA/CD)

Network Devices (Hardware)

❖Switch

– Allow different nodes to communicate with each other at the same time without slowing each other down.

- Imply less traffic and high performance and effective.
- Switch is data link layer device.
- The switch can perform error checking before forwarding data.
- less collision domain of hosts



Network Devices (Hardware)

❖Switch

- **Layer 1 switch**
  - Switching hub
- **Layer 2 switch**
  - LAN switch
  - Forwards traffic based on the MAC address
- **Layer 3 switch**
  - Routing switch
  - Forwards traffic based on IP Address
  - Used for Inter-VLAN routing
  - Don’t have WAN connectivity

Network Devices (Hardware)

❖Router

- Allow different networks to communicate with each other (redirect packets between networks)
- Routes data packets based on their IP addresses.
- Routers are protocol dependent
- Operate at Network Layer device.
- Normally connect LANs and WANs together
- have a dynamically updating routing table based on which they make decisions on routing the data packets.

Network Devices (Hardware)

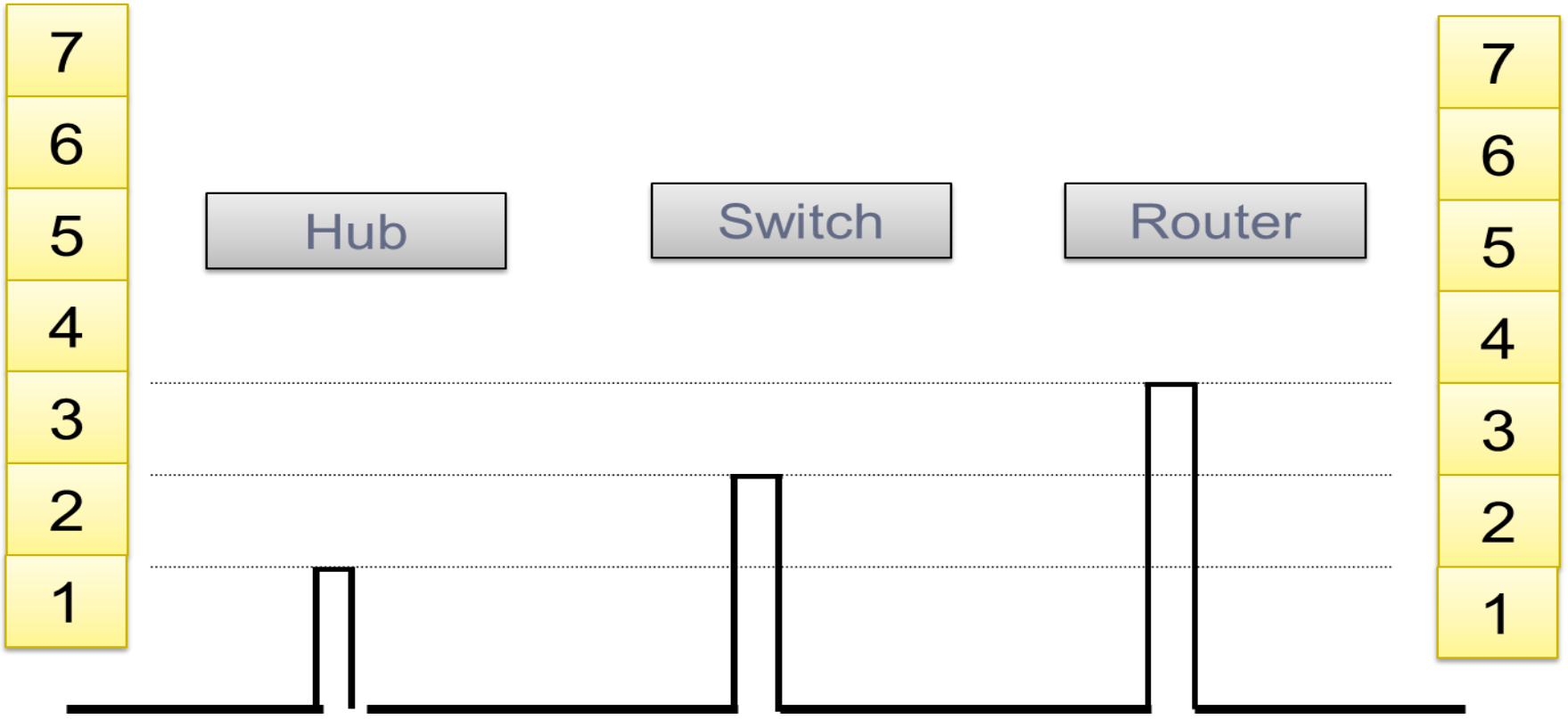
❖Router

– Routers have the following components:
  - CPU
  - Motherboard
  - RAM
  - ROM
– Routers have network adapters to which IP addresses are assigned.
– Routers forward packets based upon a routing table.

Cisco 2800 Series Router

Network Devices (Hardware)

- Hub, Switch, Router Layers



Network Devices (Hardware)

❖DHCP

- Dynamic Host Configuration Protocol
- Enables devices on a network to obtain IP addresses and other information from a DHCP server.
- DHCP is used for general purpose hosts such as end user devices,
- Static fixed addresses are used for network devices such as gateways, switches, servers and printers.

Network Devices (Hardware)

- Splitter
  - is a device that divides a telephone signal into two or more signals,
  - each carrying a selected frequency range
  - can also reassemble signals from multiple signal sources into a single signal

Network Devices (Hardware)

- Your Home “Router”
  - Main Function is Routing
  - Act as Switch
  - Act as DHCP
  - Act as Firewall
  - Act As Access point

Network Devices (Hardware)

Network Transmission Media

Wired

Wireless

Network Devices (Hardware)

Network Transmission Media

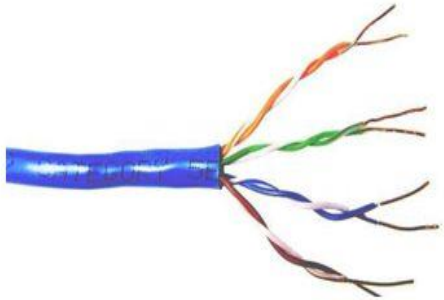
- To transmit data, a medium must exist
- The medium can be in the form of cables or wireless medium
- Most common used media for data networks
  - **Wired Media**
  - **Wireless media**

Network Devices (Hardware)

Network Transmission Media

- **Cable Media**
  - Twisted Pair Cables
    - UTP
    - STP
    - Coaxial Cables
  - Fiber Optic Cables
- **Wireless Media**
  - WIFI
  - Infra red
  - Microwave
  - Bluetooth

- Unshielded twisted pair (UTP)



- Shielded twisted pair (STP)

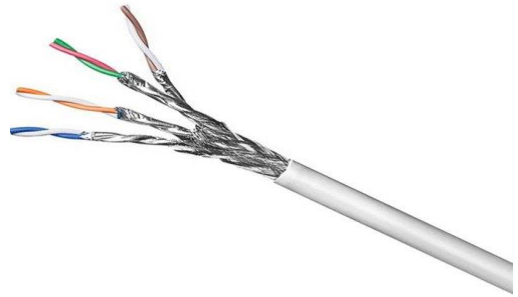
- Coaxial cable

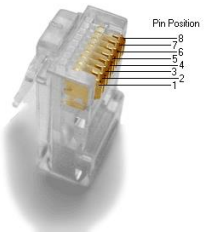
- Fiber optic

Network Devices (Hardware) -Transmission Media

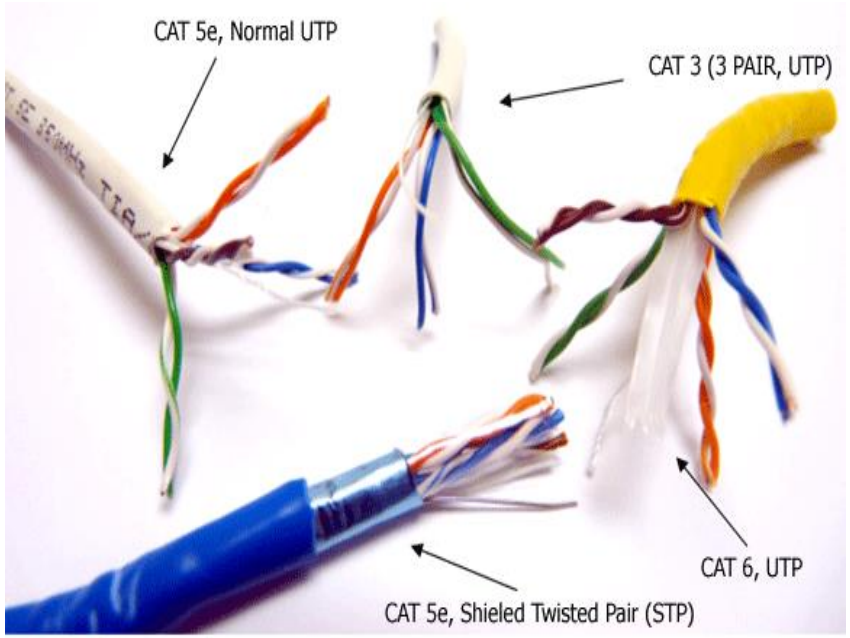
Network Transmission Media -Twisted pair cable

- Most widely used (Ethernet networks)
- Two basic types
  - STP
    - Shielded twisted pair
    - Protected
    - Hard to install
  - UTP
    - Unshielded twisted pair
    - Most common
    - Easy to install
    - Less expensive
    - Effected By electromagnetic interference
- Use RJ-45 connectors
- Crimper tool attach the twisted pair cable to RJ-45





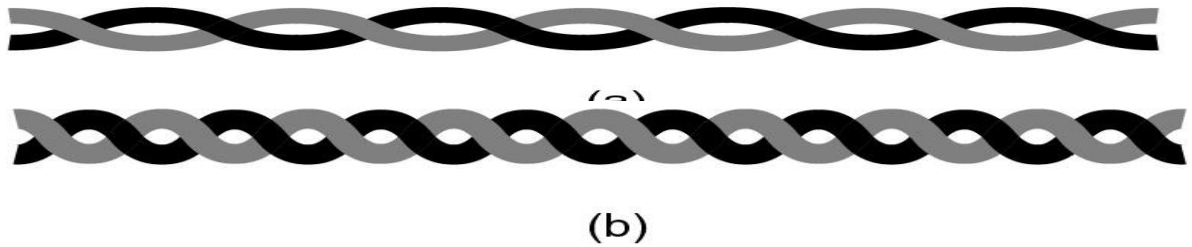
UTP Categories



Type	Use
Category 1	Voice Only (Telephone Wire)
Category 5	Data to 100 Mbps (Fast Ethernet)
Category 5e	Data to 1 Gbps (Giga Ethernet)
Category 6	Data to 1 – 10 Gbps (Giga Ethernet)

(a) Category 3 UTP.

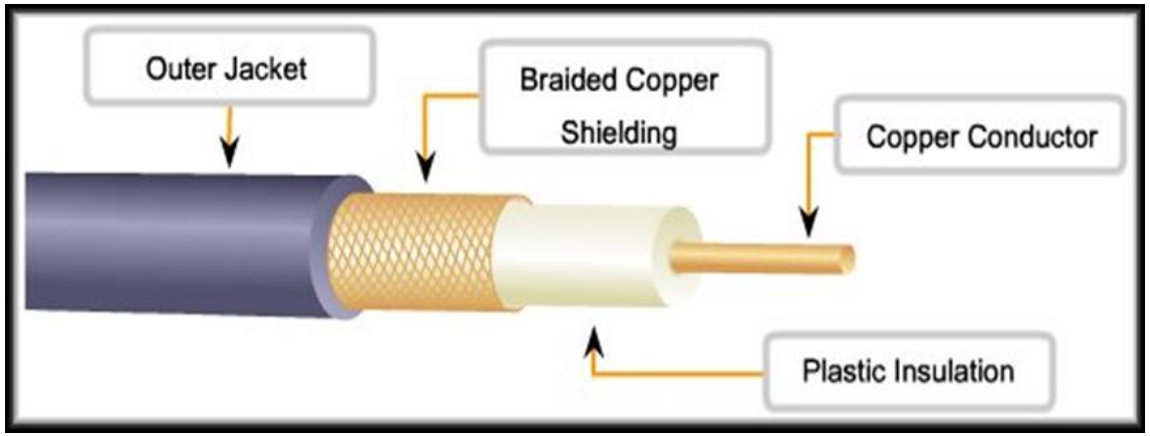
(b) Category 5 UTP.



Network Devices (Hardware) -Transmission Media

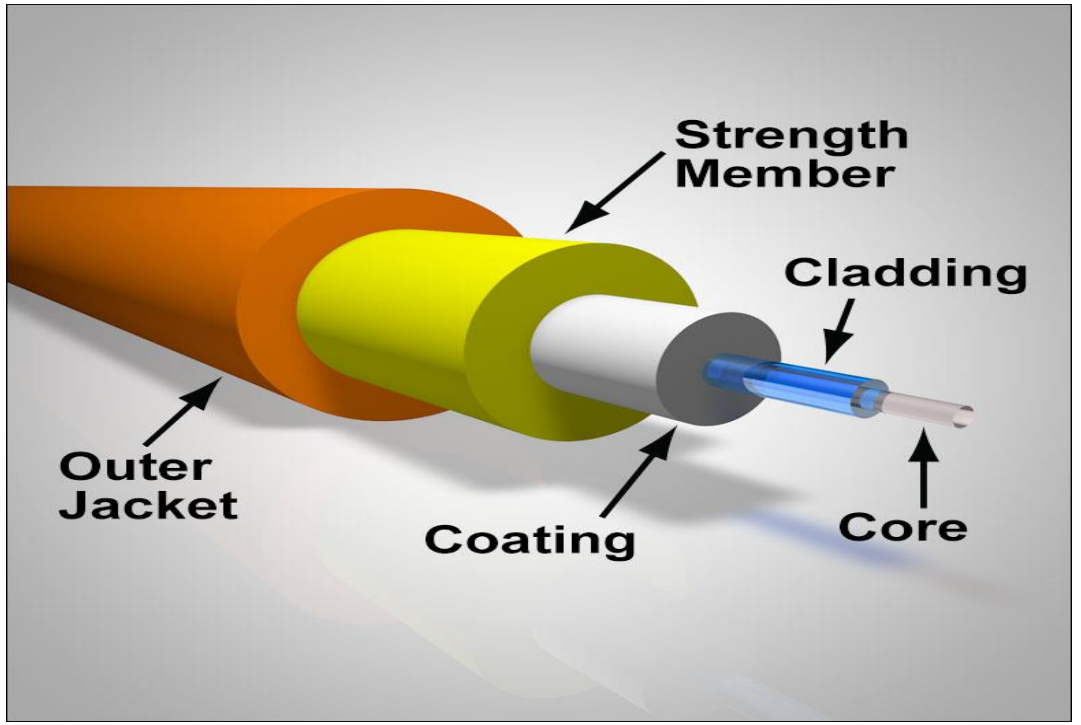
Coaxial Cable

- High capacity cable
- Used for video transfer
- Has two types
  - Thick coaxial cable (Thicknet)
    - ½ inch diameter
  - Thin coaxial cable (Thinnet)
    - ¼ inch diameter
- Use BNC connector



Fiber optic

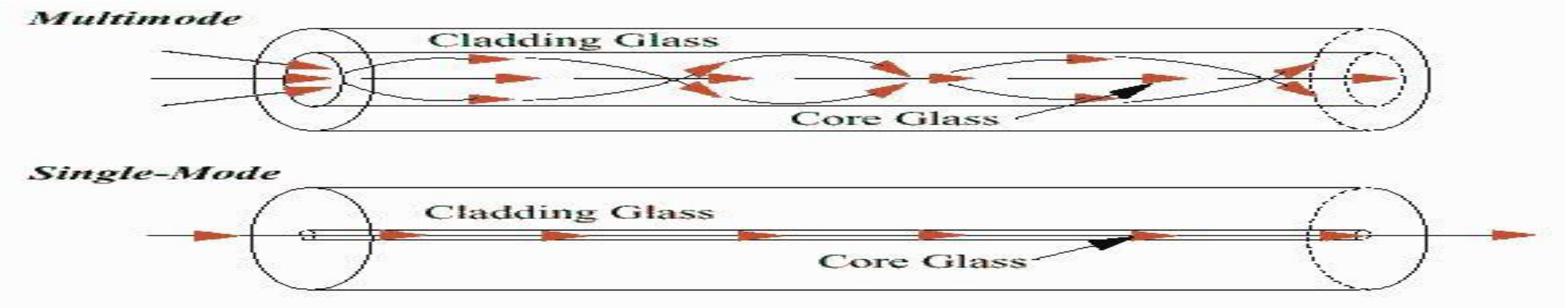
- Fiber optic cabling is composted of the following components:
- The core that carries the signals. It is made of plastic or glass
- The cladding maintains the signal in the center of the core as the cable bends.
- The sheathing protects the cladding and the core



Network Devices (Hardware) -Transmission Media

Fiber Optic Types

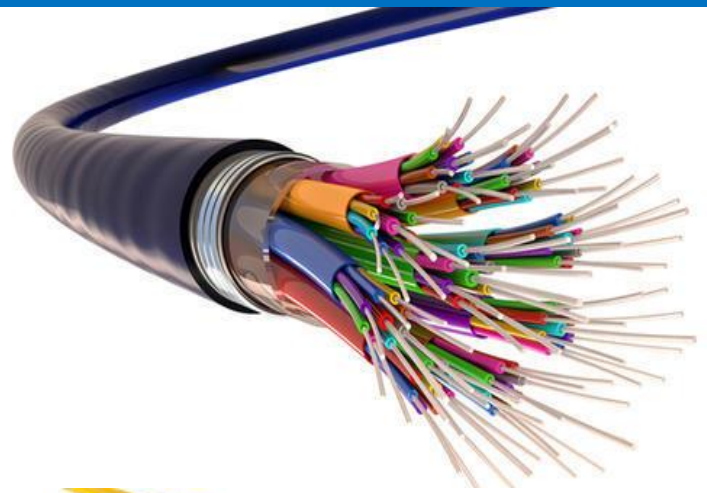
Type	Description
Single Mode	• Transfer data through the core using a single light ray • The core diameter is around 9 microns • Supports a large amount of data • Cable length can extended a great distance
Multi-Mode	• Transfers the data through the core using multiple light rays • The core diameter is around 50 to 50 microns • Cable length are limited in distance compared to single mode



Network Devices (Hardware) -Transmission Media

Fiber Optic advantages

- Advantages
  - Faster than twisted pair and coaxial
  - Send data as light pulses over glass medium
  - Free of electromagnetic interference
  - Highly resistance to Eavesdropping
  - Support extremely high data transfer rate
  - Allow grater cable distances without repeater
- Disadvantages
  - Expensive
  - Hard to install



Thanks