NETWORK TOPOLOGIES

Networked computers

■ Computers connected to each other

– Wired connections using cables

– Wireless using WIFI, 4G/5G

■ We will concentrate on wired arrangement

Physical & Logical Topologies

■ Physical Topologies define the actual layout of the wire (media)

– eg. The wiring in the computer labs are laid out in an extended star arrangement

– Terminology: Network Interface Card (NIC), Unshielded Twisted Pair (UTP), Shielded Twisted Pair (STP)

■ Logical Topology defines how the media is accessed by the hosts

– eg. In the computer labs, hosts access the media on a first come, first served basis.

PHYSICAL TOPOLOGIES

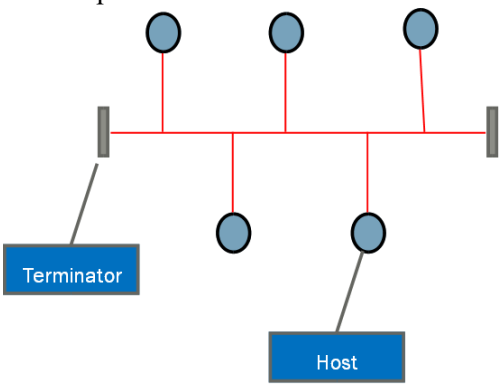
Bus topology:

■ Single backbone

■ All hosts connected to the backbone

■ Each end must be terminated

■ Susceptible to collisions

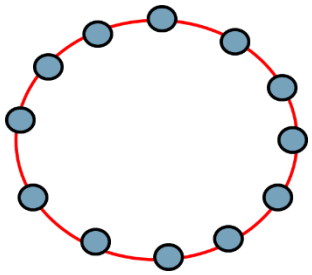


Ring Topology:

■ No Backbone

■ A host is directly connected to each of its neighbors

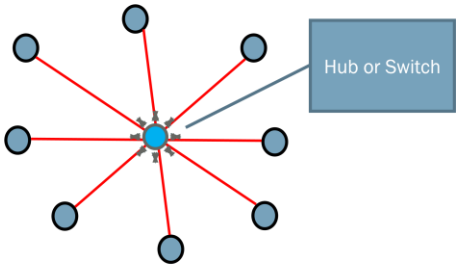
■ Used for Token Passing logical topologies



Star Topology:

■ All devices connected to a central point

■ Used for Ethernet technologies



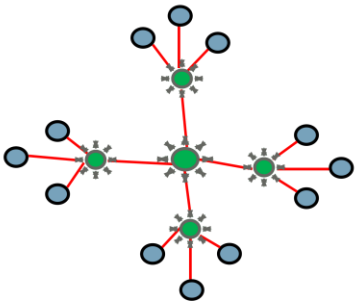
Extended Star Topology:

■ Connects Star topologies together

■ Fractal pattern

■ At the center of Star is a Hub or Switch

■ Extends the size of the network

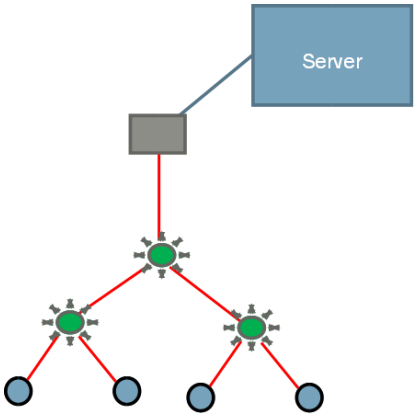


Hierarchical Topology:

■ Like the extended star

■ Except a computer controls traffic

– NOT a Hub or Switch



Mesh Topology:

■ Maximally connected:

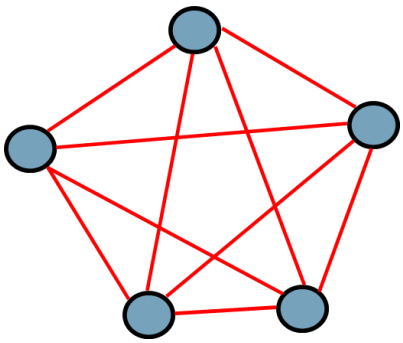
– Each host has its own connection to every other host

– Use for critical systems

■ Non-maximally connected:

– Not every host is connected to every other host

– Alternate routes if there are problems



Logical Topologies:

■ **Broadcast Topology:**

– Each host on the LAN sends (or broadcasts) its data to every other host.

– Access to media is based on “First come, first served.”

– Ethernet works this way

■ **Token Passing Topology:**

– Access to media is controlled by an electronic token

– Possession of the token gives the host the right to pass data onto the media.

TYPES OF NETWORKS

Peer-to-Peer Network

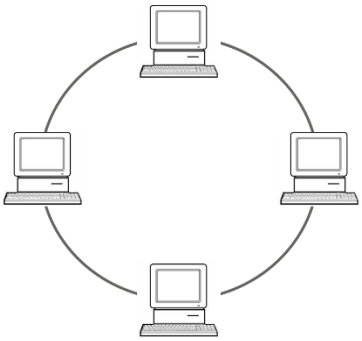
■ Networked computers are equal partners

■ Each computer can be a Server or Client

■ Each component controls its own resources

■ Resources can be shared

■ Suitable for small networks



Client/Server Network

■ Network services are located on a dedicated computer

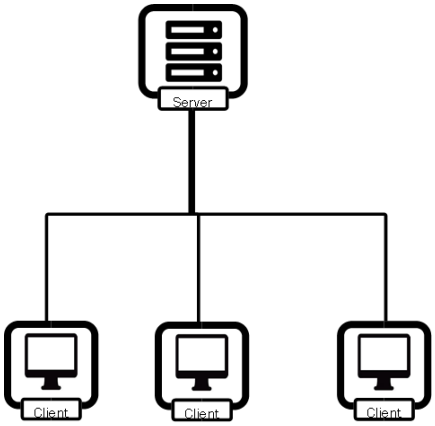
– The Server

■ Server responds to requests from Clients

■ Resources are shared

■ Server can serve many Clients simultaneously

■ Needs an administrator



Terminology: Sizes Of Networks

■ LAN

– Local Area Network

■ WAN

– Wide Area Network

■ MAN

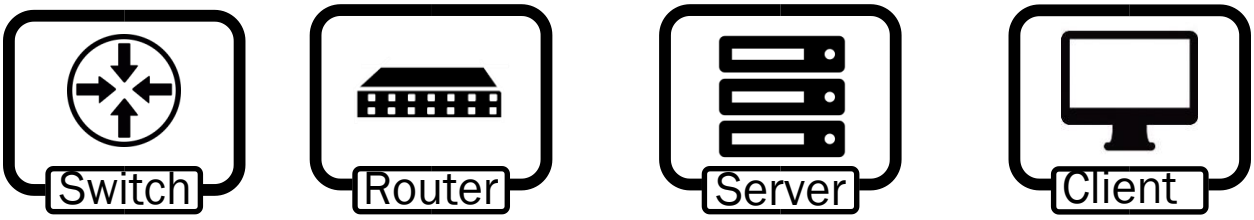
– Metropolitan Area Network

■ SAN

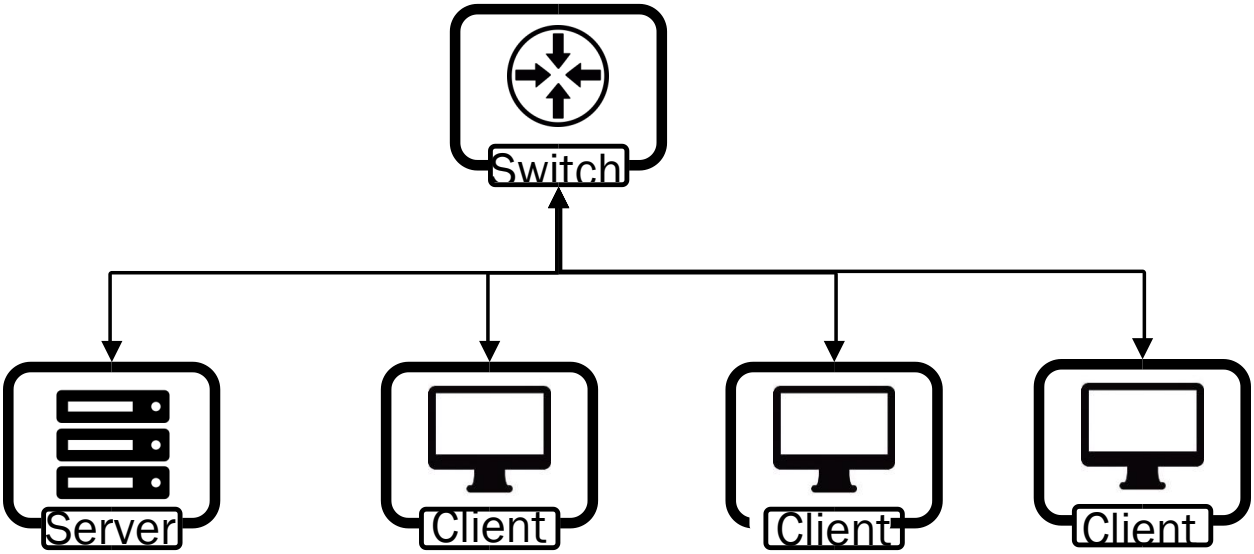
– Storage Area Network

NETWORK COMPONENTS

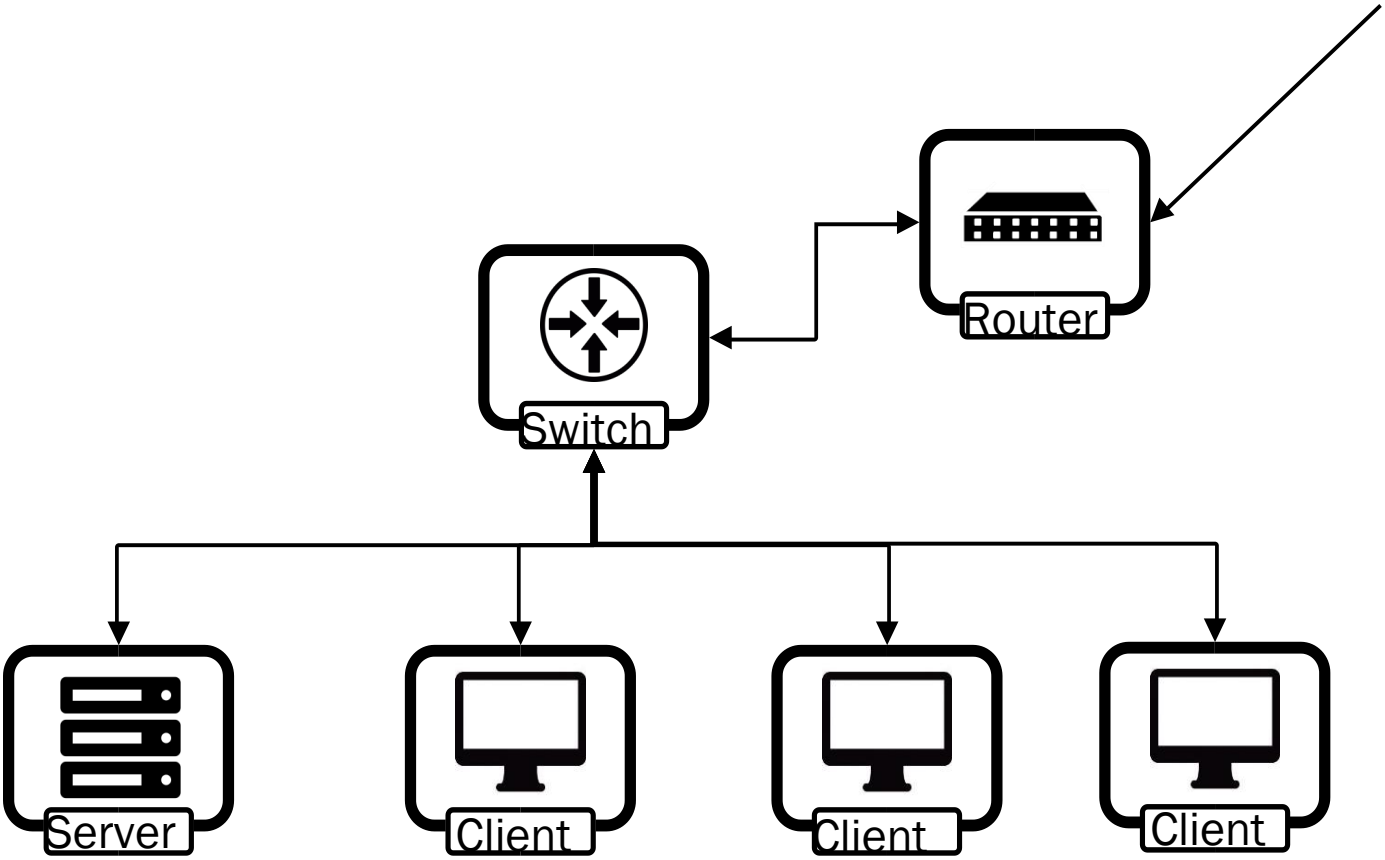
Network Components:



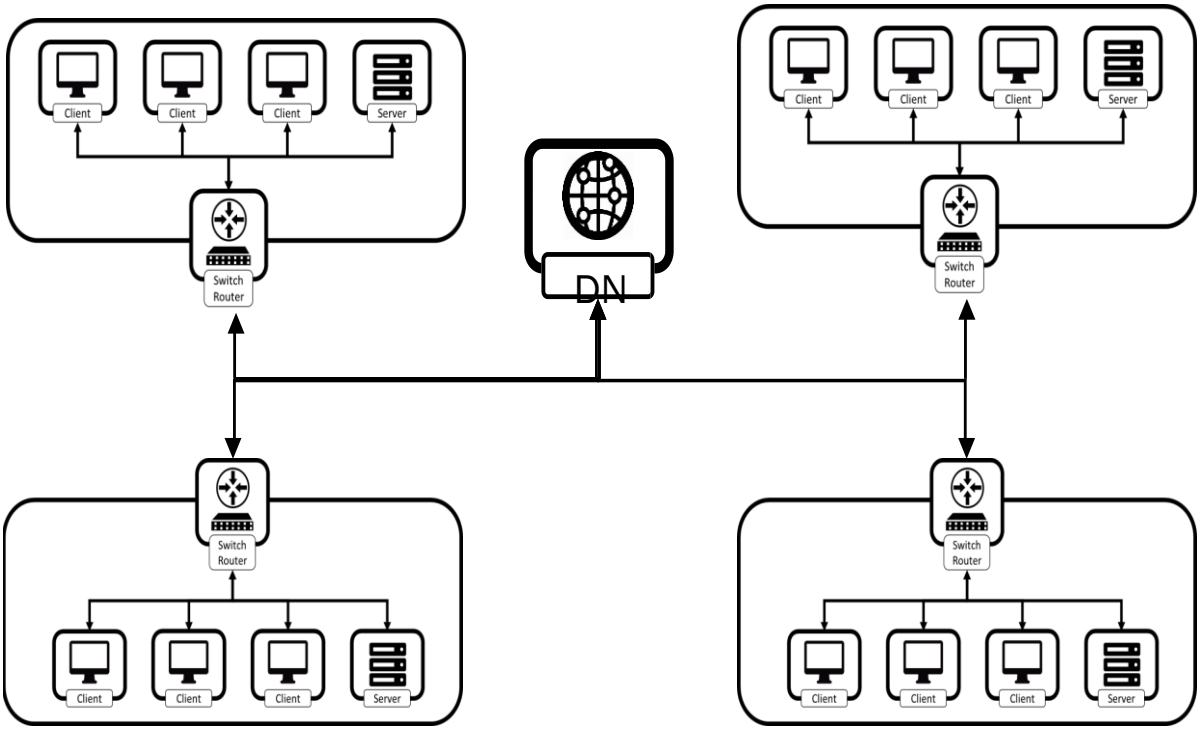
Closed Network:



Sub-Network:



Complete Network:



IP ADDRESSING

IP Addresses:

■ Unique Identification of: – Network Host

■ Source

■ Destination

■ Identifies machine's connection to a network

■ Moving to another network requires change of IP address

■ Assigned by authorities such as:

– RIPE (Regional Internet Registry for Europe)

– ARIN (American Registry for Internet Numbers)

– LIR (Local Internet Registries)

■ TCP/IP uses unique 32-bit address – Transmission Control Protocol / Internet Protocol

IP Addressing, Limitations

■ IPv4

– 32 bit address

– Broken into 4 groups of 8 bits

– 2 to the power 32 addresses in total

– 4,294,967,296

– ~2 addresses for every 3 persons on Earth

■ IPv6

– 128 bit address

– Broken into 12 groups of 8 bits

– 2 to the power 128 addresses in total

– ~3.4 × 1038

– ~5 × 1028 addresses per persons on Earth

Basic Structure of An IP V4 Address

■ 32-bit number (4 octet number ; octet = 8 bits) – Decimal representation:

■ 133.27.168.125 – Binary representation:

■ 10001010.00011011.10101000.01111101 – Hexadecimal representation:

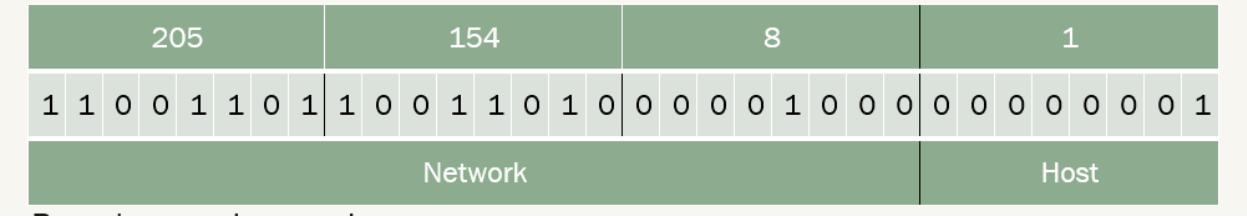
■ 85.1B.A2.7D

Anatomy of an IP Address:

■ Hierarchical Division in IP Address: – Network Part (Prefix)

■ Describes which physical network – Host Part (Host Address)

■ Describes which host on that network



■ Boundary can be anywhere – Very often NOT at a multiple of 8 bits

IP Calculations Terminology:

■ Network Address: – Identifies this network

■ Broadcast Address: – Special IP address used to send a message to all the hosts on this network

■ Valid Host Address: – And IP address that can be allocated to a host in this network

Three Flavors of Network Masks:

■ CIDR

– Classless Inter-Domain Routing

– Network Prefix

– 192.168.1.0/24

■ Network Mask

– Bitmask

– 255.255.255.0

■ Classful systems

Classless Addressing

■ Internet routing and address management today is classless

■ CIDR = Classless Inter-Domain Routing

■ VLSM = Variable–Length Subnet Masks