Introduction to Data Communications and Networks *(CYB 204)*

Introduction

Egena Onu, Ph.D.
Department of Computer Science
Bingham University
Karu.

Module Delivery

- 2 hours of lecture per week.
- Exam = 70%
- CA = 20%
- Attendance = 10%

Module Objective

- At the end of this module, you will be able to differentiate the different classifications of computer networks.

- Understand:
  - Computer Architectures
  - Types of Computer Networks
  - Local Area Network (LAN) Technologies

Introduction

- A system of interconnected computers and computerised peripherals such as printers is called a network.
- The interconnection among computers facilitates information sharing.
- Computers may connect to one another by either wired or wireless media.

Classification of Computer Networks

- Computer networks are classified based on various factors:
  - Geographical span
  - Inter-connectivity
  - Administration
  - Architecture

Geographical Span

- Geographically, a network can be viewed in the following categories:
  - It may be spanned across a table, among Bluetooth enabled devices covering a few meters.
  - It may be spanned across an entire building, including intermediate devices to connect all floors.
  - It may be spanned to cover a city.
  - It may be one network covering the whole world.

Inter-Connectivity

- Components of a network can be connected to each other differently in some fashion.
- Connected means either logically, physically, or both ways.
  - Every single device can be connected to every other device on the network to create a mesh.
  - All devices can be connected to a single medium but geographically disconnected to create a bus-like structure.

Inter-Connectivity

- All devices are connected together to create a star-like structure.

- All devices connected arbitrarily using all previous ways to connect each other thereby resulting in a hybrid structure.

Administration

- From an administrator's point of view, a network can be private or public.
  - A private network is a network that belongs to a single autonomous system and cannot be accessed outside its physical or logical domain.
  - A public network is one which is accessible to everyone.

Network Architecture

- Computer networks can be defined based on different architectures such as client-server, point-to-point and hybrid.

  - **Client-Server**
    - A client-server architecture is one in which two or more computers are connected with one being the client and the other acts as the sever.

    - The clients request services from the server who in response, provide such services if they are available.

Network Architecture

- **Point-to-Point**
  - In this network, systems are connected in a point-to-point fashion.
  - These systems reside on the same level and are called peers.
- **Hybrid**
  - A hybrid architecture involves the connections that utilises both architectures described earlier.

Network Applications

- Computer systems and peripherals are connected to form a network that provide numerous services such as:
  1. Resource sharing such as printers and storage devices.
  2. Exchange of information through e-mails and FTP.
  3. Interaction with other users using dynamic web pages.
  4. IP Phones.
  5. Video conferencing.
  6. Parallel computing.
  7. Instant messaging.

Types of Computer Networks

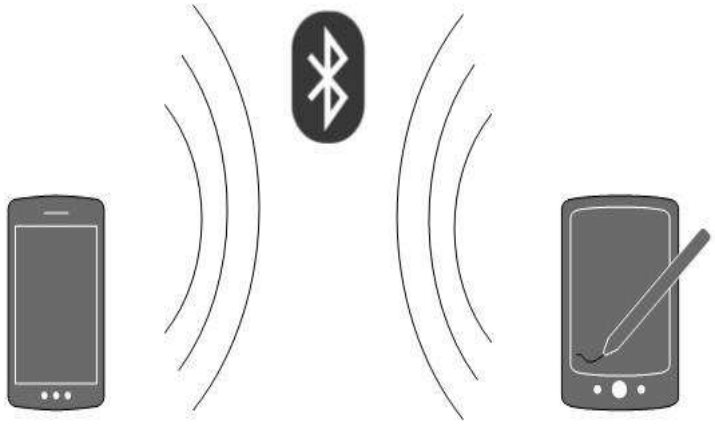
- As stated earlier, a computer network is distinguished based on the area it can cover.
- A network may cover distance as small between the mobile phone and its Bluetooth earpiece and as large as the entire world.
- The types of computer networks include:
  - Personal Area Network (PAN)
  - Local Area Network (LAN)
  - Metropolitan Area Network (MAN)
  - Wide Area Network (WAN)

Types of Computer Networks

- **Personal Area Network (PAN):**
  - A PAN is the smallest network and is very personal to a user.
  - PAN may include Bluetooth enabled devices or infra-red enabled devices.
  - PAN has a connectivity range of up to 10 meters.
  - PAN may include wireless computer keyboard and mouse, Bluetooth headphones, wireless printers and TV remotes.

Types of Computer Networks

- **Personal Area Network (PAN):**
  - PAN may take up eight devices in a master-slave fashion.



Types of Computer Networks

- **Local Area Network (LAN):**
  - LAN is a computer network that covers inside a building and operated under a single administrative system.
  - LAN covers an organisation's offices, colleges or universities.
  - The number of systems connected in LAN may vary from two to as much as 16 million.

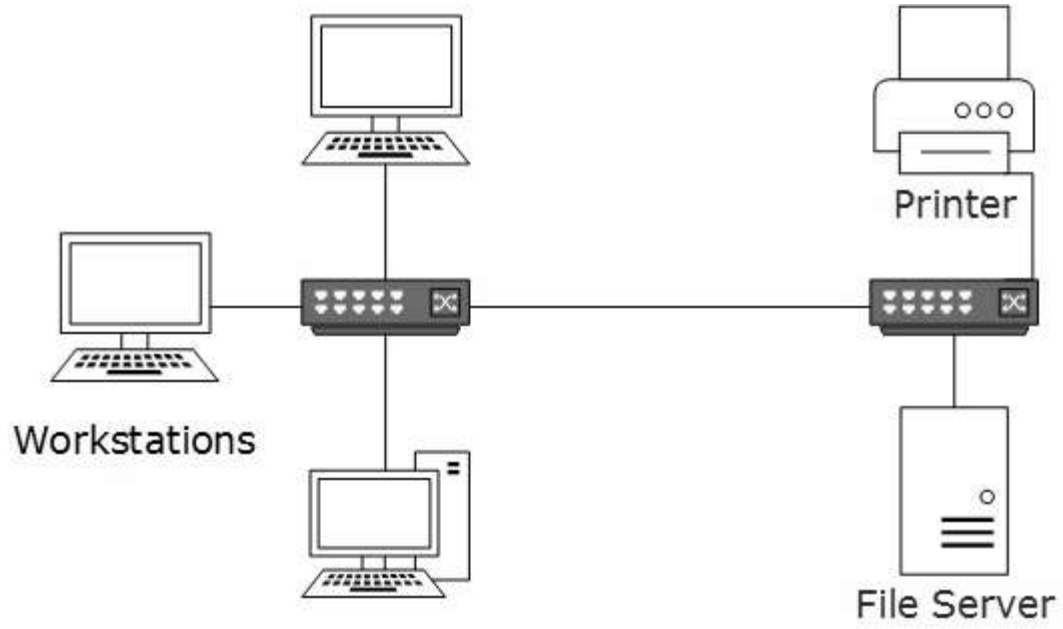
Types of Computer Networks

- **Local Area Network (LAN):**
  - LAN provides a useful way of sharing resources between end users.
  - These resources include: printers, scanners, and the internet that are sharable among computers.
  - LANs are composed of networking and routing equipments such as hubs, switches and routers.
  - A LAN may contain local servers serving file storage and other locally shared applications.

Types of Computer Networks

- **Local Area Network (LAN):**
  - A LAN mostly operates on private IP addresses and does not involve heavy routing.
  - LAN works under a local domain and controlled centrally.
  - LAN uses either Ethernet or Token-ring technology.
  - Ethernet is the mostly widely employed LAN technology.
  - A LAN can be wired, wireless or in both form at any time.

Types of Computer Networks



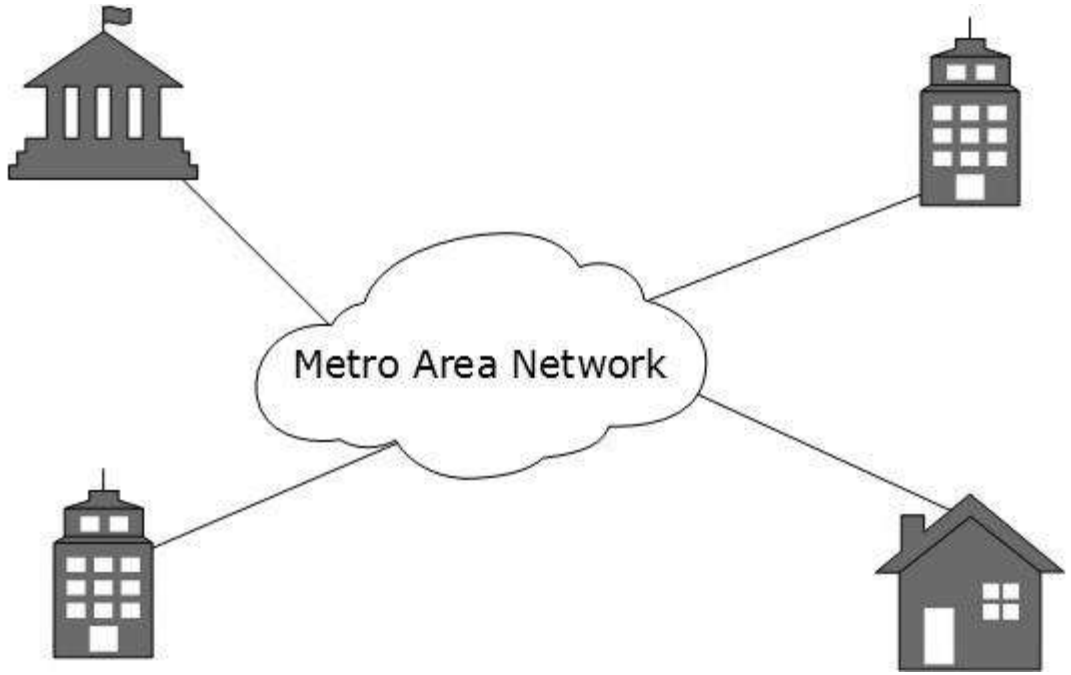
Types of Computer Networks

- **Metropolitan Area Network (MAN):**
  - MAN is a computer network that covers an entire city, such as cable TV networks.
  - MAN can use Ethernet, Token-ring, Asynchronous Transfer Mode (ATM), or Fiber Distributed Data Interface (FDDI).
  - Metro Ethernet is a service provided by ISPs.
  - This service enables users to expand their LANs.
  - For example, MAN can help an organisation to connect all of its offices in a city.

Types of Computer Networks

- **Metropolitan Area Network (MAN):**
  - The backbone of a MAN is a high-capacity and high-speed fiber optics.
  - MAN works in between LAN and Wide Area Network (WAN).
  - MAN provides the uplink for LANs to WANs or internet.

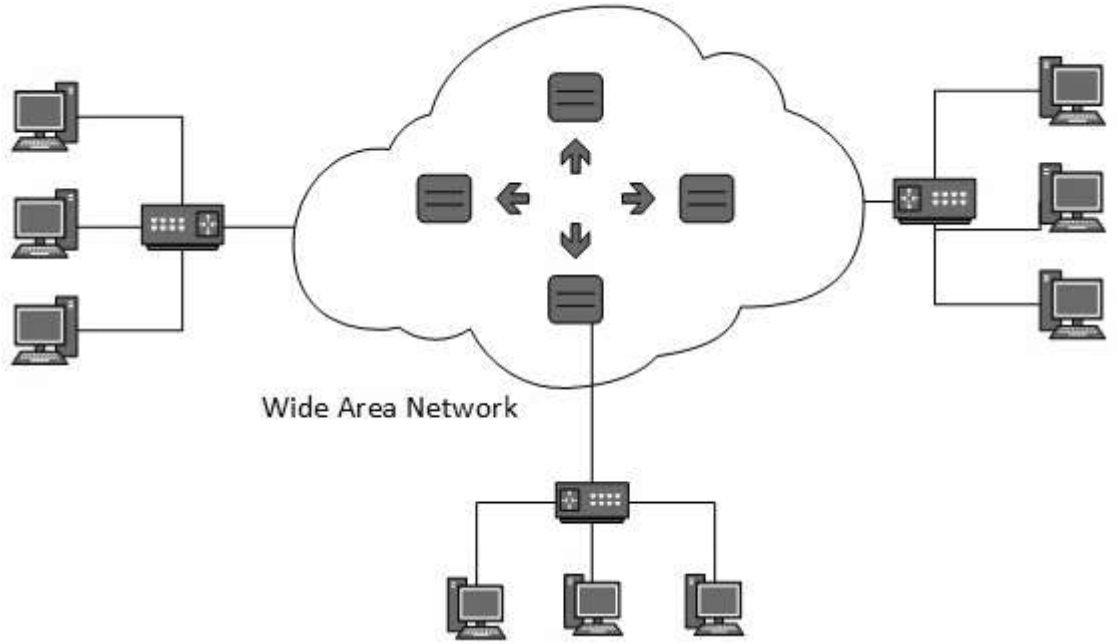
Types of Computer Networks



Types of Computer Networks

- **Wide Area Network (WAN):**
  - WAN covers a large area which may be a province or a country.
  - Telecommunication networks are WANs.
  - These networks provide connectivity to MANs and LANs.
  - WANS are equipped with high speed backbone.
  - WAN may use advanced technologies such as Asynchronous Transfer Mode (ATM), Frame Relay, and Synchronous Optical Network (SONET).
  - WAN may be managed by multiple administration.

Types of Computer Networks



Types of Computer Networks

- **Internetwork:**
  - Internetwork is the network of networks and simply referred to as Internet.
  - The internet is the largest network on the planet.
  - It connects all WANs thus bringing connections to homes and offices AKA LANs.
  - The Internet uses TCP/IP protocol suite and uses IP as the addressing protocol.

Types of Computer Networks

- **Internetwork:**
  - The internet allows users to share and access enormous amount of information using World Wide Web (WWW), FTP, email services, audio and video streaming services and a host of others.
  - The internet is based on the client-server architecture.
  - Internet uses high speed fiber optics backbone as the medium of transmission.

Types of Computer Networks

- **Internetwork:**
  - To inter-connect the various continents, fiber optic cables are laid under the sea and referred to as “submarine communication cables”.
  - Internet is widely deployed on the WWW services using HTML linked pages and accessible by client software known as the Web Browsers.

Types of Computer Networks

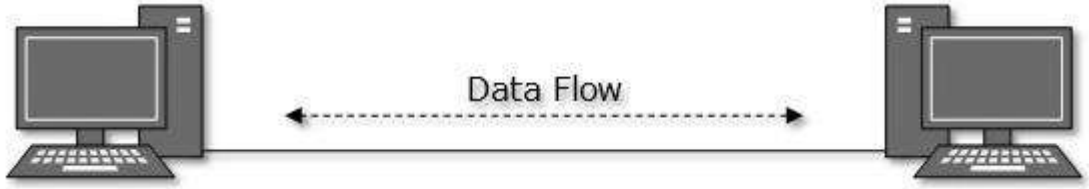
- **Internetwork:**
  - The internet serves many purposes and is involved in many aspects of our lives such as:
    1. Web sites
    2. E-mail
    3. Instant messaging
    4. Blogging
    5. Social Media
    6. Marketing
    7. Networking
    8. Resource sharing
    9. Audio and Video streaming.

Network Topologies

- A network topology is the arrangement in which network devices and user devices are connected.
- Topology may define both physical and logical aspect of the network.
- Both logical and physical topologies could be same or different in the same network.
- Network topologies include:

Network Topologies

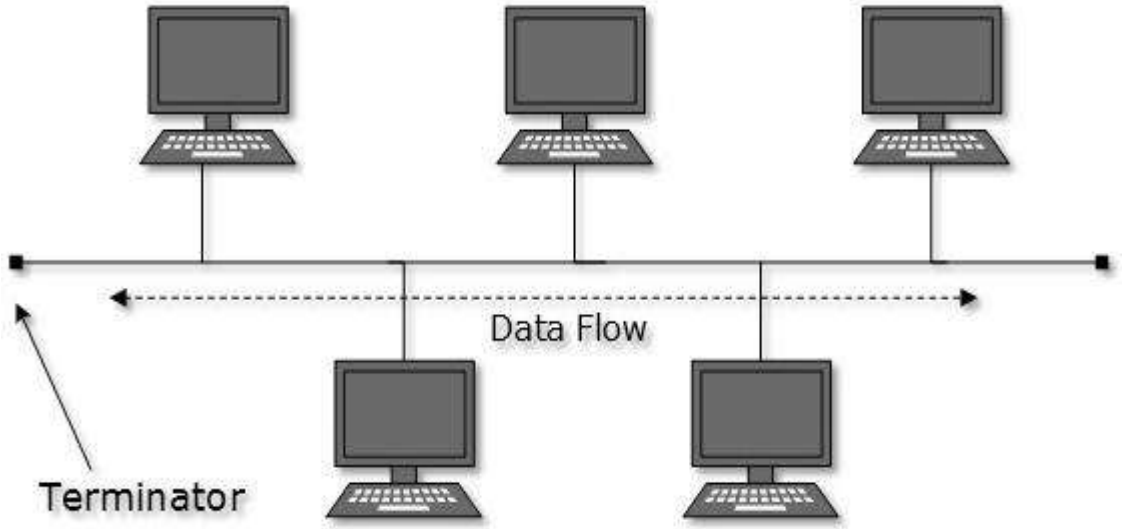
- **Point-to-Point**
  - In point-to-point networks, two host are directly connected to each other.
  - These host could be computers, switches, routers, or servers that are connected back to back using a single cable.



  - In any case, the receiving end is connected to the sending end or vice versa. If the he hosts are connected point-to-point logically, then they may have multiple intermediate devices.
  - In logical connections, the end hosts are unaware of the underlying network and see each other as though they are directly connected.

Network Topologies

- **Bus Topology**
  - In bus topology, all the devices share a single communication line/cable.
  - CSMA/CD technology is essential to bus topology because multiple hosts may send data at the same time.
  - Other than CSMA/CD, the hosts on the network may recognise one host as the bus
  - .



Network Topologies

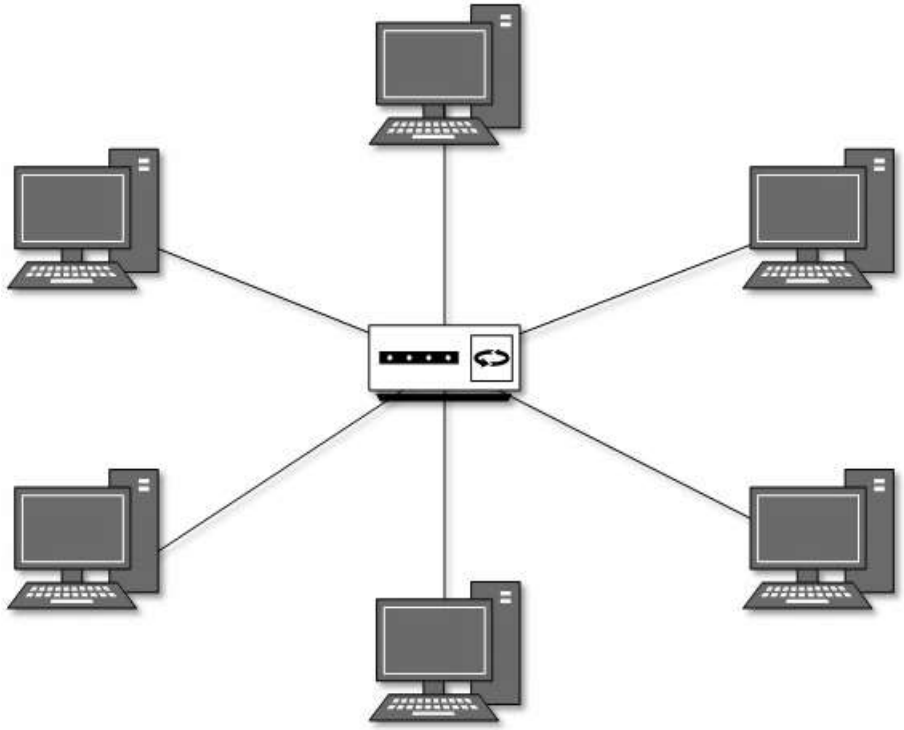
- **Bus Topology**
  - This topology is a simple form of networking in which the failure of a device does not affect the others.
  - However, failure of the shared medium affects the all the devices.
  - Both ends of the shared medium have a line terminator.
  - Data sent in only one direction and gets terminated when it reaches the extreme end.

Network Topologies

- **Star Topology**
  - In this topology, all the hosts are connected to a central device known as the hub.
  - Host to hub connection is achieved using a point-to-connection.
  - The hub device can be a:
    - Layer 1 device such as a hub or a repeater.
    - Layer-2 device such as a switch or a bridge.
    - Layer-3 device such as a router or a gateway.

Network Topologies

- **Star Topology**



Network Topologies

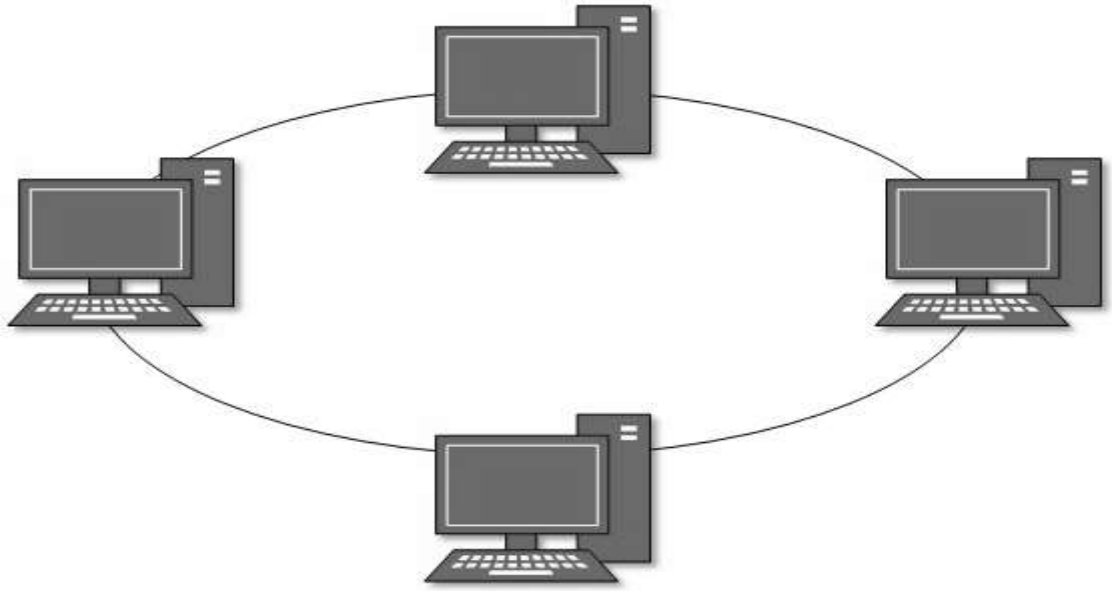
- **Star Topology**
  - In star topology, the hub is a single point of failure.
  - If the hub fails, connectivity fails, consequentially.
  - Communication between hosts takes place through the hub.

Network Topologies

- **Ring Topology**
- In this topology, each system connects exactly to other system to create a circular structure.
- When a system communicates to another, the data goes through all intermediate systems.
- Connecting a new system in this topology requires just one cable.
- A failure of one host results in the failure of the entire network.
- However, a backup ring may be implemented to counter such failure.

Network Topologies

- **Ring Topology**



Network Topologies

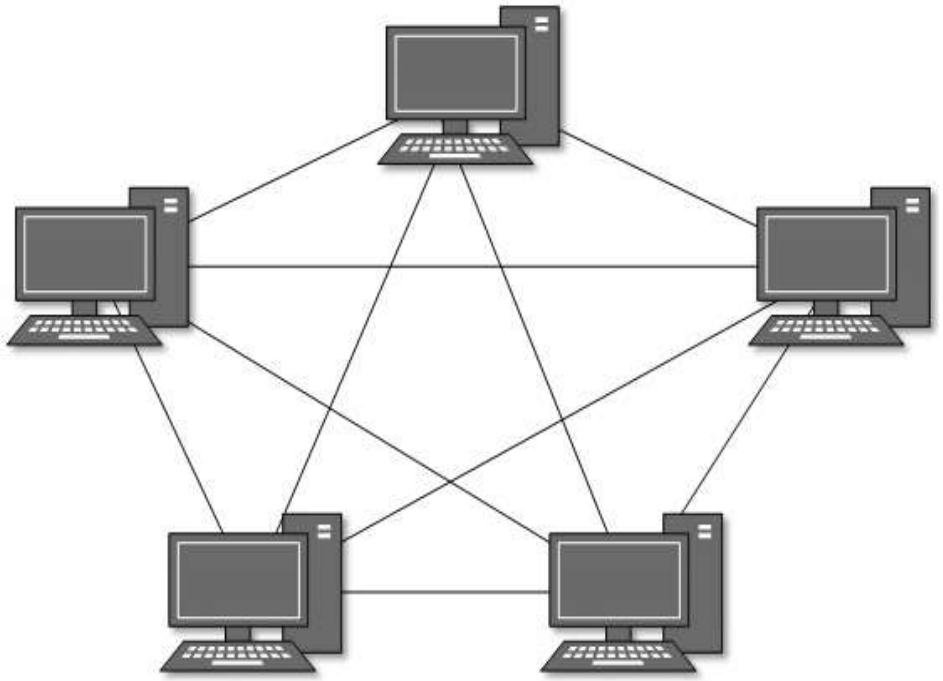
- **Mesh Topology**
  - In mesh topology, a host is connected to one or multiple hosts.
  - The topology utilises point-to-point connection to connect hosts.
  - Hosts in mesh topology may work as relay for other hosts which do not have direct point-to-point links.
  - Mesh topology includes:
    - **Full Mesh:**
      - All hosts have a point-to-point connection to every other host in the network.
      - For every new host, n(n-1)/2 connections are required.
      - This topology provides the most reliable network structure among all network topologies.

Network Topologies

- **Mesh Topology**
  - **Partially Mesh:**
    - In partially mesh topology, some hosts do not have a point-to-point connection to every other host.
    - Hosts connect to each other in some arbitrarily fashion.
    - This topology exists where there is need to provide reliability to some hosts out of all.

Network Topologies

- **Mesh Topology**

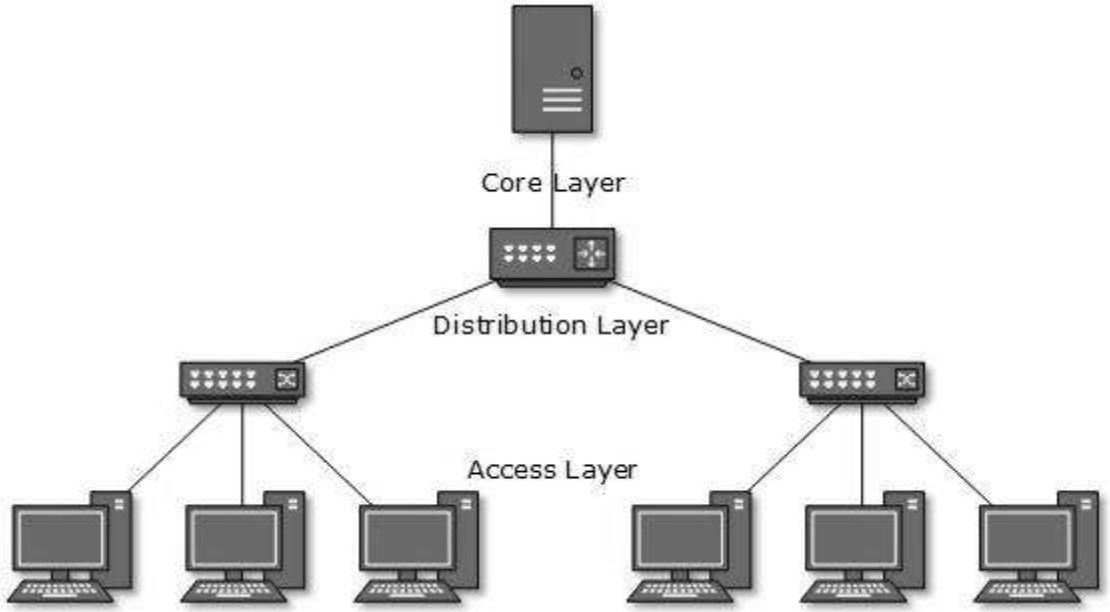


Network Topologies

- **Tree/Hierarchical Topology**
  - This is the most common form of network today.
  - The topology imitates as extended star topology with inherited properties of the bus topology.
  - This topology divides the network into multiple levels/layers of network.
  - In LANs, this topology categorises network devices into three types:
    - The lowermost is the access layer where computers are attached.
    - The middle layer is referred to as the distribution layer and works the mediator between the upper and lower layers.
    - The topmost layer is the core layer, and the central point of the network, i.e. root of the three from which all nodes forks out.

Network Topologies

- **Tree/Hierarchical Topology**



Network Topologies

- **Tree/Hierarchical Topology**
  - All the neighbouring hosts in this topology have a point-to-point connection between them.
  - Just as in bus topology, if the root goes down, the entire network suffers even though it is not a single point of failure.
  - Every connection serves as a point of failure. If the connection fails, it divides the network into unreachable segments.

Network Topologies

- **Daisy Chain Topology**
  - Daisy chain topology connects all the host in a linear fashion.
  - Just like in ring topology, all hosts are connected to two hosts only except the end hosts.

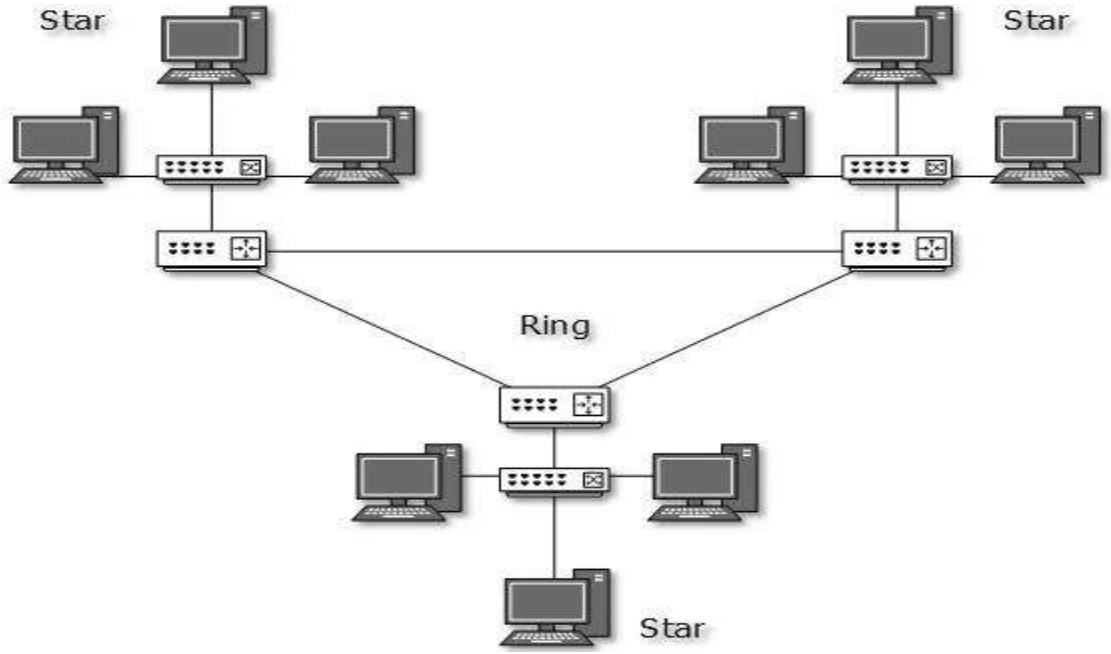
  - Each link represents a single point of failure.
  - Every link failure splits the network into two segments.
  - An intermediate host works as relay for its immediate hosts.

Network Topologies

- **Hybrid Topology**
  - Hybrid is a network whose design contains more than one topology.
  - It inherits the merits and demerits of all the incorporating topologies.
  - The combining topologies may contain attributes of the different topologies.
  - Most WANs are connected by means of dual-Ring topology and networks connected to them are star topology networks.
  - The entire Internet depicts the largest hybrid topology.

Network Topologies

- **Hybrid Topology**



Questions!!!