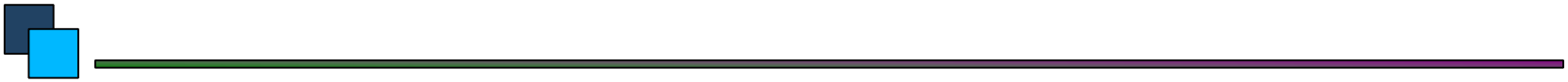
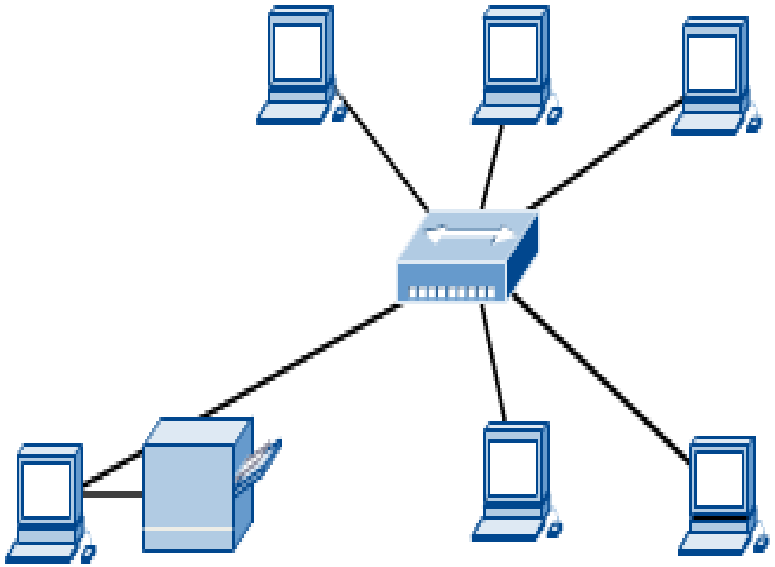


INTRODUCTION TO COMPUTER NETWORKS

Computer Networks

- Computer network connects two or more autonomous computers.
- The computers can be geographically located anywhere.



LAN, MAN & WAN

- Network in small geographical Area (Room, Building or a Campus) is called LAN (Local Area Network)
- Network in a City is call MAN (Metropolitan Area Network)
- Network spread geographically (Country or across Globe) is called WAN (Wide Area Network)

•**LAN EXAMPLES:**
•**Home Wi-Fi Network**: The network connecting your personal devices (smartphones, computers, printers) within your house.
•**Office Network**: The network within an office connecting employee computers, printers, and servers.
•**School Computer Lab**: The network that connects computers and other devices in a school's computer lab.

•**MAN EXAMPLES**
•**City-Wide Wi-Fi**: A public Wi-Fi service provided across an entire city or large urban area.
•**University Campus Network**: A university that has a large network connecting multiple buildings across different parts of a city.
•**Cable TV Network**: Networks that provide cable TV services across a town or city.

- **WAN EXAMPLES**
- **Examples**:
- **The Internet**: The largest WAN, connecting billions of devices worldwide.
- **Corporate WAN**: A multinational company connecting its offices in different countries via private WAN connections.
- **Banking Network**: A bank's network connecting branches, ATMs, and data centers across various cities and countries.

Applications of Networks

- **Resource Sharing**
  - Hardware (computing resources, disks, printers)
  - Software (application software)
- **Information Sharing**
  - Easy accessibility from anywhere (files, databases)
  - Search Capability (WWW)
- **Communication**
  - Email
  - Message broadcast
- **Remote computing**
- **Distributed processing (GRID Computing)**

Types of Computer Network Architecture

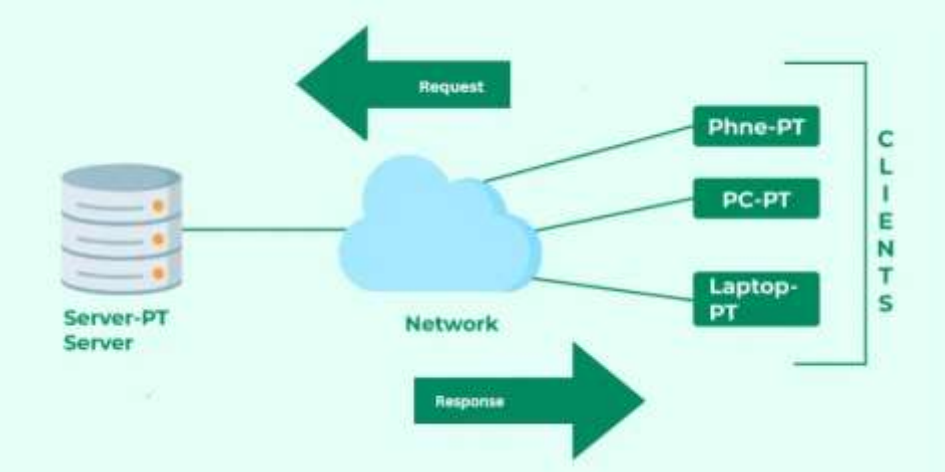
Computer Network falls under these broad Categories:

- **Client-Server Architecture:** Client-Server Architecture is a type of Computer Network Architecture in which Nodes can be Servers or Clients. Here, the server node can manage the Client Node Behaviour.

- **Peer-to-Peer Architecture:** In P2P (Peer-to-Peer) Architecture, there is not any concept of a Central Server. Each device is free for working as either client or server.

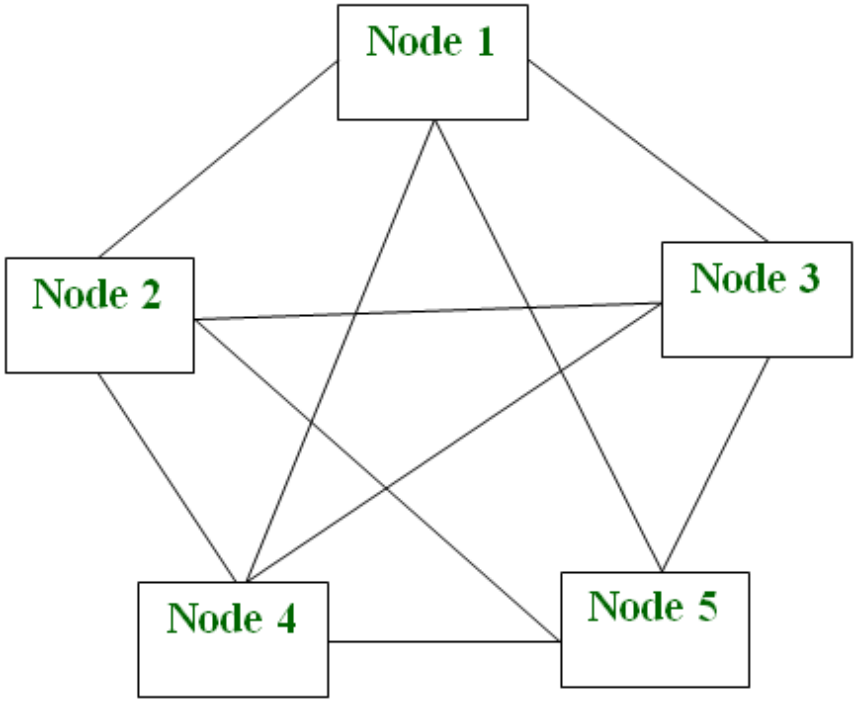
- **How Does the Client-Server Model Work?**
- **Client:** When we say the word **Client**, it means to talk of a person or an organization using a particular service. Similarly in the digital world, a **Client** is a computer (**Host**) i.e. capable of receiving information or using a particular service from the service providers (**Servers**).

- **Servers:** Similarly, when we talk about the word **Servers**, It means a person or medium that serves something. Similarly in this digital world, a **Server** is a remote computer that provides information (data) or access to particular services.



P2P Network Architecture

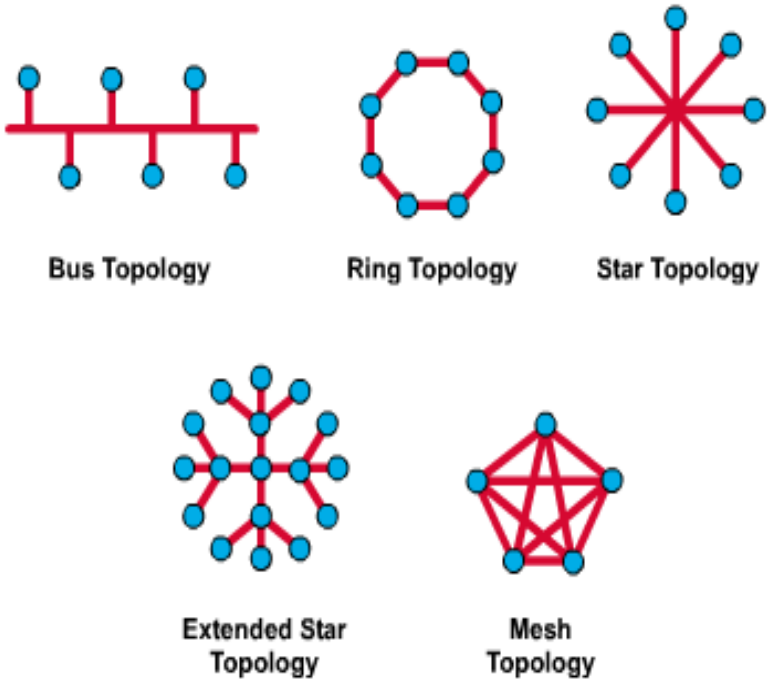
- In the P2P network architecture, the computers connect with each other in a workgroup to share files, and access to internet and printers.
- Each computer in the network has the same set of responsibilities and capabilities.
- Each device in the network serves as both a client and server.
- The architecture is useful in residential areas, small offices, or small companies where each computer act as an independent workstation and stores the data on its hard drive.
- Each computer in the network has the ability to share data with other computers in the network.
- The architecture is usually composed of workgroups of 12 or more computers.



P2P Architecture

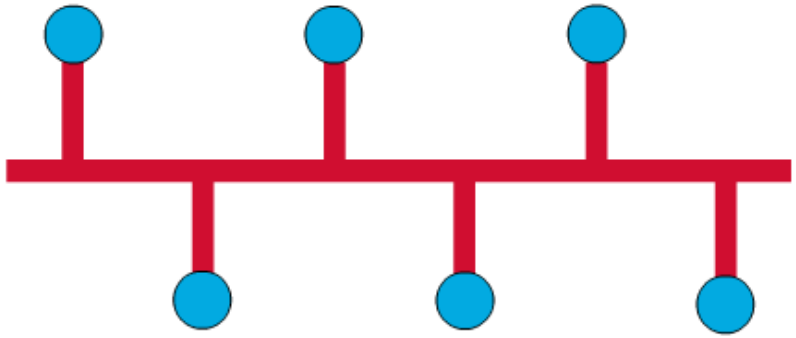
Network Topology

- The network topology defines the way in which computers, printers, and other devices are connected. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.



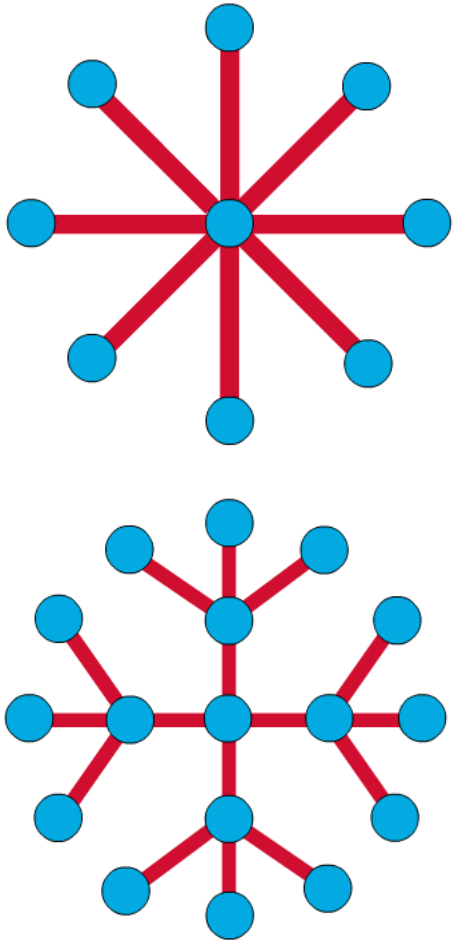
Bus Topology

- Commonly referred to as a linear bus, all the devices on a bus topology are connected by one single cable.



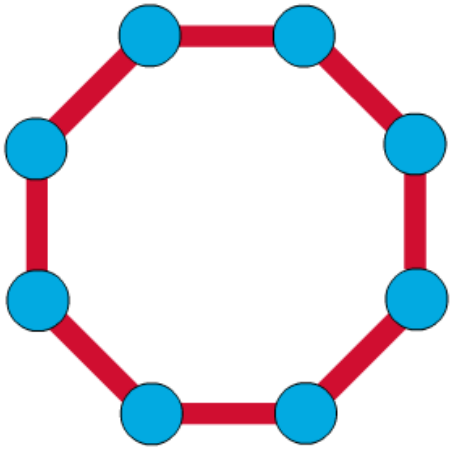
Star & Tree Topology

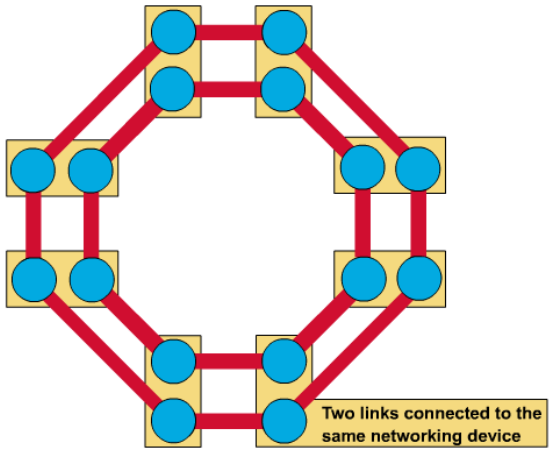
- The star topology is the most commonly used architecture in Ethernet LANs.
- When installed, the star topology resembles spokes in a bicycle wheel.
- Larger networks use the extended star topology also called tree topology. When used with network devices that filter frames or packets, like bridges, switches, and routers, this topology significantly reduces the traffic on the wires by sending packets only to the wires of the destination host.



Ring Topology

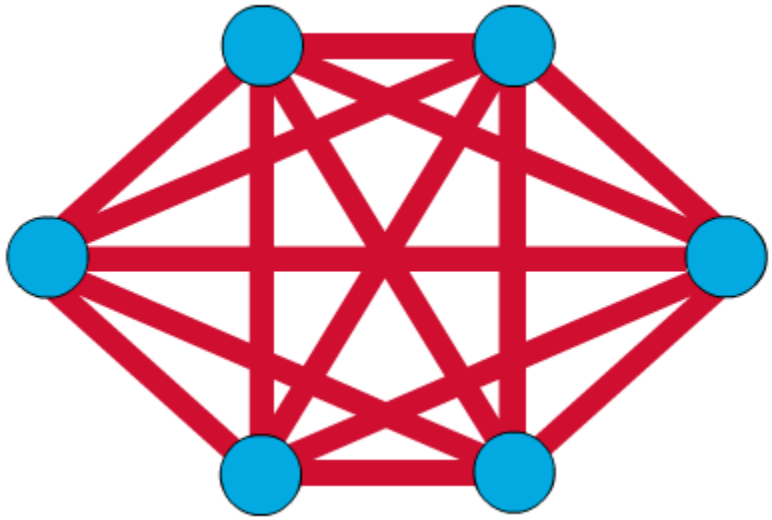
- **A frame travels around the ring, stopping at each node. If a node wants to transmit data, it adds the data as well as the destination address to the frame.**
- **The frame then continues around the ring until it finds the destination node, which takes the data out of the frame.**
  - Single ring – All the devices on the network share a single cable
  - Dual ring – The dual ring topology allows data to be sent in both directions.





Mesh Topology

- The mesh topology connects all devices (nodes) to each other for redundancy and fault tolerance.
- It is used in WANs to interconnect LANs and for mission critical networks like those used by banks and financial institutions.
- Implementing the mesh topology is expensive and difficult.



Network Devices

An interconnection of multiple devices, also known as hosts, that are connected using multiple paths for the purpose of sending/receiving data or media. Computer networks can also include multiple devices/mediums which help in the communication between two different devices; these are known as Network devices and include things such as routers, switches, hubs, and bridges.

Network Hardware Components

These are the physical devices that form the foundation of a network and enable communication between devices.

- **Router**: A device that routes data from one network to another. Routers connect different networks (e.g., your home network to the internet) and direct data packets to their destinations.
- **Switch**: A switch connects multiple devices within a network, such as computers or printers, and facilitates communication by forwarding data to the correct device. It operates at the Data Link layer (Layer 2 of the OSI model).

Router

Hub

Bridge

Wireless Router

Switch

Wireless Bridge

•**Modem**: Short for "modulator-demodulator," a modem converts digital data from a computer into signals that can be sent over analog communication lines (like a phone line) and vice versa.

•**Network Interface Card (NIC)**: A hardware component inside a computer that allows it to connect to a network, either through a wired Ethernet connection or wirelessly.

•**Access Points (APs)**: These are devices that allow wireless devices to connect to a wired network, typically part of a Wi-Fi network.
•**Cables (Ethernet, Fiber Optic)**: These are physical connections (wired) that link devices together. Ethernet cables (CAT5, CAT6) are common for wired connections, while fiber optic cables are used for high-speed data transmission over longer distances.

•**Firewall (Hardware)**: A dedicated network security device that monitors and controls incoming and outgoing network traffic based on predetermined security rules.

Network Software Components
These are the programs and protocols that manage network communication, security, and functionality.

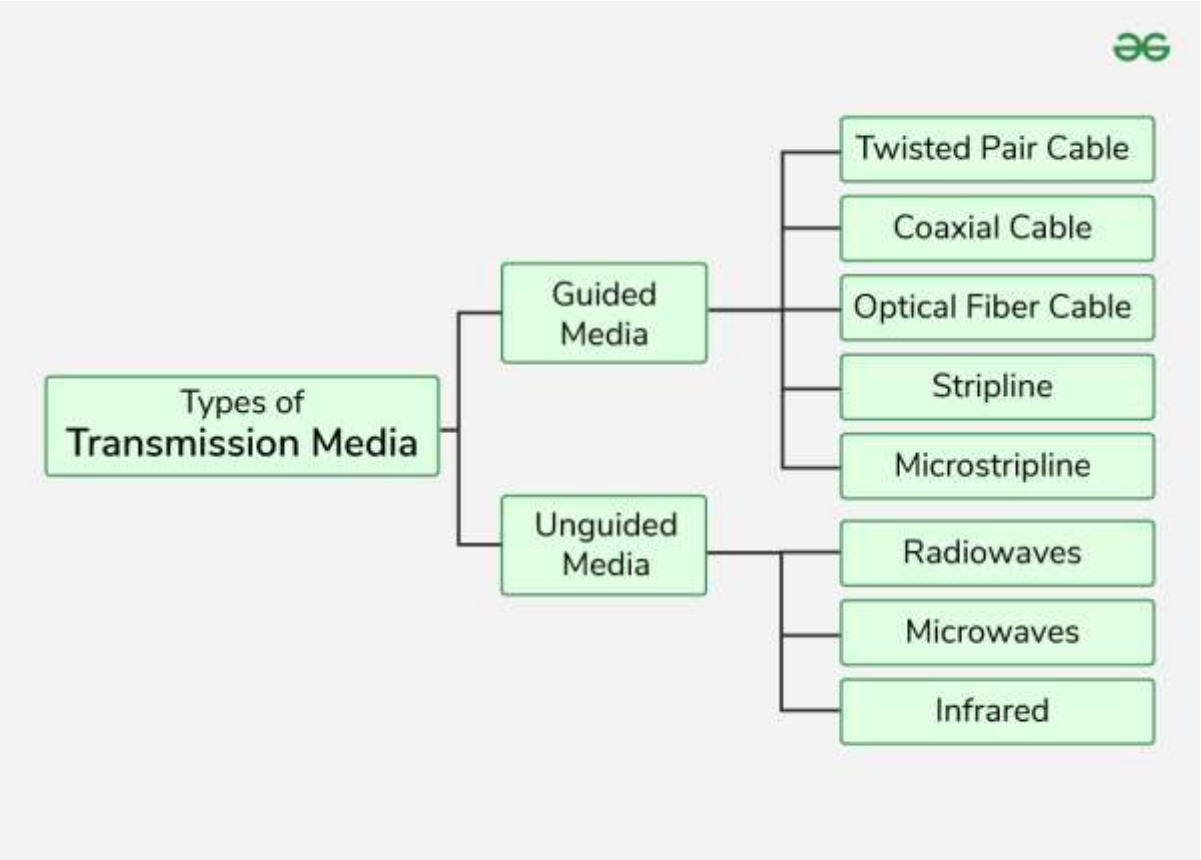
•**Operating System (OS)**: Network devices, such as routers, switches, and firewalls, often run specialized operating systems. For example, Cisco routers run on Cisco IOS, while Windows and Linux are commonly used for managing networks on computers.

•**Network Protocols**: Protocols are rules that govern data communication over a network. Common ones include:

- **TCP/IP**: The suite of communication protocols used for the internet and similar networks.
- **HTTP/HTTPS**: Protocols for transmitting hypertext over the web.
- **FTP (File Transfer Protocol)**: A protocol for transferring files over a network.
- **DNS (Domain Name System)**: Translates domain names (like www.example.com) into IP addresses.

Types of Transmission Media

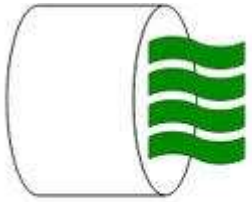
Transmission media refer to the physical pathways through which data is transmitted from one device to another within a network. These pathways can be wired or wireless. The choice of medium depends on factors like distance, speed, and interference. In this article, we will discuss the transmission media.



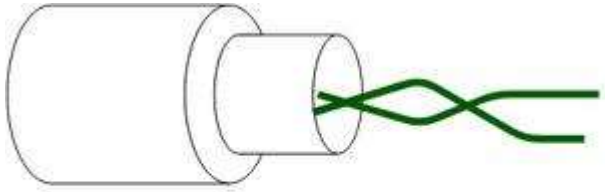
Twisted Pair Cable

It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

•**Unshielded Twisted Pair (UTP):** UTP consists of two insulated copper wires twisted around one another. This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.



Unshielded Twisted Pair



Shielded Twisted Pair

Coaxial Cable

It has an outer plastic covering containing an insulation layer made of PVC or Teflon and 2 parallel conductors each having a separate insulated protection cover. The coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables

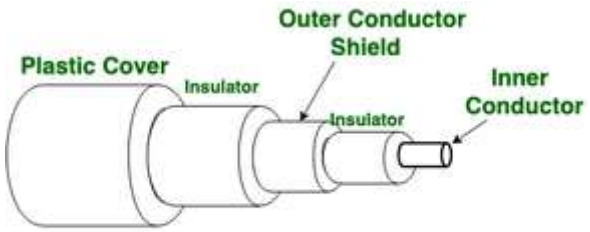


Figure of Coaxial Cable

Optical Fiber Cable

Optical Fibre Cable uses the concept of refraction of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for the transmission of large volumes of data. The cable can be unidirectional or bidirectional. The WDM (Wavelength Division Multiplexer) supports two modes, namely unidirectional and bidirectional mode.

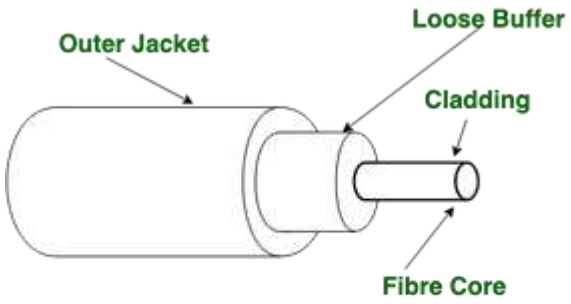


Figure of Optical Fibre Cable

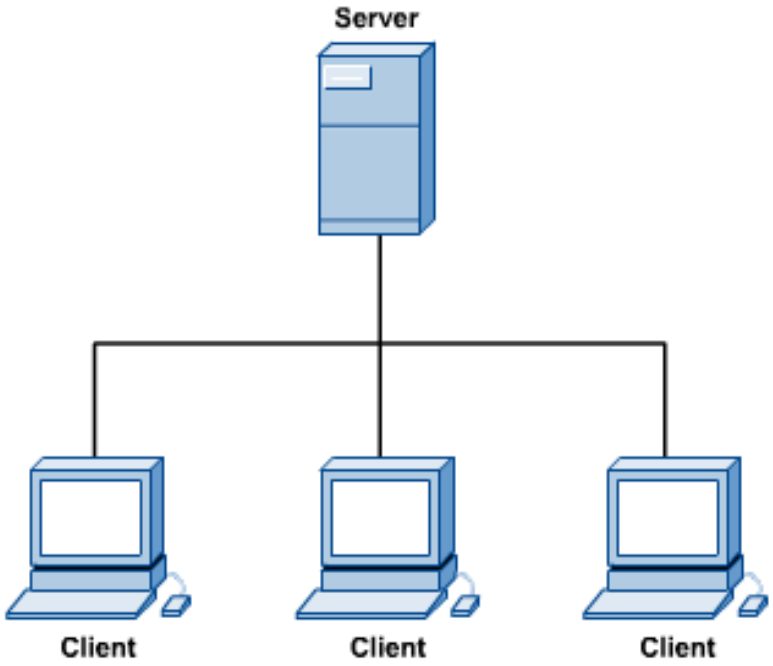
Network Components

- Physical Media
- Interconnecting Devices
- Computers
- Networking Software
- Applications

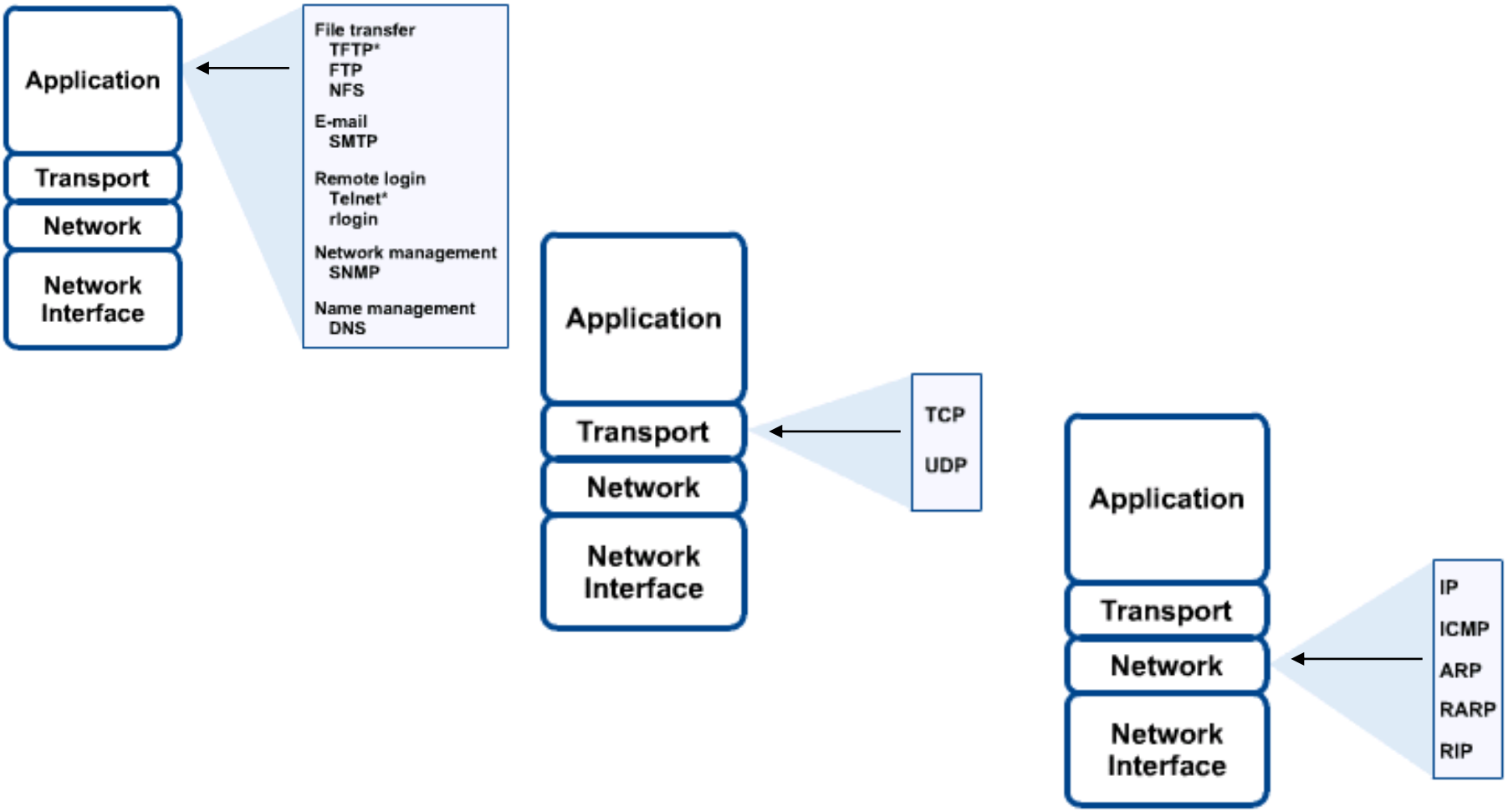
Computers: Clients and Servers

- In a client/server network arrangement, network services are located in a dedicated computer whose only function is to respond to the requests of clients.

- The server contains the file, print, application, security, and other services in a central computer that is continuously available to respond to client requests.



Networking Protocol: TCP/IP



Applications

- E-mail
- Searchable Data (Web Sites)
- E-Commerce
- News Groups
- Internet Telephony (VoIP)
- Video Conferencing
- Chat Groups
- Instant Messengers
- Internet Radio