Networks, telecommunications and the Internet

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Network Definition

- A network can be defined as two or more computers connected together in such a way that they can share resources.

- The purpose of a network is to share resources.

Definitions (cont..)

A resource may be:
- A file
- A folder
- A printer
- A disk drive
- Or just about anything else that exists on a computer.

Definitions (cont..)

- A network is simply a collection of computers or other hardware devices that are connected together,
- either physically or logically,
- using special hardware and software, to allow them to exchange information and cooperate.

Definitions (cont..)

- Networking is the term that describes the processes involved in designing, implementing, upgrading, managing and otherwise working with networks and network technologies.

Advantages of networking

- Connectivity and Communication
- Data Sharing
- Hardware Sharing
- Internet Access
- Internet Access Sharing
- Data Security and Management
- Performance Enhancement and Balancing
- Entertainment

Disadvantages of Networking

- Network Hardware, Software and Setup Costs
- Hardware and Software Management and Administration Costs
- Undesirable Sharing
- Illegal or Undesirable Behavior
- Data Security Concerns

Network Classifications

- **Local Area Networks (LANs):**
  - A **local area network (LAN)** is a computer network covering a small geographic area, like a home, office, or group of buildings

Network Classifications

- **Wide Area Networks (WANs):**
- **A WAN** is a computer network that covers a broad area (i.e., any network whose communications links cross metropolitan, regional, or national boundaries).
- Or, less formally, a network that uses routers and public communications links

Network Classifications

- The largest and most well-known example of a WAN is the Internet.
- WANs are used to connect LANs and other types of networks together, so that users and computers in one location can communicate with users and computers in other locations

Network Classifications

- **Metropolitan Area Network (MAN):**
  - A MAN is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN)
  - but smaller than the area covered by a wide area network (WAN).

Metropolitan Area Network

- The term is applied to the interconnection of networks in a city into a single larger network.
- It is also used to mean the interconnection of several local area networks by bridging them with backbone lines.
- **Backbones**
  - High-speed communication links used to enable Internet communications across a country and internationally.

Network Classifications

- The Local Network (LAN)

Network Classifications

- Wide Area Network

Network Classifications

Metropolitan Area Network (MAN)

Intranet and Internet

- **Intranet:** An intranet is a private network that is contained within an enterprise.
- It may consist of many interlinked local area networks and also use leased lines in the wide area network.
- In general it looks like a private version of the Internet

Intranet and Internet

- **Internet:** is a worldwide system of computer networks
  - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers).

Peer-to peer network

- A peer-to-peer network is a network where the computers act as both workstations and servers.
- great for small, simple, and inexpensive networks.
- In a strict peer-to-peer networking setup, every computer is an equal, a *peer* in the network.

Peer-to peer network

- Each machine can have resources that are shared with any other machine.
- There is no assigned role for any particular device, and each of the devices usually runs similar software.
- Any device can and will send requests to any other.

Peer-to peer network
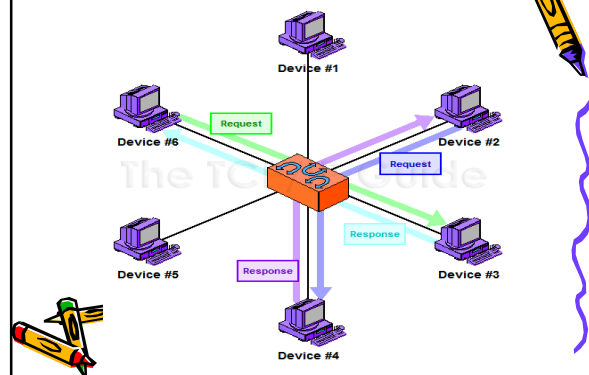
Client/Server Networking

- In this design, a small number of computers are designated as centralized *servers*
- and given the task of providing services to a larger number of user machines called *clients*

Client/Server Networking

- **Client/server**: The client/server architecture consists of client computers such as PCs sharing resources such as a database stored on more powerful server computers.

Client/Server Networking
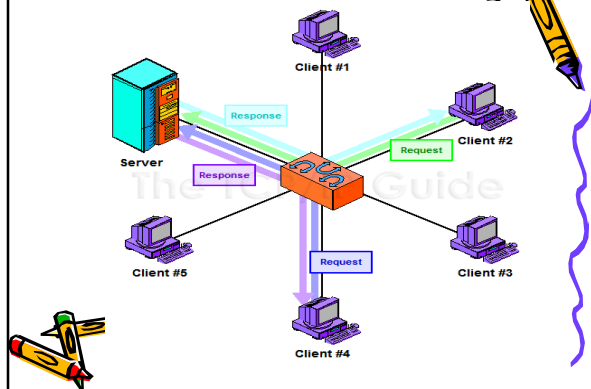
Network topology

- A *topology* is a way of "laying out" the network.
- Topologies can be either physical or logical.
- *Physical topologies* describe how the cables are run.
- *Logical topologies* describe how the network messages travel

Network topology (cont.)

- Bus (can be both logical and physical)
- Star (physical only)
- Ring (can be both logical and physical)
- Mesh (can be both logical and physical)

Network topology (cont.)

- Bus
  - A bus is the simplest physical topology. It consists of a single cable that runs to every workstation
  - This topology uses the least amount of cabling, but also covers the shortest amount of distance.
  - Each computer shares the same data and address path.

Network topology (cont.)

- With a logical bus topology, messages pass through the trunk, and each workstation checks to see if the message is addressed to itself.
- If the address of the message matches the workstation's address, the network adapter copies the message to the card's on-board memory.
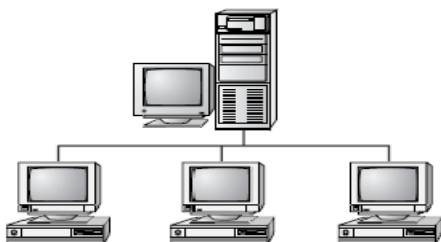
Network topology (cont.)

- it is difficult to add a workstation
- have to completely reroute the cable and possibly run two additional lengths of it.
- if any one of the cables breaks, the entire network is disrupted.
- Therefore, it is very expensive to maintain.

Network topology (cont.)

- Bus topology

Network topology (cont.)

- Star Topology
  - A physical star topology branches each network device off a central device called a *hub*, making it very easy to add a new workstation.
  - Also, if any workstation goes down it does not affect the entire network. (But, as you might expect, if the central device goes down, the entire network goes down.)
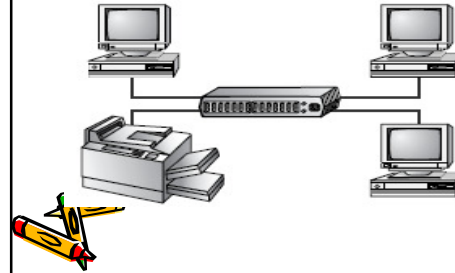
Network topology (cont.)

- Star topologies are easy to install.
- A cable is run from each workstation to the hub.
- The hub is placed in a central location in the office.
- Star topologies are more expensive to install than bus networks, because there are several more cables that need to be installed, plus the cost of the hubs that are needed.

Network topology (cont.)

- Star Topology

Network topology (cont.)

- **Ring**
  - Each computer connects to two other computers, joining them in a circle creating a unidirectional path where messages move from workstation to workstation.
  - Each entity participating in the ring reads a message, then regenerates it and hands it to its neighbor on a different network cable.
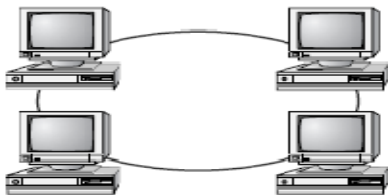
Network topology (cont.)

- The ring makes it difficult to add new computers.
- Unlike a star topology network, the ring topology network will go down if one entity is removed from the ring.
- Physical ring topology systems don't exist much anymore, mainly because the hardware involved was fairly expensive and the fault tolerance was very low.

Network topology (cont.)

- Ring Topology

Network topology (cont.)

- **Mesh**
  - The *mesh topology* is the simplest logical topology in terms of data flow, but it is the most complex in terms of physical design.
  - In this physical topology, each device is connected to every other device
  - This topology is rarely found in LANs, mainly because of the complexity of the cabling.

Network topology (cont.)

- If there are x computers, there will be $(x \times (x-1)) \div 2$ cables in the network.
- For example, if you have five computers in a mesh network, it will use $5 \times (5 - 1) \div 2$, which equals 10 cables.
- This complexity is compounded when you add another workstation.
- For example, your five-computer, 10-cable network will jump to 15 cables just by adding one more computer.

Network topology (cont.)

- Because of its design, the physical mesh topology is very expensive to install and maintain.
- Cables must be run from each device to every other device. The advantage you gain from it is its high fault tolerance.
- With a logical mesh topology, however, there will always be a way of getting the data from source to destination.
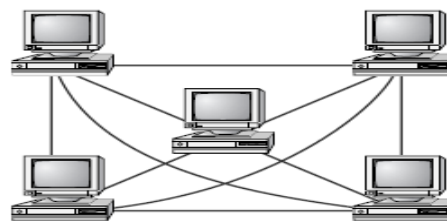
Network topology (cont.)

- It may not be able to take the direct route, but it can take an alternate, indirect route.
- It uses devices called *routers* to search multiple routes through the mesh and determine the best path.
- However, the mesh topology does become inefficient with five or more entities.

Network topology (cont.)

- Mesh Topology

Network topology (cont.)

- Advantages and Disadvantages of Network Topologies

Topology	Advantages	Disadvantages
Bus	Cheap. Easy to install.	Difficult to reconfigure. Break in bus disables entire network.
Star	Cheap. Easy to install. Easy to reconfigure. Fault tolerant.	More expensive than bus.
Ring	Efficient. Easy to install.	Reconfiguration difficult. Very expensive.
Mesh	Simplest. Most fault tolerant.	Reconfiguration extremely difficult. Extremely expensive. Very complex.

Questions