



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

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SCSA1502-COMPUTER NETWORKS AND DESIGN

UNIT II UNDERLYING LAN CONCEPTS



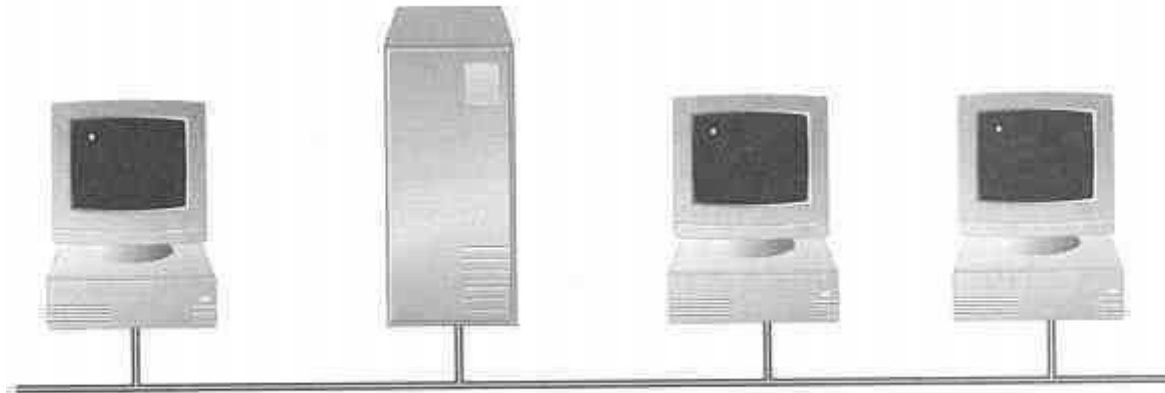
UNIT II UNDERLYING LAN CONCEPTS

LAN connectivity for small businesses –
Integration – Token-Ring – Ethernet – ATM
LAN emulation – InterLAN Switching – LAN to
Mainframe – Building networks.



Basics of Network

- Network, in computer science, a group of computers and associated devices that are connected by communications facilities
- Network is an inter connected collection of autonomous computers
- When two or more computers are joined together so that they are capable of exchanging information , they form a network.



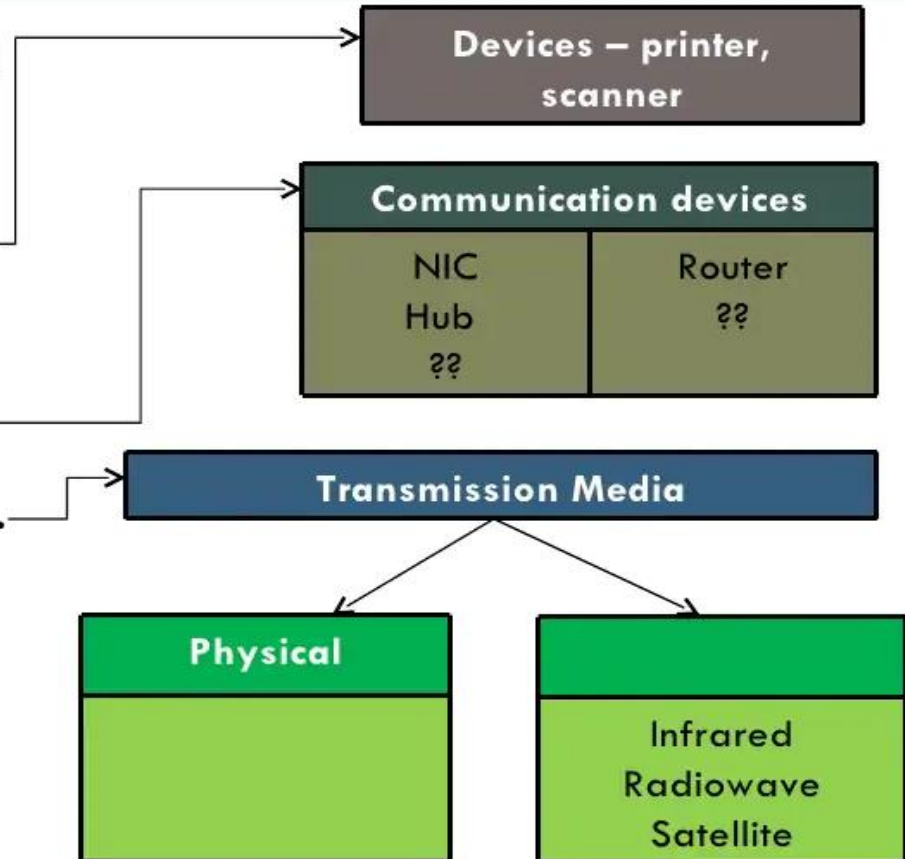


Definition of computer networks

A computer network is a collection of **computers** and **devices** —

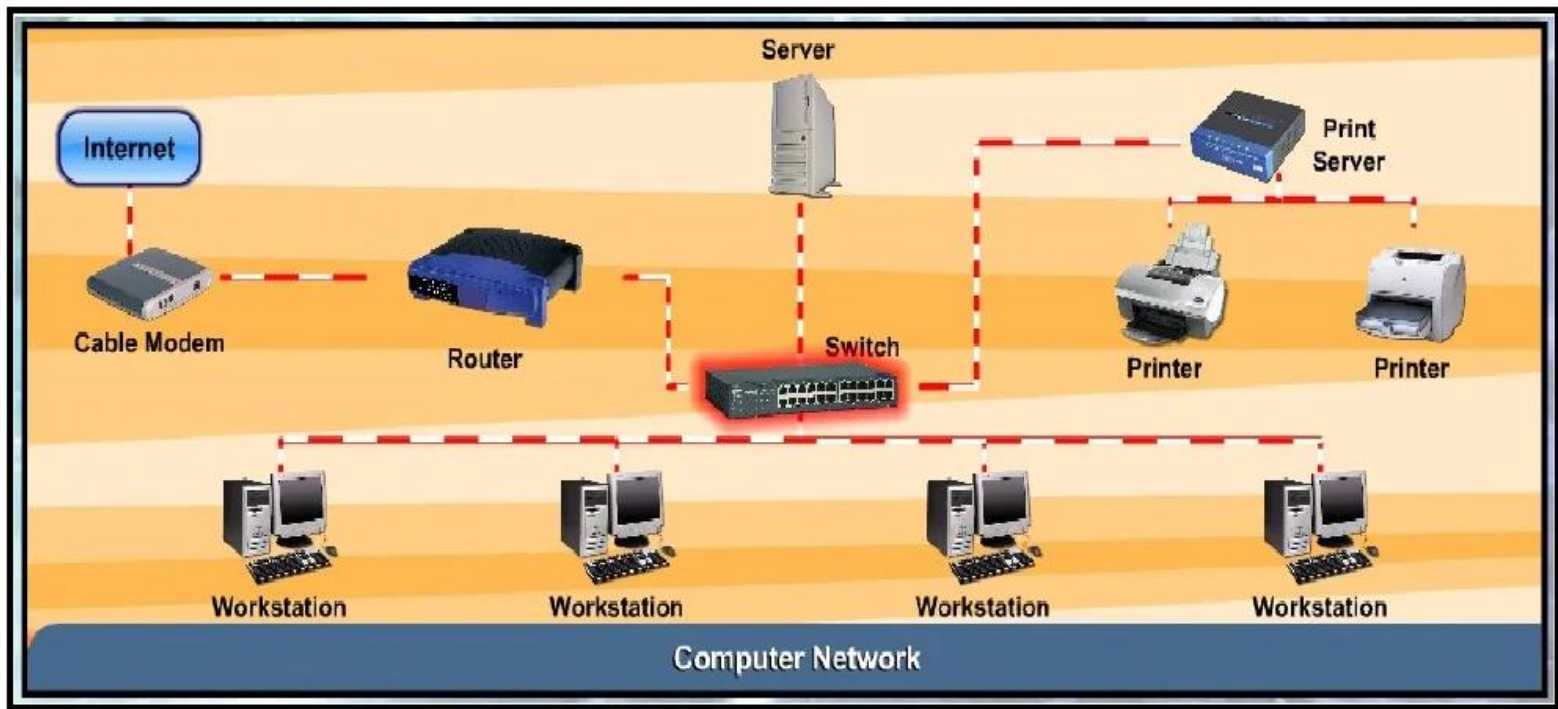
connected together via **communication devices** and **transmission media**.

For examples it may connect computers, printers and scanners.





Typical network architecture



Need for Networking

- Resource sharing – Through a network, data, s/w and h/w resources can be shared irrespective of the physical location of the resources and the user.
- Reliability – A file can have its copies on two or more computers of the network
- Reduced Cost – Sharing resources reduces the cost
- Fast Communication – Information can be exchanged at a very fast speed



SWITCHES

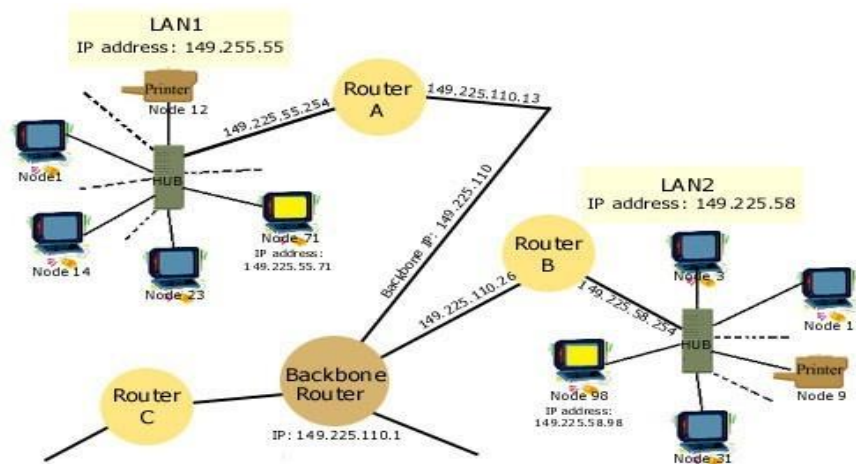


- A switch (**switching hub**) in the context of networking refers to a device which filters and forwards data packets across a network.
- Unlike a standard hub which simply replicates what it receives on one port onto all the other ports, a switching hub keeps a record of the MAC addresses of the devices attached to it.
- When the switch receives a data packet, it forwards the packet directly to the recipient device by looking up the MAC address.
- A network switch can utilise the full throughput potential of a networks connection for each device making it a natural choice over a standard hub.
- In other words, say for instance you had a network of 5 PCs and a server all connected with 10Mbps UTP cable, with a hub the throughput (10Mbps) would be shared between each device, with a switch each device could utilise the full 10Mbps connection.



ROUTERS

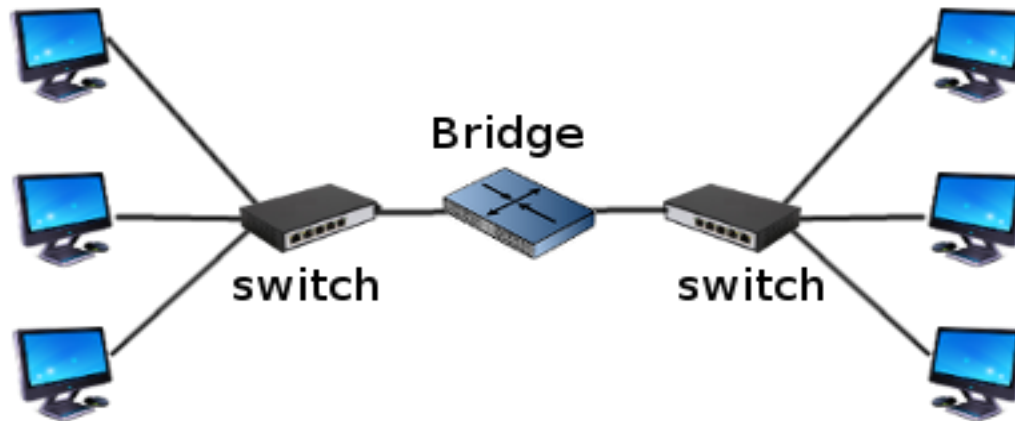
- ✓ A router is a device or a software in a computer that determines the next network point to which a packet should be forwarded toward its destination
- ✓ Allow different networks to communicate with each other
- ✓ A router creates and maintain a table of the available routes and their conditions and uses this information along with distance and cost algorithms to determine the best route for a given packet
- ✓ A packet will travel through a number of network points with routers before arriving at its destination





BRIDGES

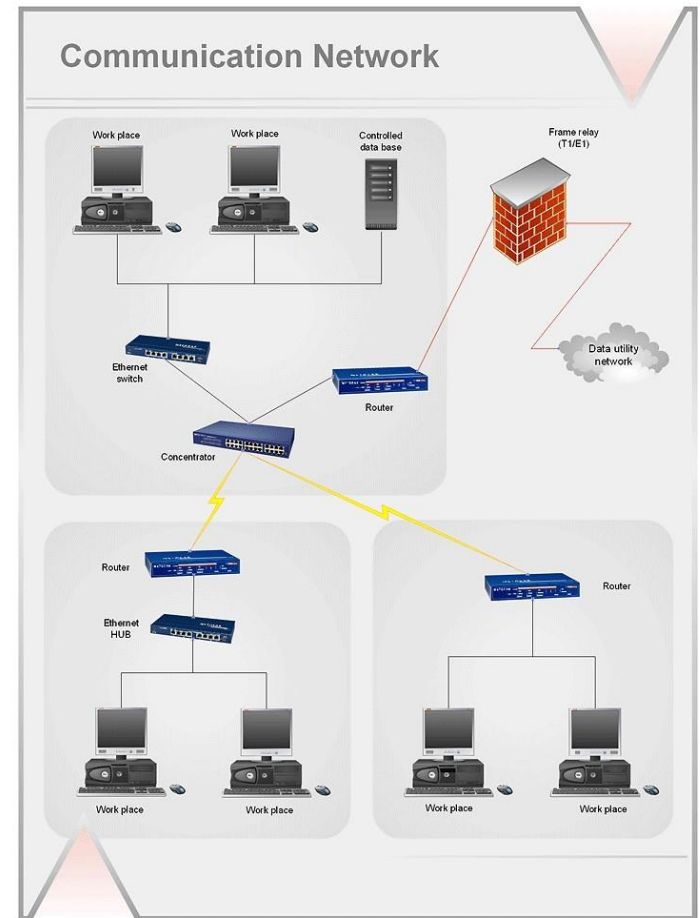
- A bridge is a product that connects a local area network (LAN) to another local area network that uses the same protocol (for example, Ethernet or token ring)
- A bridge examines each message on a LAN, "passing" those known to be within the same LAN, and forwarding those known to be on the other interconnected LAN (or LANs)

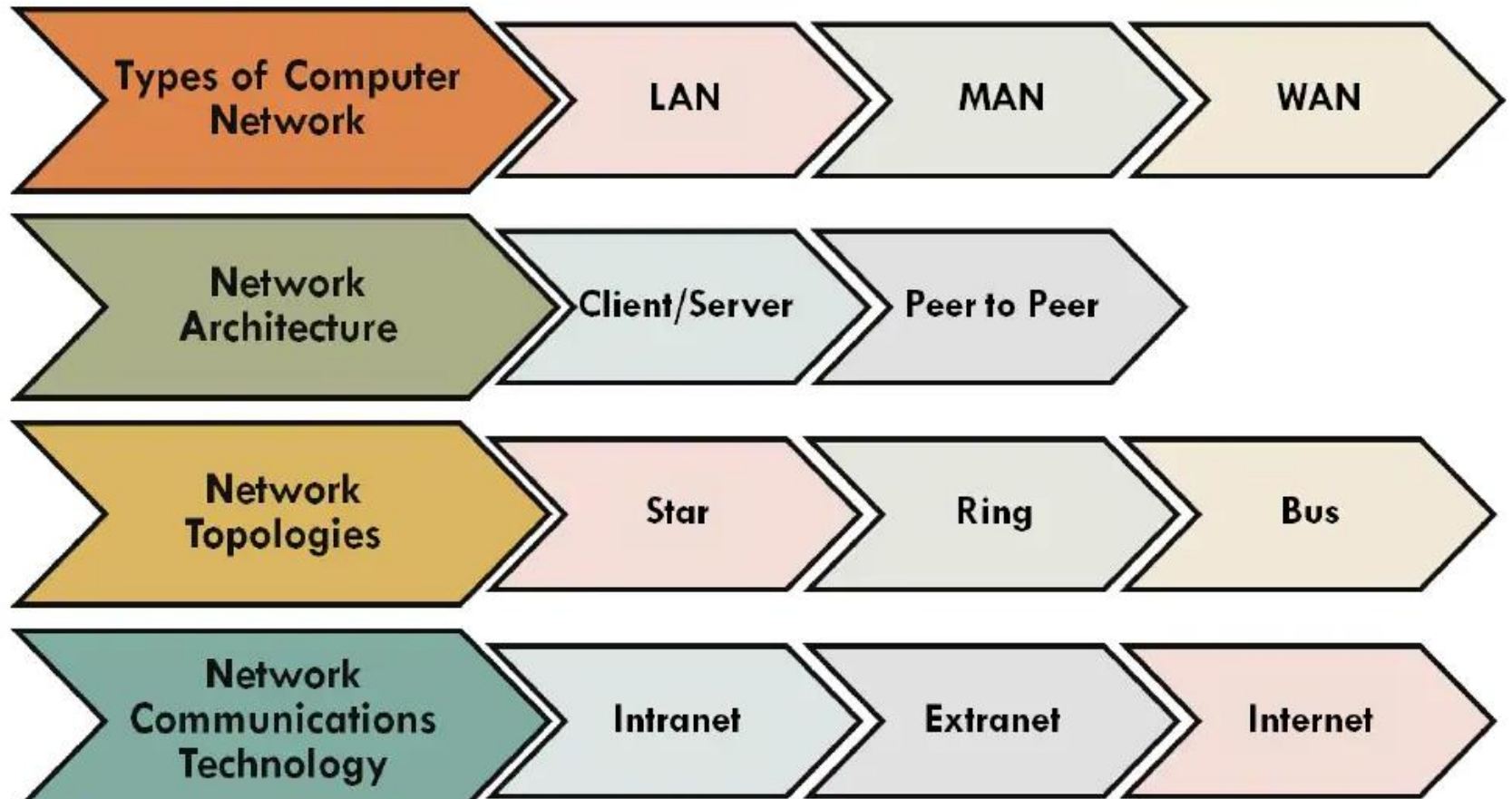




GATEWAY

- Gateway is a device that connects dissimilar networks.
- Establishes intelligent connection between a local network and external networks with completely different structures

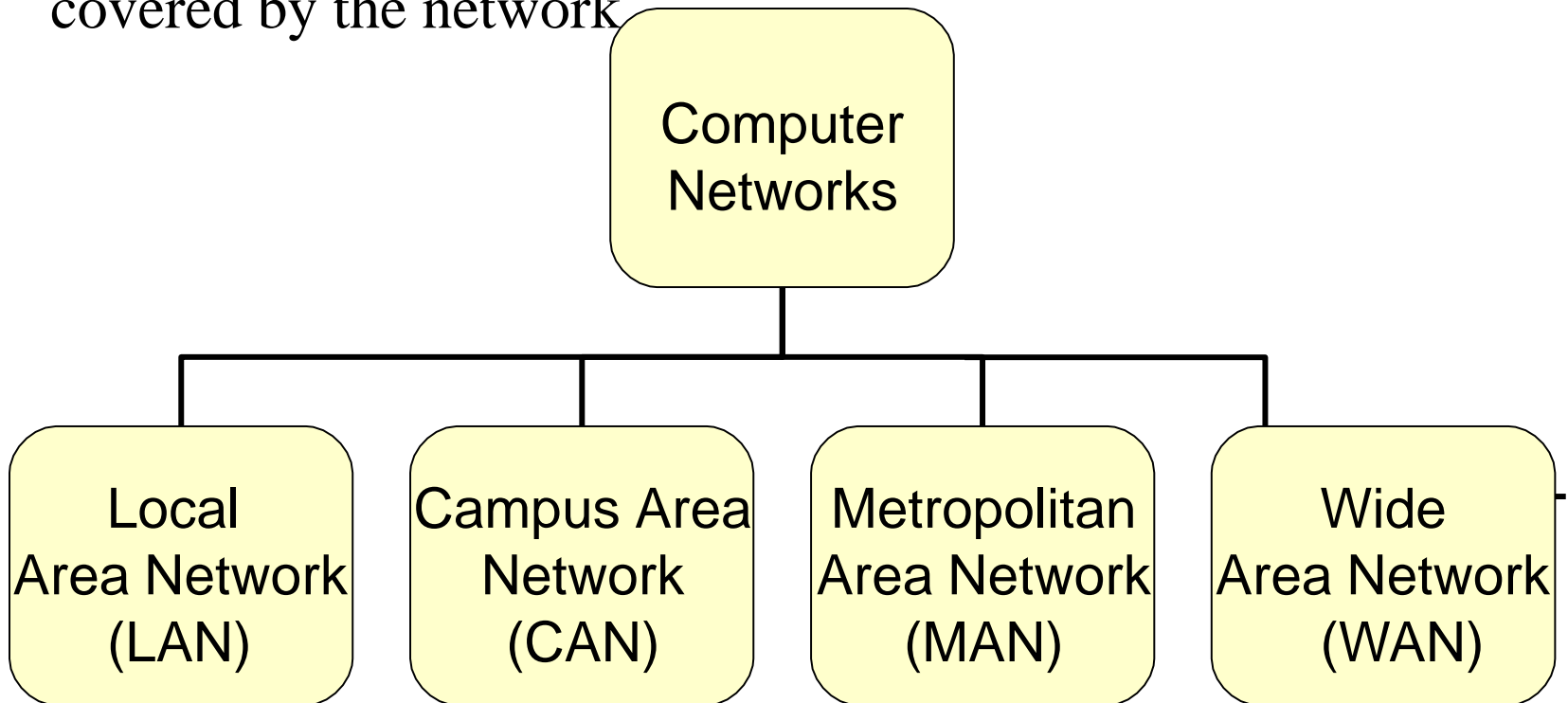






Types of Computer Networks

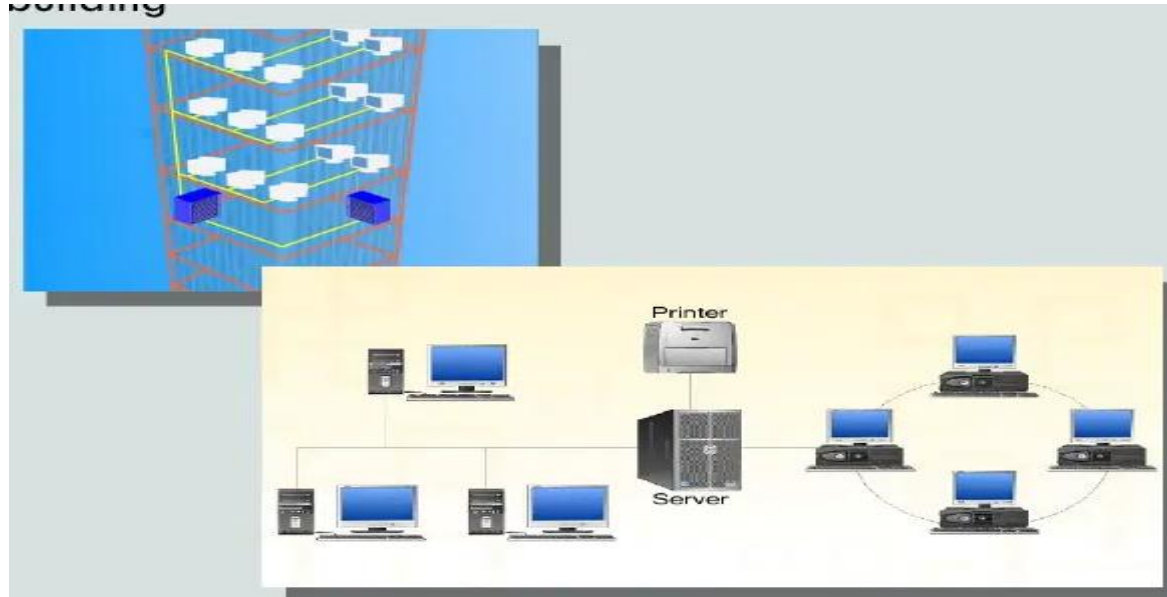
- Networks are classified depending on the geographical area covered by the network





LAN

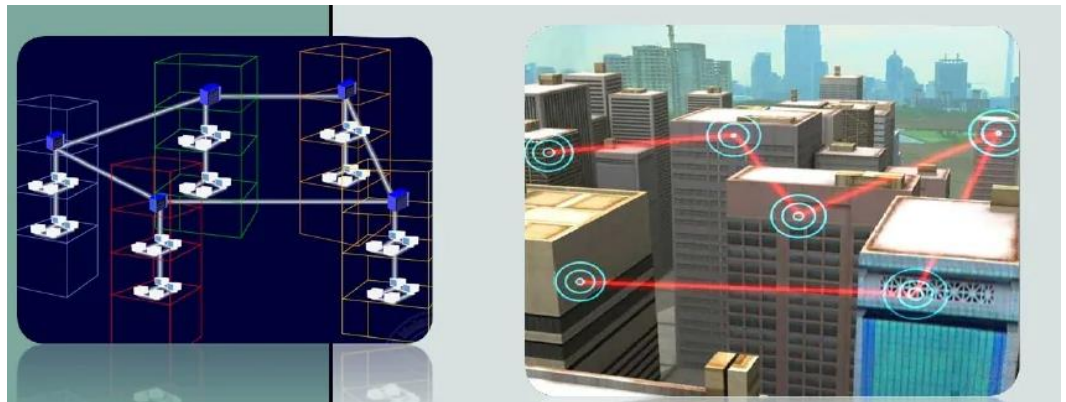
- A Local Area Network (LAN) is a relatively small network that is confined to a small geographic area, such as a single office or a building. Laptops, desktops, servers, printers, and other networked devices that make up a LAN are located relatively close to each other. A key characteristic is that all of the equipment that comprises a LAN, is owned by a single entity.





MAN

- The term Metropolitan Area Network (MAN) is typically used to describe a network that spans a citywide area or a town.
- MANs are larger than traditional LANs and predominantly use high-speed media, such as fiber optic cable, for their backbones.
- This is often the case for hospitals that need to connect treatment facilities, outpatient facilities, doctor's offices, labs, and research offices for access to centralized patient and treatment information





WAN

- A Wide Area Network (WAN) covers a significantly larger geographic area than LANs or MANs.
- A WAN uses public networks, telephone lines, and leased lines to tie together smaller networks such as LANs and MANs over a geographically dispersed area.
- Connecting devices in different geographic areas together for information sharing, WANs are an important piece of enterprise networks

Example : Visa net network



PAN

- A more recent term used to describe a type of network is a Personal Area Network (PAN).
- PAN networks are usually wireless, established in an on- demand or ad-hoc fashion when needed to communicate between two or more devices.
- PAN networks can be used between devices owned by two different parties, or between two devices owned by one person, such as a PDA and a laptop or mobile phone.
- These networks are usually characterized as short-range, often limited to 10 meters or less in range.

Example: Bluetooth





Network Architecture

Two classifications are

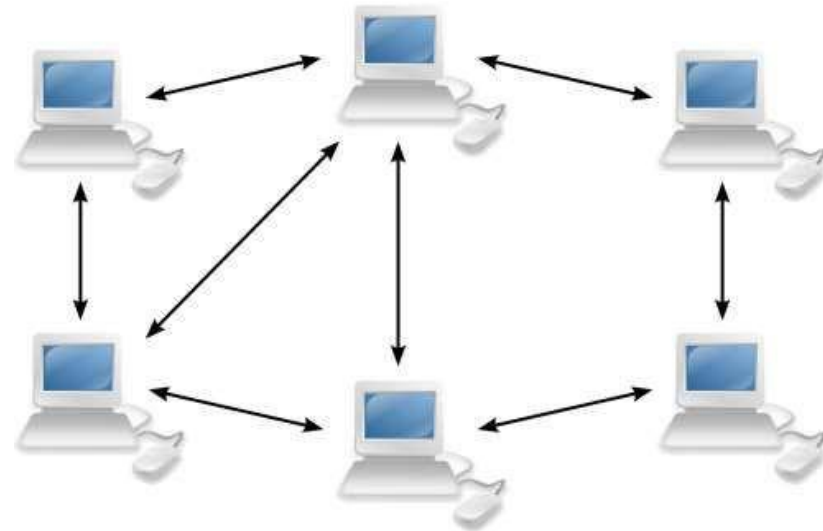
❑ Peer-to-Peer network

❑ Server based network



Peer to Peer network

- ✓ Nodes provide and request services
- ✓ User in each node administers resources
- ✓ No extra investment
- ✓ Easy to setup
- ✓ Very weak security
- ✓ Additional load on nodes





- **Peer-to-Peer Network :**

In the P2P (Peer-to-Peer) network, “peers” generally represent computer system. These peers are connected to each other with help of Internet. Files might be shared directly without requirement of central server among these systems on the network. It can be said that each of computers on P2P network usually becomes file server even as client also. In this architecture, system is generally decomposed into various computational nodes that contain the same and equivalent capabilities, abilities, and responsibilities.



Advantages and disadvantages

Advantages of peer-to-peer networks:

- ❑ Low cost
- ❑ Simple to configure
- ❑ User has full accessibility of the computer

Disadvantages of peer-to-peer networks:

- ❑ May have duplication in resources
- ❑ Difficult to uphold security policy
- ❑ Difficult to handle uneven loading

Where peer-to-peer network is appropriate:

- ❑ 10 or less users
- ❑ No specialized services required
- ❑ Security is not an issue
- ❑ Only limited growth in the foreseeable future



Client Server Application

✓ Network Clients (Workstation)

- Computers that request network resources or services
- Network Servers
- Computers that manage and provide network resources and services to clients
- Usually have more processing power, memory and hard disk space than clients
- Run Network Operating System that can manage not only data, but also users, groups, security, and applications on the network
- Servers often have a more stringent requirement on its performance and reliability



Advantages and disadvantages

Advantages of client/server networks

- Facilitate resource sharing – centrally administrate and control
- Facilitate system backup and improve fault tolerance
- Enhance security – only administrator can have access to Server
- Support more users – difficult to achieve with peer-to-peer networks

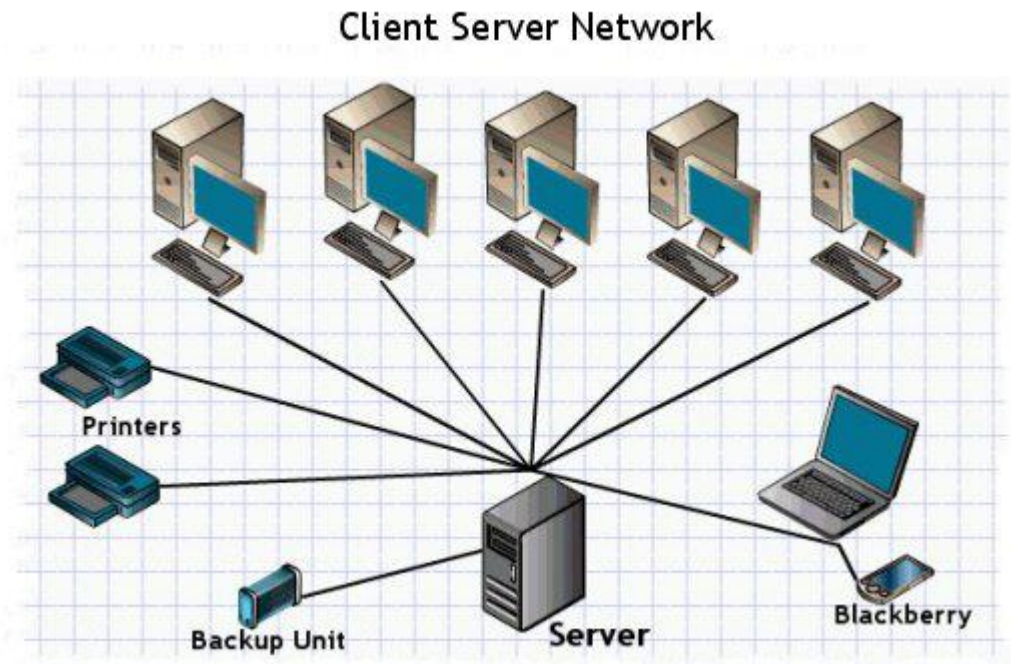
Disadvantages of client/server networks

- High cost for Servers
- Need expert to configure the network
- Introduce a single point of failure to the system



Application

- File transfer protocol
- Mail server
- Application server
- Message server
- Proxy server
- Database server
- Web server





Local Area Network Overview

Applications

- Personal computer LANs
 - Low cost
 - Limited data rate
- Back end networks
 - Interconnecting large systems (mainframes and large storage devices)
 - High data rate
 - High speed interface
 - Distributed access
 - Limited distance
 - Limited number of devices



LAN applications

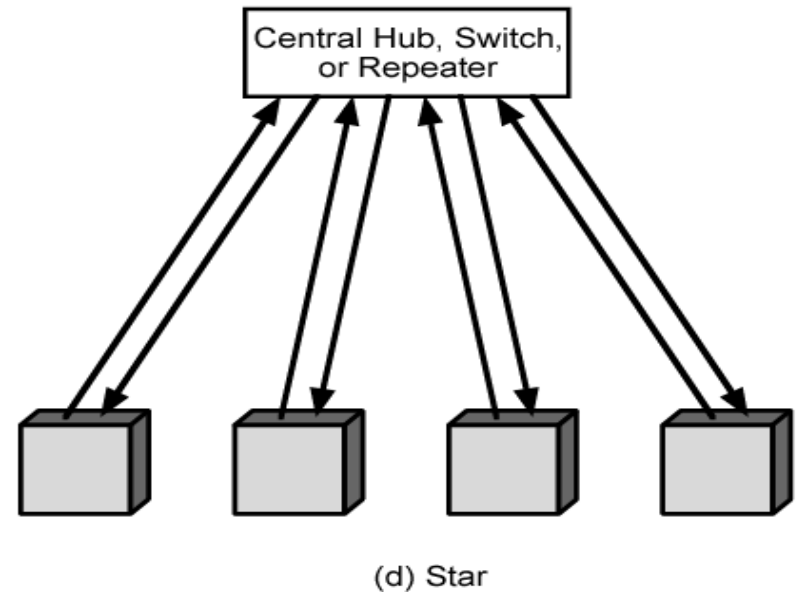
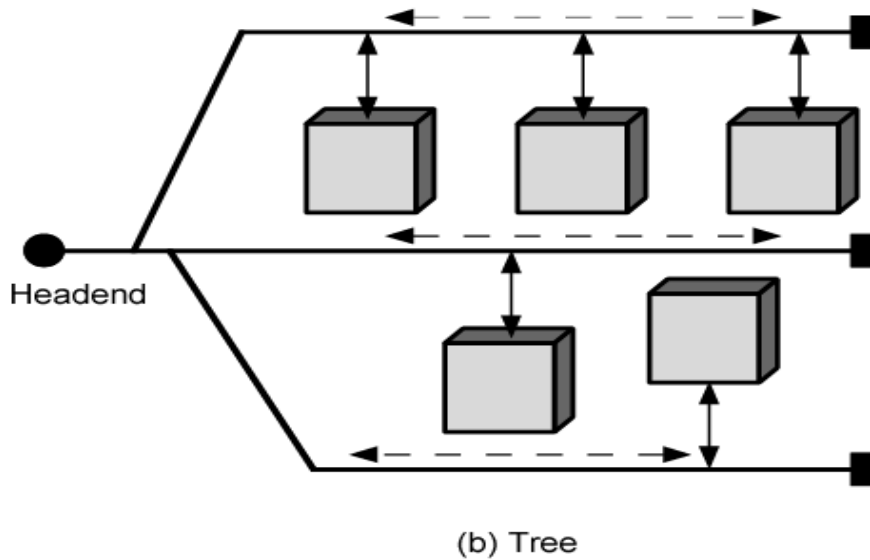
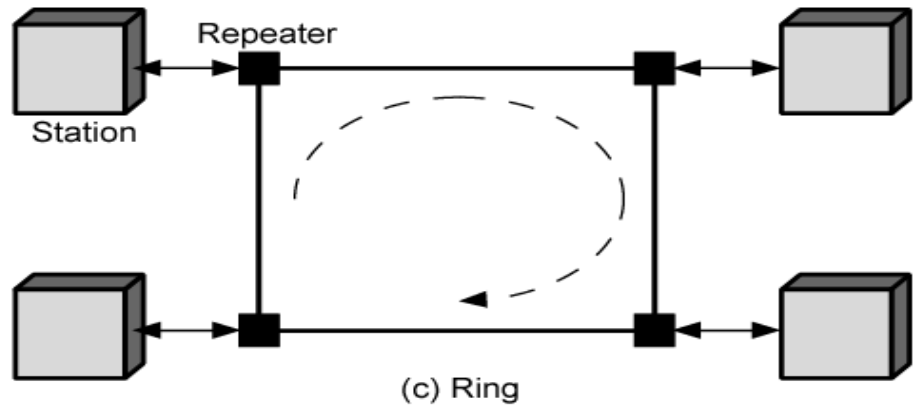
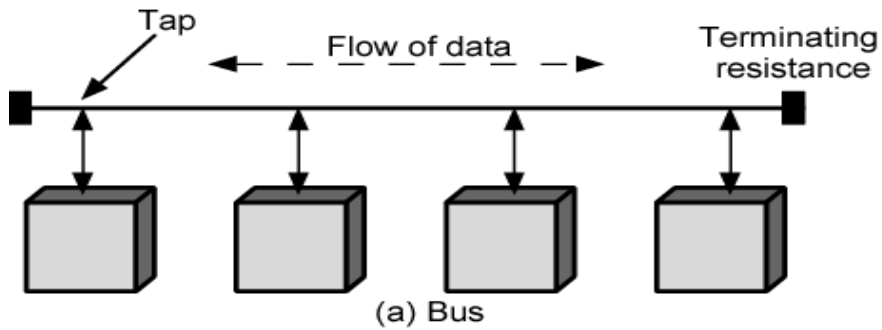
- Storage Area Networks
 - Separate network handling storage needs
 - Detaches storage tasks from specific servers
 - Shared storage facility across high-speed network
 - Hard disks, tape libraries, CD arrays
 - Improved client-server storage access
 - Direct storage to storage communication for backup
- High speed office networks
 - Desktop image processing
 - High capacity local storage
- Backbone LANs
 - Interconnect low speed local LANs
 - Reliability
 - Capacity
 - Cost



LAN Architecture

- Topologies
- Transmission medium
- Layout
- Medium access control

LAN Topologies





Choice of Topology

- Reliability
- Expandability
- Performance
- Needs considering in context of:
 - Medium
 - Wiring layout
 - Access control



LAN transmission medium

- Voice grade unshielded twisted pair (UTP)
 - Cat 3
 - Cheap
 - Well understood
 - Use existing telephone wiring in office building
 - Low data rates
- Shielded twisted pair and baseband coaxial
 - More expensive than UTP but higher data rates
- Broadband cable
 - Still more expensive and higher data rate



LAN transmission medium

- High performance UTP
 - Cat 5 and above
 - High data rate for small number of devices
 - Switched star topology for large installations
- Optical fiber
 - Electromagnetic isolation
 - High capacity
 - Small size
 - High cost of components
 - High skill needed to install and maintain
 - Prices are coming down as demand and product range increases



LAN transmission medium

Wireless Transmission

- ✓ Frequency range (line of sight):
 - 26 GHz to 40 GHz: for microwave with highly directional beam as possible
 - 30 MHz to 1 GHz: for omni directional applications
 - 300MHz to 20000 GHz: for infrared spectrum; used for point to point and multiple point application (line of sight)
- ✓ Physical applications:
 - Terrestrial microwave – long haul telecommunication service (alternative to coaxial or optical fiber)
 - Few amplifier and repeaters
 - Propagation via towers located without blockage from trees, etc (towers less than 60 miles apart)
- ✓ Wireless LAN
- ✓ Hiper LAN (European standard; allow communication at up to 20 Mbps in 5 GHz range of the radio frequency (RF) spectrum)
- ✓ Hiper LAN/2 operate at about 54 Mbps in the same RF band



LAN design for Small business

Requirements:

- A CPA firm with 5 departments
- Total of 560 employees
- One building
 - No current LAN operating
 - Need for easy future expansion
 - Need for fast access for each department
- Reliability of the network



Design goals

- Functionality - the network must work with reasonable speed and reliability.
- Scalability - the network must be able to grow without any major changes to the overall design.
- Adaptability - the network must be designed with an eye toward future technologies, and should include no element that would limit implementation of new technologies as they become available.
- Manageability - the network would be designed to facilitate network monitoring and management.



Network design outline

- Gathering the users requirements and expectations
- Determining data traffic patterns now and in the future based on growth and Server placements
- Defining all of the layer 1, 2 &3 devices and along with LAN and WAN topology
- Document the physical and logical network implementation



Methodology

- Analyze customer's requirements
- Choose and Develop LAN structure (topology)
- Set up addressing and routing



Step 1: Analyse requirements

- Business issues
- Technology issues
- Administrative issues



Some datas to be gathered

- Corporate Structure – small CPA firm with 560 employees.
- Business information flow - ?
- Applications in use - ?
- Current topology - NONE
- Performance characteristics of current network - N/A
- Determine if documented policies are in place - ?
- Mission-critical data - ?
- Mission-critical operations - ?
- Approved protocols and platforms - ?
- Control versus distributed authority - ?
- Availability requirements –
- Throughput
- Response time
- Access to resources



Network load analysis

- Client/Server applications
- Host/terminal applications
- Routing protocols
- Regularly scheduled services, such as file backup
- Estimate worst-case traffic load during the busiest times for users and during regularly scheduled network services



Step 2: choosing and developing topology

- Keeping in mind the first step requirements choose a suitable topology.
- In our case given the scarce requirements I would recommend a collapsed backbone topology .
- Another issue that comes into play is how Tall is the building and how are the departments physically located in it.

Step 3: Addressing and Routing

- In this step the LAN engineer must carefully to consider where to place bridges and routers in order to minimize collision domains and to provide back up routes in case of bridge failures.
- Creating subnets and networks.
- Mapping physical and logical addressing.
- Develop and document the IP addressing scheme.



Selecting the Physical medium

- Considering the requirement for fast access and the possibility for a future expansion the best fitting LAN would be fast Ethernet
- With the same consideration in mind the specific choice would be 100Base-TX using CAT5(UTP or STP).



More specification

- Choosing main distribution facility (MDF) and intermediate distribution facilities (IDF). MDF is usually placed in the base of the building, Whereas each floor can have its own IDF.
- Choice of backbone (vertical) cabling .
- Choice of horizontal cabling.