

# **Computer Networks**

**For**

**Computer Science  
&  
Information Technology**

**By**



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## Syllabus for Computer Networks

Concept of Layering, LAN Technologies (Ethernet), Flow and Error Control Techniques, Switching, IPv4/IPv6, Routers and Routing Algorithms (Distance Vector, Link State), TCP/UDP and Sockets, Congestion Control, Application Layer Protocols (DNS, SMTP, POP, FTP, HTTP), Basics of Wi-Fi, Network Security, Authentication, Basics of Public Key and Private Key Cryptography, Digital Signatures and Certificates, Firewalls.

### Previous Year GATE Papers and Analysis

#### GATE Papers with answer key

[thegateacademy.com/gate-papers](https://thegateacademy.com/gate-papers)



#### Subject wise Weightage Analysis

[thegateacademy.com/gate-syllabus](https://thegateacademy.com/gate-syllabus)



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"Successful leaders recognize that great innovation comes from observing the same ideas as everyone else and seeing something different."

...Reed Markham

## CHAPTER

# 1

# Introduction

## Learning Objectives

After reading this chapter, you will know:

1. Computer Network
2. Goals / Advantages of Networking
3. Components of Network
4. Criteria of a Network
5. Classification of Network
6. Types of Network Connection
7. Network Topology
8. Transmission Modes
9. Data and Data Communication
10. OSI Model

## Computer Network

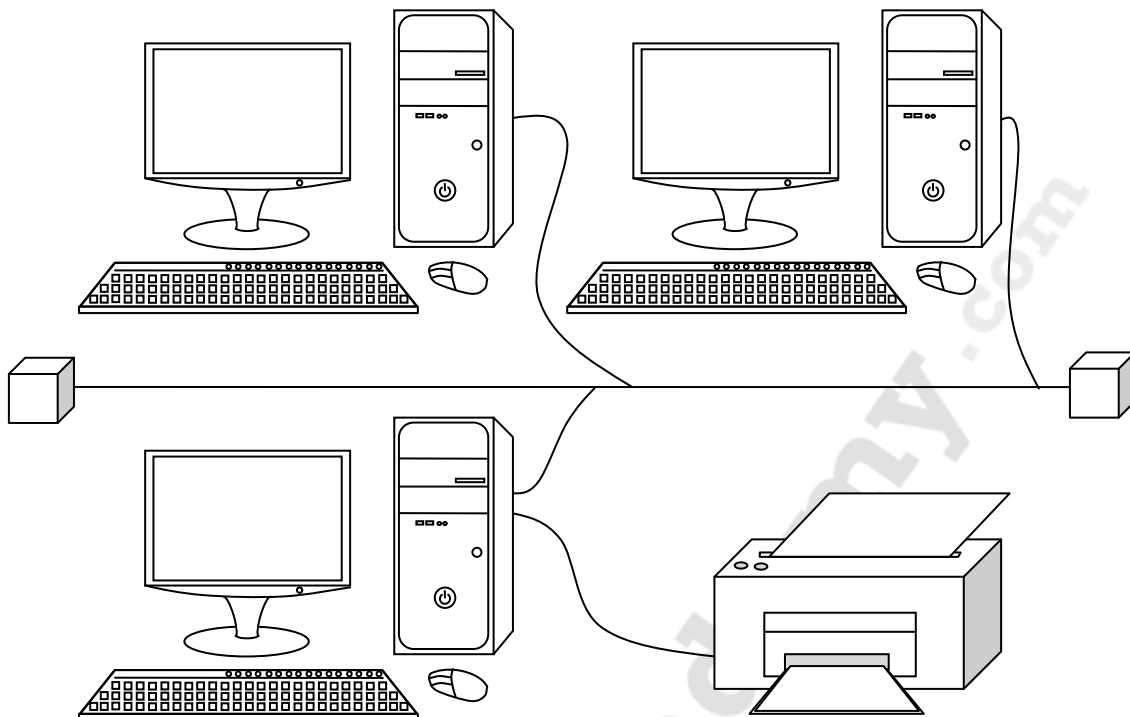
A computer network is created when several computers and terminal devices are connected together by data communication system. (Links and devices)

A computer network is a group of computer system and other computing hardware devices are linked together through communication channels to facilitate communication and resource sharing among a wide range of users.

A network is basically a communication system for computers.

Just as the telephone system allows two people to talk, networks allow computers to communicate.

Figure below illustrates a simple computer network where computer A and B can communicate and share resources through computer C.



**Computer A and B can Access Files on C, and  
Can Use the Printer Connected to C**

## Goals / Advantages of Networking

### (1) Program and File Sharing

Software resources can also be used more effectively as computer systems are connected to each other in n/w;. With stand-alone computers (i.e. not connected to network), the software used on the computer must be present on each computer's hard disk. It is also difficult and time consuming to install and configure the software individually on every computer. With a network one can centrally install and configure the softwares, which can be accessed on all the computers connected to the network.

### (2) Network Resource Sharing

Network resources include printers, plotters, Fax modems, scanners, floppy disks, CD-ROMS and storage devices (i.e. Hard disks) which can be shared by terminals connected to network. For example the sharing of a resource such as a storage device. Server space utilization and cloud computing are latest network facilities.

### (3) Database Sharing

A database program is an ideal application for a network. A network feature called record locking lets multiple users access simultaneously a file without redundancy and in consistency of the data.

Record locking insures that no two users edit the same record at the same time.

### (4) Economical Expansion of the PC Base

Networks provide an economical way to expand the number of computers in an organization; to provide multiple resources at a single terminal location.

(5) **Ability to use Network Software**

A class of software called Groupware is designed specifically for networks. It lets users interact and coordinate their activities.

**Note:** Not all softwares will use a network even if one is installed. You should check the software documentation to see what features, if any, the software provides in a network environment.

(6) **Ability to use Electronic Mail**

Electronic mail lets users easily communicate with one another. Messages are dropped in “mailboxes” for the recipients to read at a convenient time.

(7) **Creation of Workgroups**

Groups are important in networks. They can consist of users who work in a department or who are assigned a special project. With Netware (a network operating system) one can assign users to groups and then can give each group access to special directories and resources not accessible by other users. This saves the trouble of defining access of each individual user.

(8) **Centralized Management**

Network user’s dedicated servers can be grouped in one location, along with the shared resource attached to them, for easier management.

Hardware upgrades, software backups, system maintenance and system protection are much easier to handle when these devices are in one location.

(9) **Security**

A network provides more secure environment for a company’s important information. Security starts with the login procedure to ensure that a user accesses the network using his or her own account. This account is tailored (i.e. made according to the user requirements) to give the user access only to authorized areas of the server and the network. Login restrictions can force a user to login at one specific station and only during specific time frame or period.

(10) **Access to more than one Operating System**

Netware provides connections for many different operating systems, including DOS, OS/2, UNIX, and Apple Talk. Users of these systems can access files on the Network server.

Having different-different operating systems provide unique facilities of each OS in a single network but it also increases the overhead to manage them in a single network.

(11) **Enhancement of the Corporate Structure**

Networks can change the structure of an organization and the way it is managed. Users who work in a specific department and for a specific manager no longer need to be in the same physical area. Their offices can be located in areas where their expertise is most needed. The network ties them to their department managers and systems. This arrangement is useful for special project in which individuals from different departments, such as research, production and marketing, need to work closely with each other; and cannot be at a same location all the time.

## Components of Network

Computer networks have the following fundamental components:

1. Server
2. Workstations
3. Network Interface Cards
4. Cabling system
5. Shared Resources and Peripherals.

## Criteria of a Network

A network must be able to meet a certain number of criteria. The most important of these are as follows

- (i) **Performance:** performance can be measured in many ways, including transmit time and response time. The performance of a network depends upon these following factors:
  - Number of users
  - Type of transmission medium
  - Capacity of connected hardware
  - Efficiency of the software
- (ii) **Reliability:** In addition to accuracy of delivery; Network reliability is measured by the frequency of failure, the time it takes for a Link or a device to recover from a failure.
- (iii) **Security:** Network security issues include protecting data from the unauthorized access. Providing security in network is difficult task as there are no. of people/users are connected to network.

## Classification of Network

Network contains two or more computer along with a transmission path to share information and resource of communication system. By the networking we can make interconnection of two or more network devices.

Depending upon the geographical area, we can divide the computer network in 3 parts.

- (i) LAN (Local Area Network)
- (ii) MAN (Metropolitan Area Network)
- (iii) WAN (Wide Area Network)

- (i) **LAN:** It spans over a diameter of 2 km, typically data transfer rate for LAN is 10-100 Mbps, it is used by a single organization. It propagates high transmission over inexpensive media. Example co-axial cable, twisted pair cable.
- (ii) **MAN:** It spans over 10 – 100km diameter. Data rate for MAN is 10 Mbps. Some special equipments are required for transmission.
- (iii) **WAN:** It spans across the country or nation. Data transfer rate for WAN is 1.5 mbps. It is used by multiple organizations.



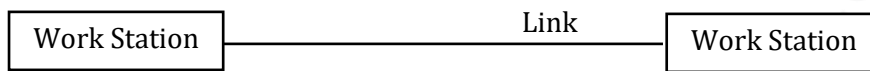
## Types of Network Connection

In a network two or more devices are connected together through link. Link is a path for communication that transfers data from one device to another.

There are two possible types of connection.

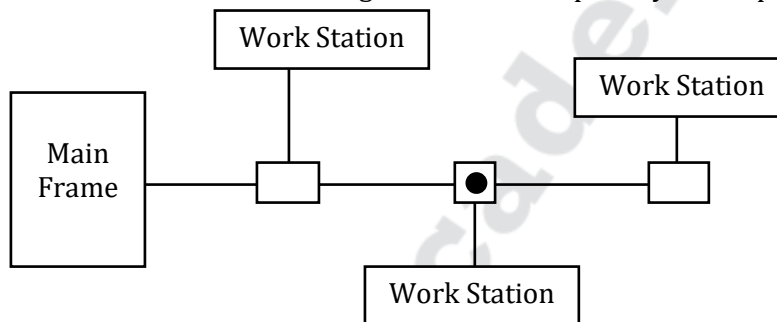
- (i) Point to point
- (ii) Multi-point

- (i) Point to point: In this case one device is connected to one other device.



**Point to Point Connection**

- (ii) Multi-point: Here two or more devices are connected to each other. In a multipoint connection the capacity of the channel is shared among devices either spatially or temporarily.



**Multi-Point Connection**

## Network Topology

There are two types of Topology

1. Physical Topology
2. Logical Topology

1. **Physical Topology:** Physical topology represents the physical structure of computer network. It tells how different computers are connected across its communication path. There are seven basic topologies possible.

- (i) Mesh
- (ii) Star
- (iii) Ring
- (iv) Hybrid
- (v) Bus
- (vi) Cellular
- (vii) Tree

- (i) **Mesh Topology:** In mesh topology every device has a dedicated point to point link to every other device. A fully connected mesh network has  $n(n - 1)/2$  physical channels to link  $n$  devices. To accommodate those many links, every device on the network must have  $(n - 1)$  input/output ports.

**Advantages**

- Eliminate traffic problems
- A mesh topology is robust
- It is more secure and private
- Fault identification and fault isolation is easy
- Communication is faster.

**Disadvantages**

- Huge number of cabling required, also each node requires more  $[(n - 1)]$  I/O ports.
- Installation and reconnection are difficult
- Expensive if number of nodes are more.

(ii) **Star Topology:** In star topology, each device has a dedicated point to point link only to a central controller, usually called a hub. Star topology does not allow direct traffic between devices.

**Advantages**

- Less expensive than mesh topology. Only one I/O port required for each device
- Star topology is robust. Since if one link fails, only that link and node are affected all other links and nodes remain active and connected.

(iii) **Bus Topology:** Bus topology is user multipoint connection. One long cable acts a backbone link and all the devices are in network. Nodes are connected to the bus cable by drop-lines and taps

**Features of Bus Topology**

- (i) Easy to install
- (ii) Required less number of transmission media/cable.
- (iii) Easy to expand.

