

# Introduction to Systems and Networks

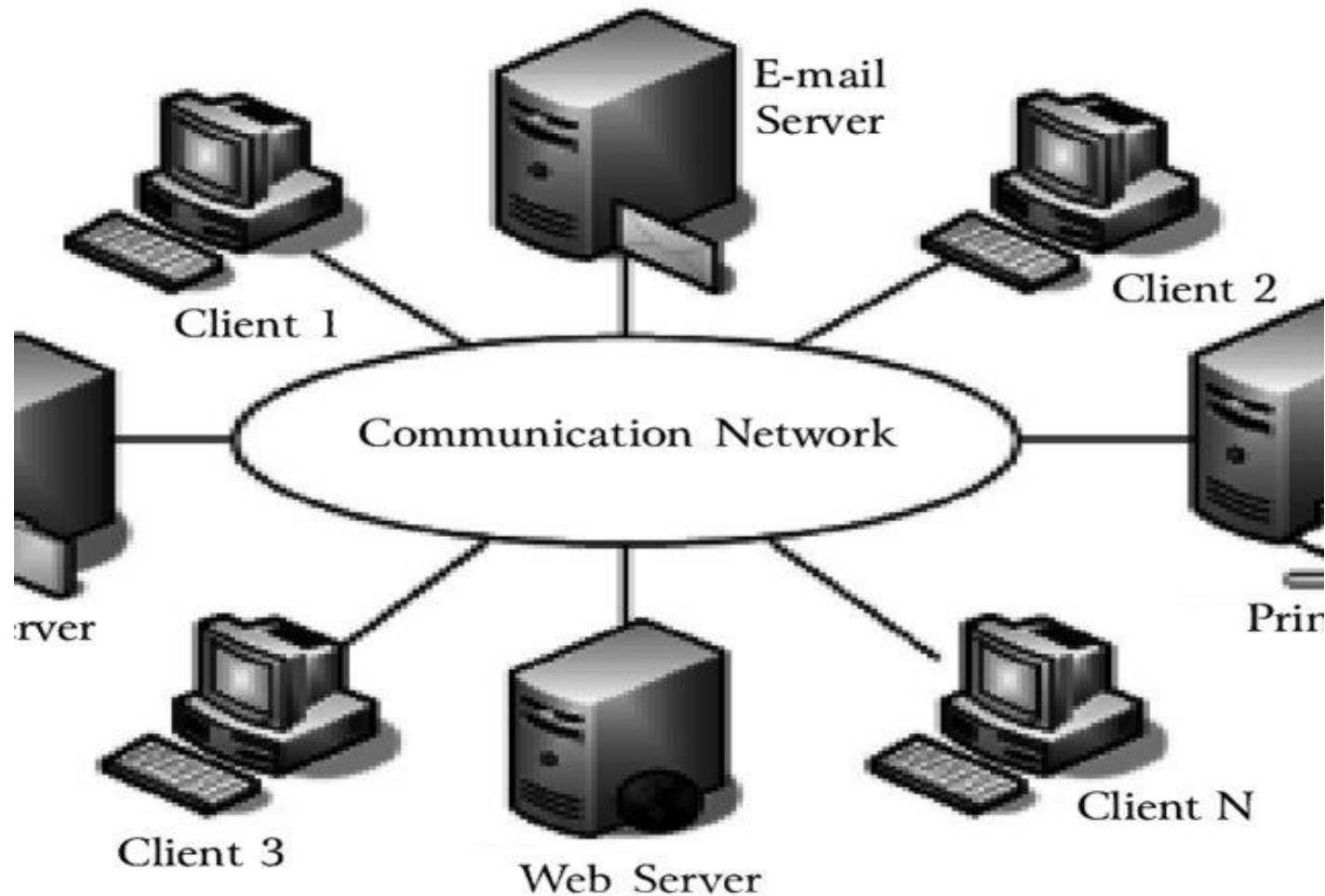
**INSY 3071**

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# Chapter 1

## Overview of Computer Networks

# What is Computer Networking?



# Computer Network

- A computer network is a group of computers and associated peripheral devices connected by a communication channel capable of sharing files and other resources among several users.
- Computer network is a connection of two or more computers that are connected with one another for the purpose of communicating data or information electronically.

# Computer Network

- This connecting together of computers and other devices is called a *Network*, and the concept or practice of connected computers sharing resources is called *Networking*.

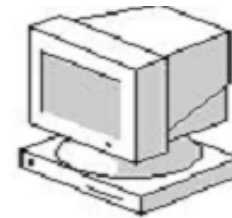


# Computer Network

- A computer network can range from a peer-to-peer network connecting a small number of users in an office or department, to a LAN connecting many users over permanently installed cables and dial-up lines, to a MAN or WAN connecting users on several networks spread over a wide geographic area.

# Computer Network

- Computer networking arose as an answer to the need of **data sharing in a timely fashion**.
- Before networks, users needed either to print-out documents or copy document files to a **disk** for others to edit or use them.
- This was, and still is, known as "working in a stand-alone environment."



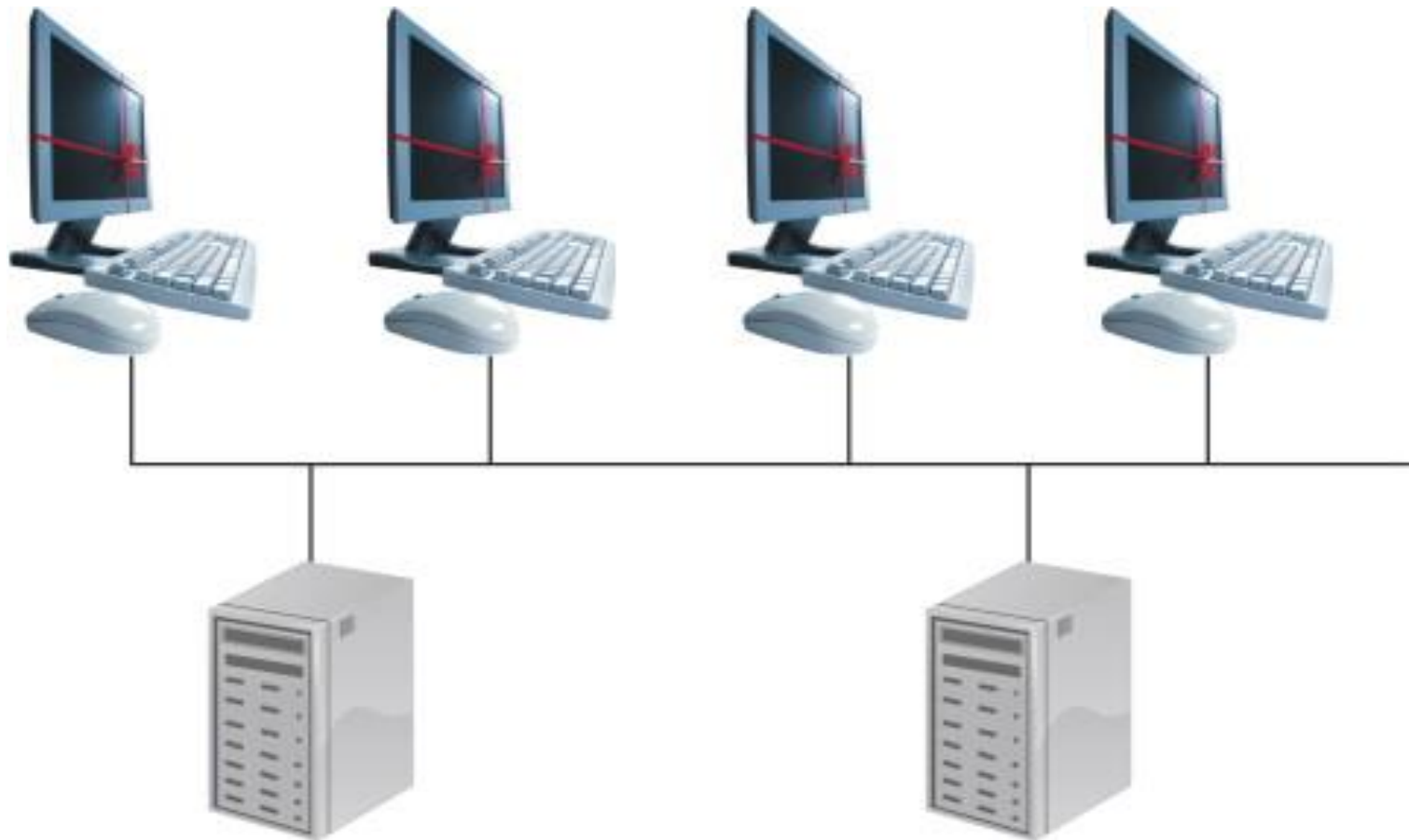
*Stand-alone Computer*

# Computer Network

- But what if a computer was connected to other computers? Then, it could **share data/information** with the other computers or send documents to a printer.
- The early computer networks were limited to exchanging **character-based information** between connected computer systems.
- The current networks have evolved to carry voice, video streams, text, and graphics between many different types of devices.



# Computer Network

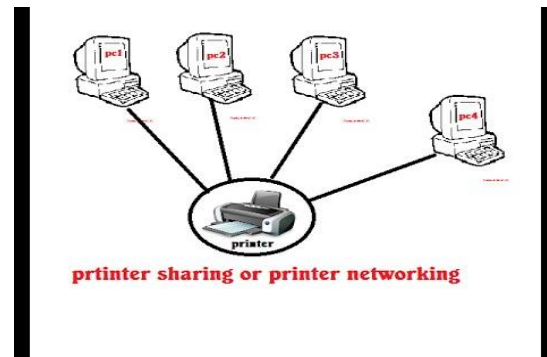


# Benefits of Computer Networks

- Computer networks have the following basic goals:
  - Sharing Information (or Data)
  - Sharing Hardware (Peripheral Devices)
  - Sharing Programs (application Software)
  - Centralizing network administration and support

# Sharing Hardware

- Computer networks enable us to share expensive hardware resource among several computers.
- A typical example of shared hardware resource is a **printer**. For example, a company may prefer to acquire **one expensive printer** and connect it to the network to provide high quality printing to users. This avoids the need to have separate printer for each computer in the office.



## Sharing Hardware

- **Central Disk storage:** Network system provide the possibility of using a **dedicated file server** to store all the company data in one location.
- Users will be able to access their data over the network from their workstations. Using central disk storage system facilitates data backup operations from a central location guarantying complete data recovery in case of system failures.

# Sharing Data/Information

- Data sharing is the ability to share the same data resource with multiple applications or users.
- Users in a certain network environment have the freedom of sharing data and information across the network.
- Data sharing enables different users to work on a certain file concurrently.

# Examples of sharing data

- **Database:** - databases are often managed centrally and several users can have access to the database at same time. For example, in a networked banking system, different bank branches can have access to the central account database. This enables bank clients to carry their transactions on any branch bank office.
- **E-mail:** email communication can be achieved over the network enabling networked users in the company to communicate messages across the network using email.

# Sharing Data

- **Intranet:** Intranets are similar to World Wide Web (WWW) where centrally stored hypertext documents can be accessed using the web. Unlike the WWW, intranets are available **only to user within the company** network system. Intranet is a very common service in large networked organizations (example, AAUNet).
- **Extranet:** Although similar to intranet, extranet provides selected users from **outside the organization** to access data from the internal network. Extranets are commonly used by suppliers to provide data to company clients.

# Centralizing Administration and Support

- Networking computers can simplify support tasks as well.
- Network administrator is responsible for setting up user accounts and maintains a network. The network administrator provides each new user with a user ID and starter password. In this way centralized administration and support can be achieved.



# Centralizing Administration and Support

- Network administration tasks include:
  - Managing users and security.
  - Making resources available.
  - Maintaining applications and data.
  - Installing and upgrading application and operating system software.

# Advantages of Networks

- Speed (Email)
- Cost (cost of printer)
- Security (access control)
- Resource Sharing (data/information)
- Electronic Mail
- Centralized Software Management
- .....

# Disadvantages Network

- Expensive to Install (initial setup)
- Requires Administrative Time
- Server (fileserver) May Fail
- Cables May Break
- Vulnerable to computer viruses and malware

## **Other benefits of computer networks**

- Documents (memos, spreadsheets, invoices, and so on).
- E-mail messages.
- Word-processing software.
- Project-tracking software.
- Illustrations, photographs, videos, and audio files.
- Live audio and video broadcasts.
- Printers, Fax machines.
- Hard drives.

## Other benefits of computer networks

- Networks Supporting The Way We Live
- Networks Supporting Daily Lives
- Networks Support the way we Learn
- Networks Supporting the Way We Work

# **Networks Supporting The Way We Live**

- The methods that we use to share ideas and information are constantly changing and evolving.
- Whereas the human network was once limited to face-to-face conversations, media breakthroughs continue to extend the reach of our communications.
- From the printing press to television, each new development has improved and enhanced our communication.

# Networks Supporting Daily Lives

- Decide what to wear using online current weather conditions.
- Find the least congested route to your destination, displaying weather and traffic video from webcams.
- Check your bank balance and pay bills electronically.
- Receive and send e-mail, or make an Internet phone call.
- Obtain health information and nutritional advice from experts all over the world, and post to a forum to share related health or treatment information.

# **Networks Support the way we Learn**

- Communication, collaboration, and engagement are fundamental building blocks of education.
- Institutions are continually striving to enhance these processes to maximize the dissemination of knowledge.
- Robust and reliable networks support and enrich student learning experiences. These networks deliver learning material in a wide range of formats. The learning materials include interactive activities, assessments, and feedback.



# **Networks Support the way we Learn**

- Availability of current and accurate training materials.
- Availability of training to a wide audience. Online training is not dependent on travel schedules, instructor availability or physical class size.
- Cost reduction. In addition to reducing the cost of travel and the lost time associated with travel, there are other cost reducing factors for business related to online training.
- Online distance learning has removed geographic barriers and improved student opportunity.

# **Networks Supporting the Way We Work**

- Initially, data networks were used by businesses to internally record and manage financial information, customer information, and employee payroll systems.
- These business networks evolved to enable the transmission of many different types of information services, including e-mail, video, messaging, and telephony.

## **Networks Supporting the Way We Work**

- Intranets, private networks in use by just one company, enable businesses to communicate and perform transactions among global employee and branch locations.
- Companies develop extranets, or extended internetworks, to provide suppliers, vendors, and customers limited access to corporate data to check order status, inventory, and parts lists.
- Today, networks provide a greater integration between related functions and organizations than was possible in the past.

# The Network Architecture

- Networks must support a wide range of **applications and services**, as well as operate over many different types of **physical infrastructures**.
- Network architecture refers to both:
  - the technologies that support the **infrastructure** and
  - the **services** and **protocols** that move the messages across that infrastructure.

# The Network Architecture

- There are four basic characteristics that the underlying architectures need to address in order to meet user expectations:
  - Fault tolerance
  - Scalability
  - Quality of services
  - Security

# Fault Tolerance network

- A fault tolerant network is one that limits the impact of a hardware or software **failure** and can recover quickly when such a failure occurs.
- These networks depend on **redundant links**, or paths, between the source and destination of a message.

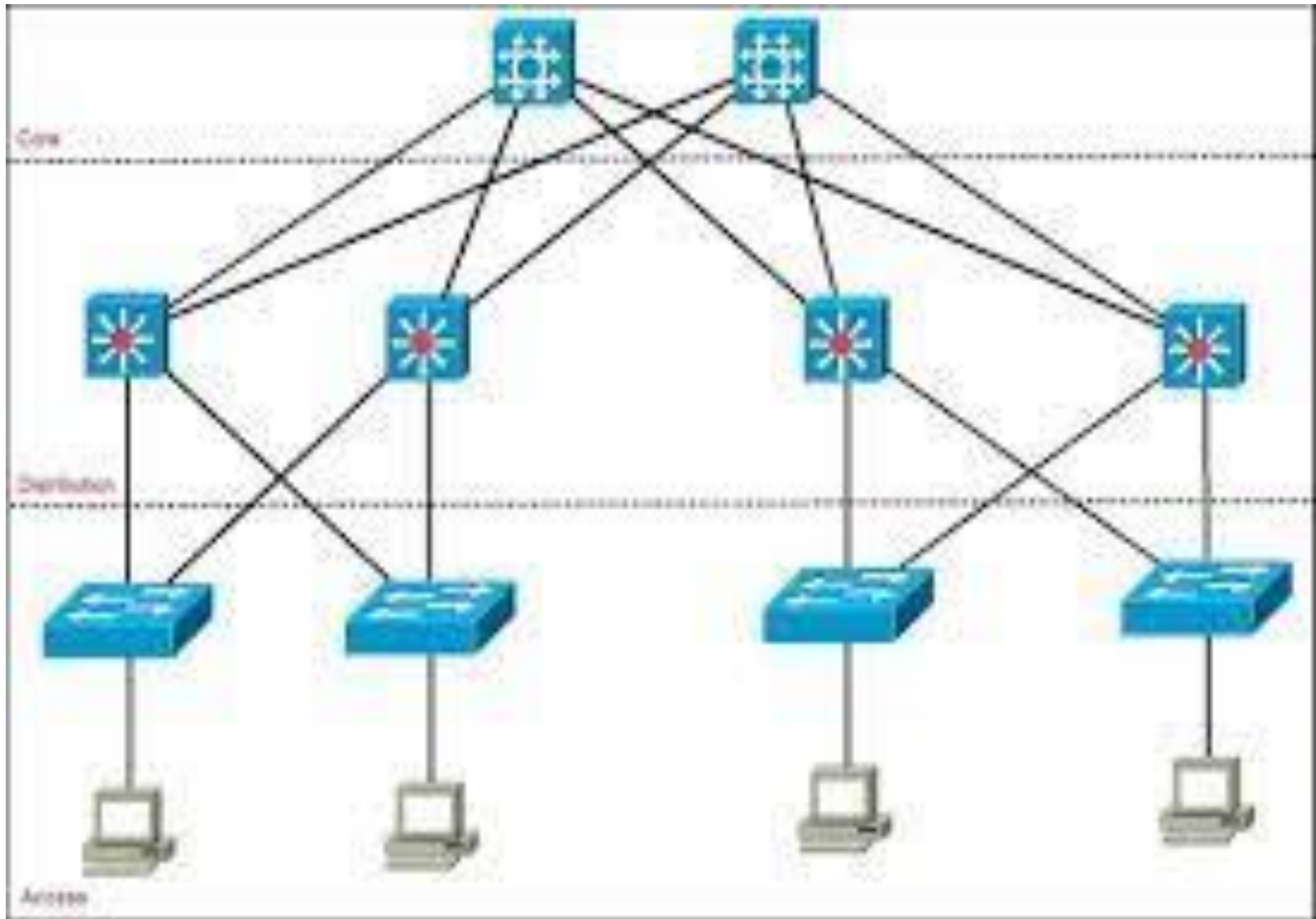
# Fault Tolerance

- If one link or path fails, processes ensure that messages can be instantly routed over a different link transparent to the users on either end.
- Both the physical infrastructures and the logical processes that direct the messages through the network are designed to accommodate this redundancy.

# Scalability

- A scalable network can expand quickly to support **new users and applications** without impacting the performance of the service being delivered to existing users.
- The ability of the network to support these new interconnections depends on a **hierarchical layered design** for the underlying physical infrastructure and logical architecture.
- The operation at each layer enables users or service providers to be added without causing disruption to the entire network.





# QoS (Quality of Service)

- Quality of Service (QoS) is a set of technologies that work on a network **to guarantee its ability to dependably run high-priority applications and traffic under limited network capacity.**
- Measurements of concern to QoS are:
  - bandwidth (throughput)
  - latency (delay)
  - jitter (variance in latency)
  - error rate

# QoS (Quality of Service)

- The Internet is currently providing an acceptable level of fault tolerance and scalability for its users.
- But **new applications** available to users over internetworks create higher expectations for the quality of the delivered services.
- Voice and live video transmissions require a level of consistent quality and uninterrupted delivery that was not necessary for traditional computer applications.
- Quality of these services is measured against the quality of experiencing the same audio or video presentation in person.

# Security

- Network Security **protects your network and data from breaches, intrusions and other threats.**
- Network security describes hardware and software solutions as well as processes or rules and configurations relating to network use, accessibility, and overall threat protection.
- The security and privacy expectations that result from the use of internetworks to exchange confidential and business critical information exceed what the current architecture can deliver.

# Security

- Rapid expansion in communication areas that were not served by traditional data networks is increasing the **need to embed security into the network architecture.**
- As a result, much effort is being devoted to this area of research and development.
- In the meantime, many tools and procedures are being implemented to combat inherent security flaws in the network architecture.