School of Information Science
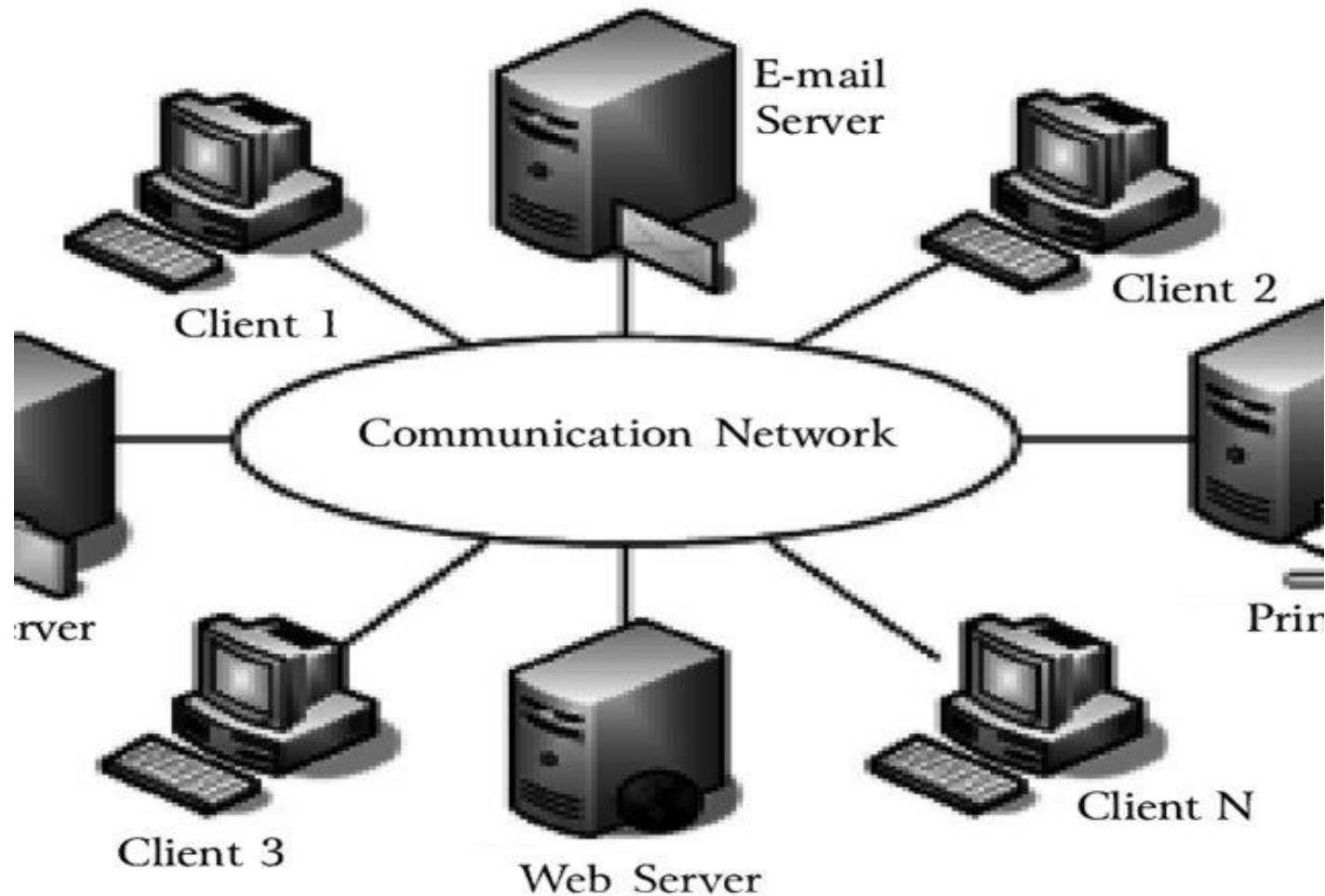
Introduction to Systems and Networks

(INSY 3071)

Instructor :Tsegaye Berhanu

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.*
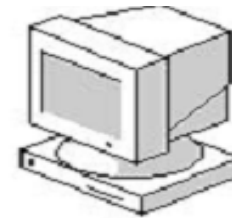
Computer Network

- 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.

- Early data networks were limited to exchanging character-based information between connected computer systems.

- Current networks have evolved to carry voice, video streams, text, and graphics between many different types of devices.

Computer Network
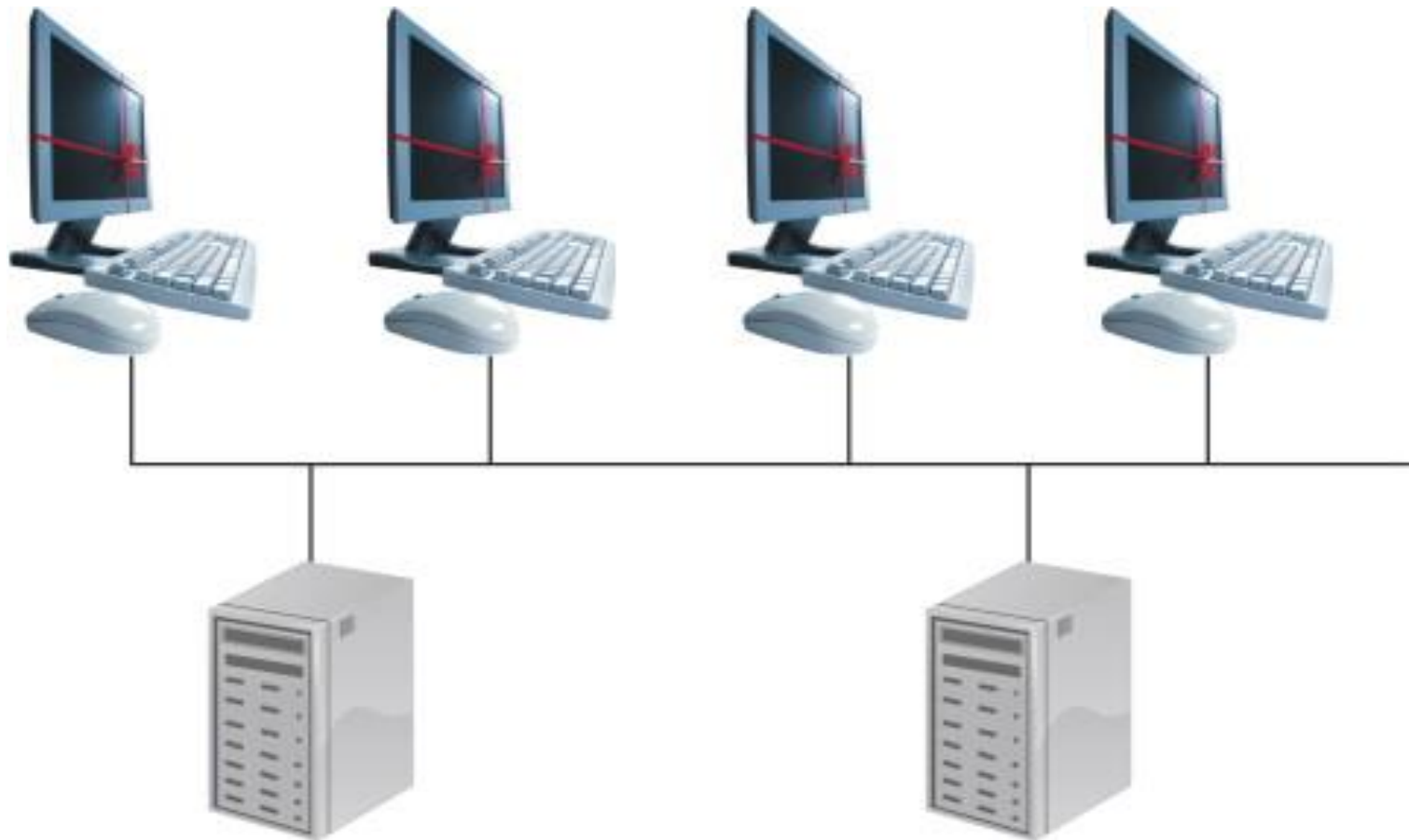
Benefits of Computer Networks

- 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.

prtinter sharing or printer networking
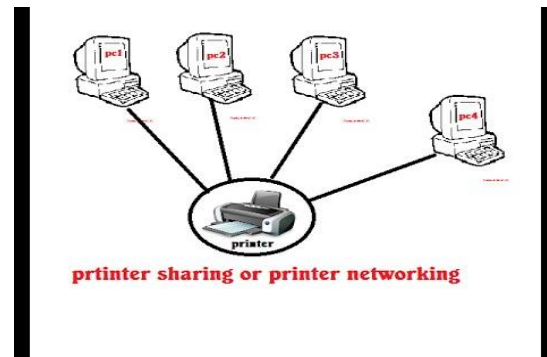
Sharing Hardware

- **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.

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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.

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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.

Core

Distribution

Access

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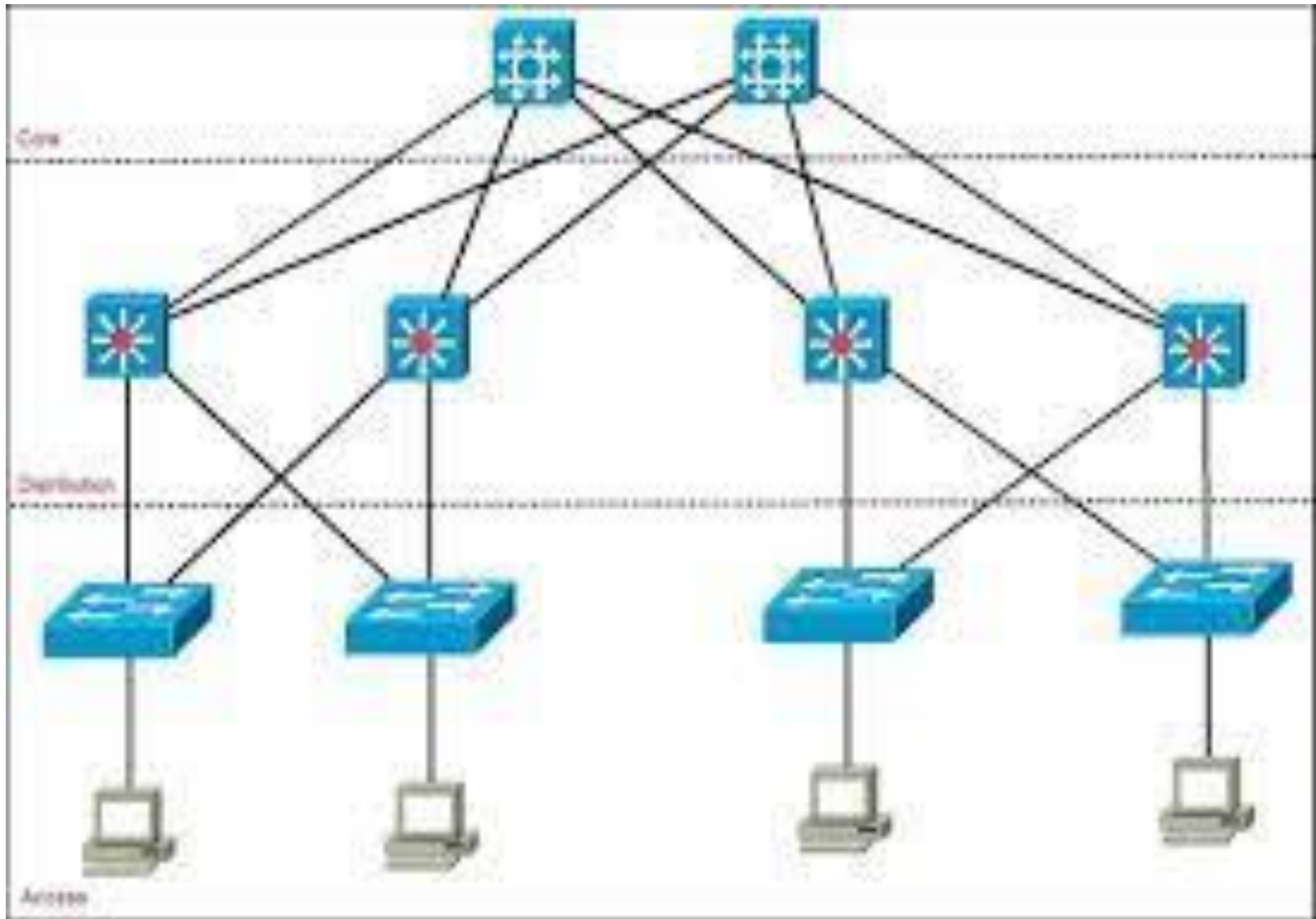
QoS (Quality of Service)

- 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

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.