Introduction to Networks and Systems

INSY 3071

Chapter 1

Overview of Computer Networks

Outline

➤ *Overview of Networks*

➤ *The impact of Networks*

➤ *The network as a platform*

➤ *Network Role & Elements*

➤ *Network Architecture Characteristics*

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.

- A 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 net-works spread over a wide geographic area.

Computer Network

- Computer networking arose as an answer to the need to share data in a timely fashion.

- Personal computers are powerful tools that can process and manipulate large amounts of data quickly, but they do not allow users to share that data efficiently.

Computer Network

- Before networks, users needed either to print out documents or copy document files to a disk for others to edit or use them.

- If others made changes to the document, there was no easy way to merge the changes. This was, and still is, known as "working in a stand-alone environment."
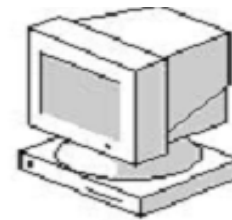
Stand-alone Computer

Computer Network

- But what if a computer was connected to other computers? Then, it could share data with the other computers or send documents to a printer.

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

Computer Network

- 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.

- 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
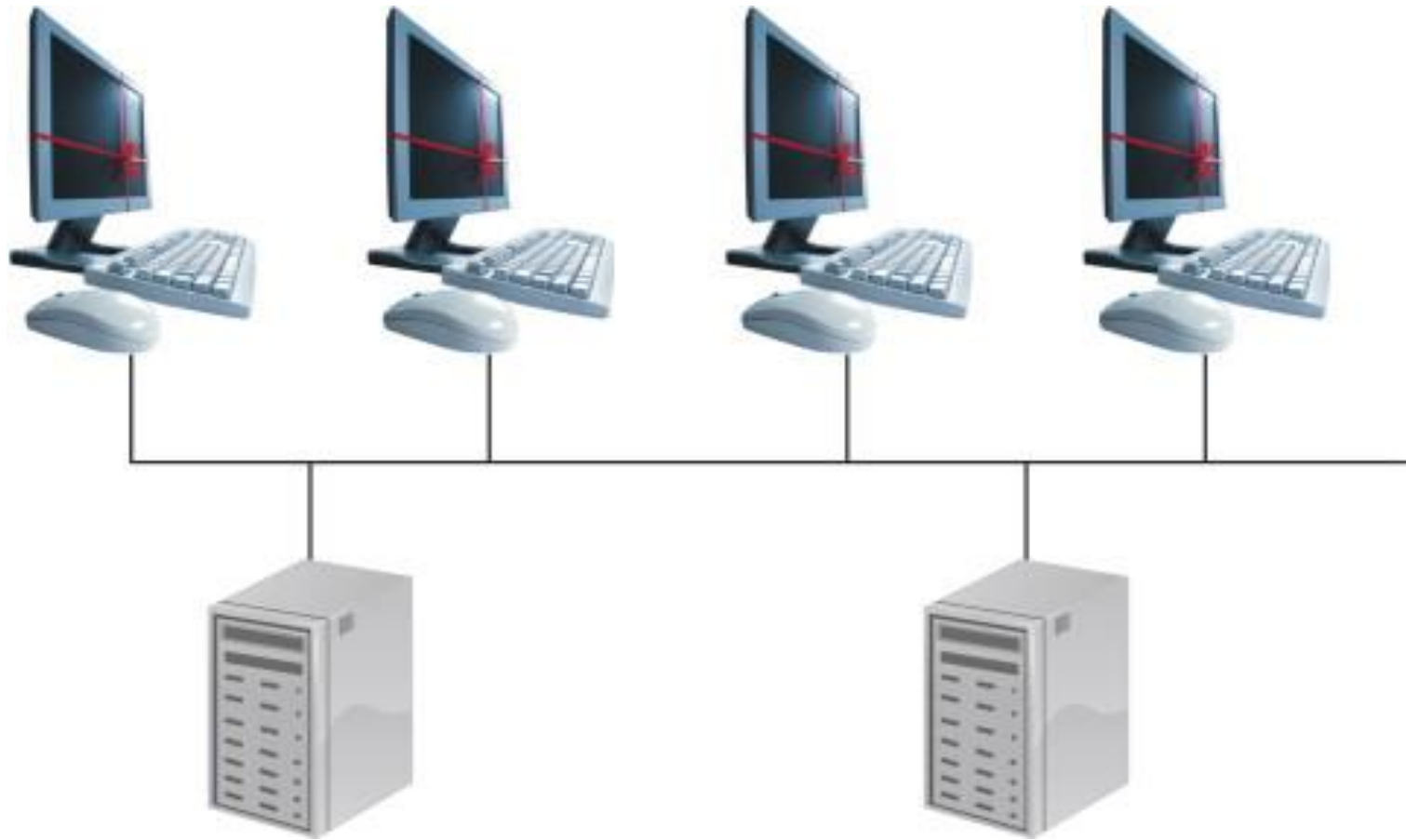
Benefits of Network Computing

- Networks increase efficiency and reduce costs.
- Computer networks achieve these goals in four primary ways:
  - ➤ Sharing Information (or Data)
  - ➤ Sharing Hardware(Peripheral Devices)
  - ➤ Sharing Programs/Software
  - ➤ Centralizing Administration and Support

Sharing Hardware

- Computer networks enable us to share expensive hardware resource among several computers.

- A typical example of shared resource is 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
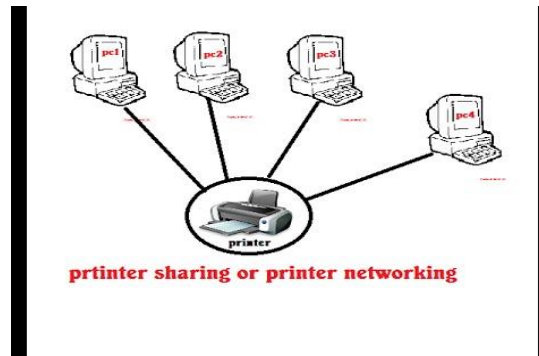
Sharing Hardware

- **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

- 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.

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.

- It is far more efficient for technical personnel to support one version of one operating system or application and to set up all computers in the same manner than to support many individual and unique systems and setups

Centralizing Administration and Support

- **The login Process:** Even if your computer is physically connected to a network, you cannot typically use network resources until you log into the network. When you log in, you formally identify yourself to the network by providing your ID and password.

- For such network environment, a network administrator is required who 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.

- 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
- Cost
- Security
- Resource Sharing
- Electronic Mail
- Flexible Access
- Centralized Software Management

Disadvantages Network

- Expensive to Install

- Requires Administrative Time

- File Server May Fail

- Cables May Break

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.

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.

Popular Communication Tools

Instant Messaging

- Instant messaging (IM) is a form of real-time communication between two or more people based on typed text.

- The text is conveyed via computers connected over either a private internal network or over a public network, such as the Internet.

Popular Communication Tools

- Developed from earlier Internet Relay Chat (IRC) services, IM also incorporates features such as file transfer, voice, and video communication.

- Like e-mail, IM sends a written record of the communication. However, whereas transmission of e-mail messages is sometimes delayed, IM messages are received immediately.

- The form of communication that IM uses is called realtime communication.

Popular Communication Tools

Weblogs (blogs)

- A **blog** post is usually one person's opinion, followed optionally by comments

- Weblogs (Blogs) are web pages that are easy to update and edit.

- Unlike commercial websites, which are created by professional communications experts, blogs give anyone a means to communicate their thoughts to a global audience without technical knowledge of web design

Popular Communication Tools

Wikis

- Wikis are web pages that groups of people can edit and view together.

- A *wiki* is a knowledge base website on which users collaboratively modify content and structure directly from the web browser

- Whereas a blog is more of an individual, personal journal, a wiki is a group creation. As such, it may be subject to more extensive review and editing. Like blogs, wikis can be created in stages, and by anyone, without the sponsorship of a major commercial enterprise.

Popular Communication Tools

- There is a public wiki, called Wikipedia, that is becoming a comprehensive resource - an online encyclopedia - of publicly-contributed topics.

- Private organizations and individuals can also build their own wikis to capture collected knowledge on a particular subject.

Popular Communication Tools

Podcasting

- Podcasting is an audio-based medium that originally enabled people to record audio and convert it for use with iPods - a small, portable device for audio playback manufactured by Apple.

- The ability to record audio and save it to a computer file is not new. However, podcasting allows people to deliver their recordings to a wide audience.

- The audio file is placed on a website (or blog or wiki) where others can download it and play the recording on their computers, laptops, and iPods.

Popular Communication Tools

Collaboration Tools

- Collaboration tools give people the opportunity to work together on shared documents. Without the constraints of location or time zone, individuals connected to a shared system can speak to each other, share text and graphics, and edit documents together.

- The broad distribution of data networks means that people in remote locations can contribute on an equal basis with people at the heart of large population centers.
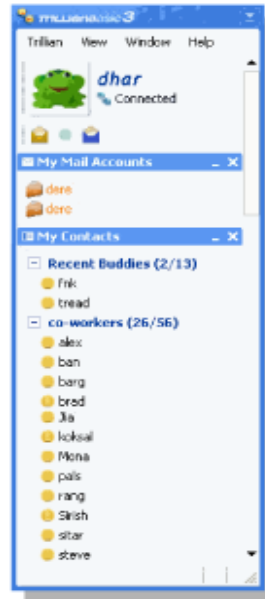
Popular Communication Tools

Podcasting

You can listen to your favorite radio show on your portable audio player whenever you have the time and wherever you are. Every time a new show becomes available, it can be automatically downloaded.

Instant Messaging

Instant messaging is everywhere and can include audio and video conversations. IM can send text messages to mobile phones.

Weblog

You can express your thoughts online, share your photos, and join a community of fellow thinkers.

The Network as a Platform

Communicating over Networks

- Being able to reliably communicate to anyone, anywhere, is becoming increasingly important to our personal and business lives.

- In order to support the immediate delivery of the millions of messages being exchanged between people all over the world, we rely on a web of interconnected networks.

The Network as a Platform

Communicating over Networks

- These data or information networks vary in size and capabilities, but all networks have four basic elements in common:
  - Rules or agreements to govern how the messages are sent, directed, received and interpreted
  - The messages or units of information that travel from one device to another
  - A means of interconnecting these devices - a medium that can transport the messages from one device to another
  - Devices on the network that exchange messages with each other

Elements of a Network

Networks vary in size and capabilities, but all networks have five basic elements in common:

- Sender/Source
- Media/Channel
- Message/Information
- Receiver/Destination
- Protocol/Rule

Data Communication

There are five components in data communication system.

- **Message**: the information to be communicated
- **Sender**: the device that sends the message
- **Receiver**: the device that receives the message
- **Medium**: the transmission medium is the physical path that communicates the message from sender to receiver.
- **Protocol**: refers to a set of rules that coordinates the exchange of information. Both the sender and the receiver should follow the same protocol to communicate data.

The Network Architecture

- Networks must support a wide range of applications and services, as well as operate over many different types of physical infrastructures.

- The term network architecture, in this context, refers to both the technologies that support the infrastructure and the programmed services and protocols that move the messages across that infrastructure.

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The Network Architecture

- As the Internet, and networks in general, evolve, we are discovering that 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.

Scalability

- The operation at each layer enables users or service providers to be inserted without causing disruption to the entire network.

- Technology developments are constantly increasing the message carrying capabilities and performance of the physical infrastructure components at every layer.

- These developments, along with new methods to identify and locate individual users within an internetwork, are enabling the Internet to keep pace with user demand.

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), and 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.

QoS (Quality of Service)

- Traditional voice and video networks are designed to support a single type of transmission, and are therefore able to produce an acceptable level of quality.

- New requirements to support this quality of service over a converged network are changing the way network architectures are designed and implemented.

Security

- The Internet has evolved from a tightly controlled internetwork of educational and government organizations to a widely accessible means for transmission of business and personal communications.

- As a result, the security requirements of the network have changed.

- 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.