COMPUTER NETWORKS (CSGE 30) zautam Assistant Professor

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UNIT 1

Computer Networks: Introduction to computer network, data communication, components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet, extranet.

INTRODUCTION

Data communications and networking

- Change the way we do business and the way we live
- Business decisions have to be made more quickly
- Decision depends on immediate access to accurate information
- Business today rely on computer networks and internetworks
- Before get hooked up, we need to know:
 - How networks operate
 - What types of technologies are available
 - Which design best fills which set of needs

INTRODUCTION

- Development of the PC changes a lot in business, industry, science and education.
- Similar revolution is occurring in data communication and networking
 - Technologies advances are making it possible for communications links to carry more and faster signals
 - Services are evolving to allow the use of this expanded capacity
 - For example telephone services extended to have:
 - Conference calling
 - Call waiting
 - Voice mail
 - Caller ID

1.1 DATA COMMUNICATIONS

Communication:

- Means sharing information
 - Local (face to face) or remote (over distance)
- Telecommunication
 - Telephone, telegraph and television
 - Means communication at a distance
 - Tele is Greek for far

DATA COMMUNICATIONS

Data:

- Refers to information
 - Presented in any form
 - Agreed upon by the parties (creating & using)

Data communication : is the exchange of data between two devices via some form of transmission medium (wire cable).

DATA COMMUNICATIONS

- Communication system made up of a combination of hardware and software
- Effectiveness of data communication system depends on:
 - 1. Delivery : The system must deliver data to correct destination. Data received by the indented user only
 - 2. Accuracy: The system must deliver data accurately (no change). Data changed & uncorrected is unusable
 - 3. Timeliness: The system must deliver data in timely manner
 - Data arrived late are useless
 - In the same order (video and audio) & without delay (Real time transmission)
 - 4. Jitter: Variation in the packet arrival time (uneven quality in the video is the result)

DATA COMMUNICATIONS



 A data communication system is made up of five components



- 1. Message: the information (data) to be communicated
 - Consist of text, numbers, pictures, audio, or video
- 2. Sender: the device that sends the data message
 - Computer, workstation, telephone handset, video camera, ...
- 3. Receiver: the device that receives the message
 - Computer, workstation, telephone handset, television,

- 4. Medium: The physical path by which a message travels from sender to receiver
 - twisted pair, coaxial cable, fiber-optic, radio waves





5. Protocol: a set of rules that govern data communications

- An agreement between the communicating devices
- Devices may be connected but not communicating (no protocol)
- Arabic speaker with Japanese speaker



Text:

- Sequence of bits (Os or 1s)
- Different sets of patterns to represent text symbols (each set is called: code)
- ASCII: 7 bits (128 symbols)
- common coding system today is:
- Unicode uses: 32 bits to represent a symbol or character in any language



(4,294,967,296)

10101010 10101010 10101010 10101010 10101010 10101010 10101010

Numbers:

- Represented by bit patterns
- The number is directly converted to a binary number

Images:

- Represented by bit patterns
 DIXEIS

- A matrix of
- Resolution: size of the pixels
- High resolution: more memory is needed
- Each pixel is assigned a bit pattern
 - 1-bit pattern (black and white dots image)
 - 2-bit pattern (4 levels of gray)
 - RGB (color images)

Audio:

- Continuous not discrete
- Change to digital signal

Video:

- Recording or broadcasting of a picture or movie
- Change to digital signal

Communication between two devices can be:

- Simplex
- Half-Duplex
- Full-Duplex

Simplex (one way street)

- The communication is unidirectional
- Only one device on a link can transmit; the other can only receive
- Use the entire capacity of the channel to send data
- Example: Keyboards, Monitors



Half-Duplex (one-lane with two-directional traffic)

- Each station can both transmit and receive, but not at the same time
- When one device is sending, the other can only receive, and vice versa
- The entire capacity of a channel is taken over by the transmitting device
 Example: Walkie-talkies





Full-Duplex (Duplex) (two-way street)

- Both stations can transmit and receive at same time
- Signals going in either direction sharing the capacity of the link
- Sharing can occur in two ways:
 - · Link has two physically separate transmission paths
 - \cdot One for sending and the other for receiving
 - The capacity of the channel is divided to the signals travelling in both directions
- Example: Telephone network





EXERCISE

What mode of data flow the following exhibits shows?



Answer: Full-Duplex

- Network : A set of devices (nodes) connected by communication links
 Node : computer, printer, ...
 - Distributed Processing :
 - Most networks used it
 - Task is divided among multiple computers instead of one single large computer

Network Criteria

- -Network must meet a certain number of criteria
- -The most important of the network criterions are:
 - Performance
 - Reliability
 - Security

Performance

- Transit time: A mount of time required for a message to travel from one device to another
- Response time: Elapsed time between an inquiry and a response

Performance

Performance depends on :

- 1- Number of users: large number slow response time.
- 2- Type of transmission medium: fiber-optic cabling faster than others cables.
- 3- Capabilities of the connected hardware: affect both the speed and capacity of transmission.
- 4- Efficiency of the software: process data at the sender and receiver and intermediate affects network performance.

Performance

- Performance is evaluated by two contradictory networking metrics:
 - Throughput (high): a measure of how fast we can actually send data through a network
 - Delay (low)

Reliability

Reliability is measured by:

- 1. Frequency of failure
- 2. Recovery time of a network after a failure
- 3. Network's robustness in a catastrophe: protect by good back up network system

Security

- Protecting data from unauthorized access
- Protecting data from damage and development
- Implementing policies and procedures for recovery from breaches and data losses (Recovery plan)

Physical Structures:

Type of connection

- Network: Two or more devices connected through links
- Link: Communication pathway that transfers data from one device two another
- Two devices must be connected in some way to the same link at the same time. Two possible types:
 - Point-to-Point
 - Multipoint

Point-to-Point

- Dedicated link between two devices
- Entire capacity of the link is reserved for transmission between those two devices
- Use an actual length of wire or cable



Point-to-Point

- Other options, such as microwave or satellite is possible
- Example: Television remote control



Multipoint (multidrop)

- More than two devices share a single link
- Capacity is shared
- Channel is shared either spatially or temporally
 - Spatially shared: if devices use link at same time
 - Timeshare: if users must take turns



b. Multipoint

Physical Topology

- The way a network is laid out physically
- Two or more links form a topology
- The topology of a network is the geometric representation of the relationship of all the links and linking devices (nodes) to one another.
- Four topologies : Mesh, Star, Bus, and Ring



PHYSICAL TOPOLOGY

Mesh

- Every link is dedicated point-to-point link
- The term dedicated means that the link carries traffic only between the two devices it connects


Mesh

To link *n* devices fully connected mesh has:
n (*n* - 1) / 2 physical channels (Full-Duplex)

Every Device on the network must have
n - 1 ports



Mesh

• Example:

8 devices in mesh has links: n(n-1) / 2

number of links = 8 (8-1)/2 = 28

number of ports per device = n - 1 = 8 - 1 = 7



Mesh

Advantages

- Each connection carry its own data load (no traffic problems)
- A mesh topology is robust
- Privacy or security
- Fault identification and fault isolation



Mesh:

- Disadvantages
 - Big amount of cabling
 - Big number of I/O ports
 - Installation and reconnection are difficult
 - Sheer bulk of the wiring can be greater than the available space
 - Hardware connect to each I/O could be expensive

Mesh topology is implemented in a limited fashion; e.g., as backbone of hybrid network



Star:

- Dedicated point-to-point to a central controller (Hub)
- No direct traffic between devices
- The control acts as an exchange



Star

Advantages

- Less expensive than mesh
 - (1 Link + 1 port per device)
- Easy to install and reconfigure
- Less cabling
- Additions, moves, and deletions required one connection
- Robustness : one fail does not affect others
- Easy fault identification and fault isolation



Star

- Disadvantages
 - Dependency of the whole topology on one single point (hub)
 - More cabling than other topologies (ring or bus)

Used in LAN



Bus

- It is multipoint
- One long cable acts as a backbone
- Used in the design of early LANS, and Ethernet LANs



Bus

- Nodes connect to cable by drop lines and taps
- Signal travels along the backbone and some of its energy is transformed to heat
- Limit of number of taps and the distance between taps



Bus

Advantages

- Ease of installation
- Less cables than mesh, star topologies

Disadvantages

- Difficult reconnection and fault isolation (limit of taps)
- Adding new device requires modification of backbone
- Fault or break stops all transmission
- The damaged area reflects signals back in the direction of the origin, creating noise in both directions



Ring

- Each device has dedicated point-to-point connection with only the two devices on either side of it
- A signal is passed along the ring in one direction from device to device until it reaches its destination



Ring

Advantages

- Easy of install and reconfigure
- Connect to immediate neighbors
- Move two connections for any moving (Add/Delete)
- Easy of fault isolation
- Disadvantage
 - Unidirectional
 - One broken device can disable the entire network. This weakness can be solved by using a dual ring or a switch capable of closing off the break



Hybrid Topology

 Example: having a main star topology with each branch connecting several stations in a bus topology

CATEGORIES OF NETWORKS

Network Category depends on its size

Two primary categories

- LAN: Covers area < 2miles</p>
- WAN: Can be worldwide

• MAN: Between LAN & WAN, span 10s of miles

LOCAL AREA NETWORK (LAN)

Privately owned

Links devices in the same office, building, or campus

Simple LAN: 2 PCs & 1 printer in home or office

Size is limited to a few kilometers

Allow resources to be shared (hardware, software, or data)



An isolated LAN connecting 12 computers to a hub in a closet

LOCAL AREA NETWORK (LAN)

LAN is distinguished by:

- Size (# users of OS, or licensing restrictions)
- Transmission medium (only one type)
- Topology (bus, ring, star)

Data Rates (speed):

- Early: 4 to 16 Mbps
- Today: 100 to 1000 Mbps



WIDE AREA NETWORKS (WAN)

Provides long-distance transmission of data over larça accordance (country, continent, world)



WIDE AREA NETWORKS (WAN)

Switched WAN

Backbone of the Internet

Dialup line point-to-point WAN

Leased line from a telephone company

WIDE AREA NETWORKS (WAN)



a. Switched WAN



b. Point-to-point WAN

METROPOLITAN AREA NETWORKS (MAN)

Size between LAN and WAN

Inside a town or a city

Example: the part of the telephone company network that can provide a high-speed DSL to the customer

INTERCONNECTION OF NETWORKS: INTERNETWORKS



Internet has revolutionized many aspects of our daily lives.

It has affected the way we do business as well as the way we spend our leisure time.

Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use

An internet is 2 or more networks that can communicate with each other

The Internet is a collaboration of more than hundreds of thousands of interconnected networks

An internet (small i) is two or more networks

Notable internet is called the Internet (hundreds of thousands interconnected networks)

 Private individuals + government agencies + school + research facilities + Corporations + libraries in more than 100 countries

This communication system came in 1969

Mid-1960 (ARPA) Advanced Research Projects Agency in (DOD) was interested to connect mainframes in research organizations

1967, ARPA presented its ideas for ARPANET

- Host computer connecting to (IMP) interface message processor.
- Each IMP communicate with other IMP

1969, four nodes (universities) connected via IMPs to form a network

Software (NCP) Network Control Protocol provided communication between the hosts.

1972, Vint Cerf and Bob Kahn invented (TCP) Transmission Control Protocol

Later TCP was split to (TCP) Transmission Control Protocol and (IP) Internetworking Protocol

Internet Today

- Made of many LANs and WANs
- Every day new networks area added and removed
- Internet services Providers (ISPs) offer services to the end users
 - International service providers
 - National service providers
 - Regional service providers
 - Local service providers





a. Structure of a national ISP



Hierarchical organization of the Internet

PROTOCOLS AND STANDARDS

Protocol synonymous with rule

Standards: agreed-upon rules

Protocols

- A protocol is a set of rules that govern data communications
- Defines What, How, and When it is communicated

PROTOCOLS AND STANDARDS Elements of a protocol:

- Syntax: structure or format of data
 - Example: 8-bits address of sender, 8-bits address of receiver
- Semantics: meaning of each section of bits
 - Example: Does the address is a route to be taken or the final destination of the message
- Timing: when data should be sent and how fast they can be sent
 - Example: sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps ⇒ overload and data loose

Essential in creating and maintaining an open and competitive market for equipment manufactures

Guaranteeing national and international interoperability of data and telecommunication technology and processes

Providing guidelines to manufacturers, vendors, government agencies, and other service providers to ensure the kind of interconnectivity necessary in today's marketplace and in international communications

Two categories

- De facto: not approved by an organized body but adopted as standards through widespread use
- De jure: Legislated by an officially recognized body

Standards are developed through the cooperation of:

- Standards Creation Committees
 - ISO, ITU-T, CCITT, ANSI, IEEE, EIA

Forums

- Created by special-interest groups
- Present their conclusions to the standards bodies
- Regulatory Agencies
 - Ministry of Telecommunication and Information Technology (KSA)
 - Purpose: Protecting the public by regulating radio, television, and communication

Internet standards

- Tested thoroughly tested specification that is useful to be adhered to by those who work with the Internet
- Formalized regulation that must be followed
- Specification become Internet standard
 - Begins as Internet draft for 6 months
 - Upon recommendation from the Internet authorities draft published as Request for Comment (RFC)
 - RFC is edited, assigned a number, and made available to all interested parties

INTERNET AND THE WORLD WIDE WEB

Internet

- Worldwide collection of millions of computers and networks of all sizes
- Derived from the term internetworking which meant connecting networks
- Advanced Research Projects Agency Network (ARPANET)
 - Project started in 1969 by the U.S. Department of Defense was the beginning of the Internet

INTERNET AND THE WORLD WIDE WEB

Internet backbone

- Foundation network linked with fiber-optic cables that can support high bandwidth
- Made up of many interconnected government, academic, commercial, and other high capacity data routers
- Private companies operate their own Internet backbones that interconnect at network access points (NAPs)

INTERNET AND THE WORLD WIDE WEB

World Wide Web (WWW, or "the Web") changed the Internet in 1989 by:

Introducing graphical interface to the text-based Internet

Hypermedia

Documents include embedded references to audio, text, images, video, and other documents

Hypertext

- Embedded references in hypermedia documents
- Consists of links users can click to follow a thread

DOMAIN NAME SYSTEM (DNS)

 Protocol which converts domain names into IP addresses when information is transferred from one network to another

Domain names: Unique identifiers of computer or network addresses on the Internet

Internet Protocol (IP) address

Assigned by the Internet Corporation for Assigned Names and Numbers (ICANN)
DOMAIN NAME SYSTEM (DNS)

Uniform resource locators (URLs)

- Address of a document or site on the Internet
- Otherwise known as universal resource locators, identify a Web page

TLD: Denotes the type of organization or country the address specifies

- Organizational (gTLDs)
- Country-code (ccTLDs)

Table 7.1GENERIC TOP-LEVEL DOMAINS

gTLD	Purpose
.com	Commercial organizations (such as Microsoft)
.edu	Educational institutions (such as California State University)
.int	International organizations (such as the United Nations)
.mil	U.S. military organizations (such as the U.S. Army)
.gov	U.S. government organizations (such as the Internal Revenue Service)
.net	Backbone, regional, and commercial networks (e.g., the National Science Foundation's Internet Network Information Center)
.org	Other organizations, such as research and nonprofit organizations (e.g., the Internet Town Hall)

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HYPERTEXT MARKUP LANGUAGE (HTML)

Language used to create Web pages

Defines a page's layout and appearance by using tags and attributes

- Tag delineates a section of the page, such as the header or body
- Attribute specifies a value
 - Font color, for a page component

TYPES OF INTERNET CONNECTIONS

Dial-up

Cable modems

Digital Subscriber Line (DSL)

- Symmetric DSL (SDSL)
- Asymmetric DSL (ADSL)
- Very High-Speed DSL (VDSL)

CATEGORIZATION OF TOOLS

Navigational tools

• Used to travel from website to website - as in surf the Internet

Search engines

 Information system that enables users to retrieve data from the Web by using search terms

CATEGORIZATION OF TOOLS

Directories

 Indexes of information based on keywords embedded in documents which allows search engines to find what is being looked for

NAVIGATIONAL TOOLS: WEB BROWSERS

- Microsoft Internet Explorer (IE), Mozilla Firefox, Google Chrome, and Apple Safari, and Opera
- Consists of menu options
- Includes options for:
 - Viewing your browsing history
 - Bookmarking favorite websites
 - Setting viewing preferences
 - Navigation buttons

PROCESS FOLLOWED BY SEARCH ENGINES

Crawling the Web

- Search engines use software called crawlers, spiders, bots, and other similar names
- Crawlers
 - Find the new data
 - Checks to see what links are on the page and confirms that the links are working
 - Identify broken link and includes the information as part of the data about that page

PROCESS FOLLOWED BY SEARCH ENGINES

- Gathered data is sent back to the search engine's data center
 - Ensures that search engine has updated information on the web

Indexing

- Housed at server farms, search engines use keywords to index data coming in from crawlers
- Each keyword has an index entry that is linked to all Web pages containing that keyword

PROCESS FOLLOWED BY SEARCH ENGINES

Searching

- Search engine:
 - Uses the index created in earlier step to look up the term
 - Identifies all Web pages linked to the term if the term exists in the index
 - Varies in intelligence

TYPES OF DIRECTORIES

- Automated or crawler-based: Creates indexes of search terms and collects these terms automatically by using crawlers
 - Google, Yahoo!, Ask.com
- Human powered: Requires keywords to be manually submitted for a Web page to be listed in a search engine's results

INTERNET SERVICES

Services made possible by the TCP suite of protocols

- Simple Message Transfer Protocol (SMTP)
- Post Office Protocol (POP)

Popular services

• E-mail, newsgroups, discussion groups, Internet Relay Chat, instant messaging, and Internet telephony

E-MAIL

Widely used services on the Internet

Main types

- Web-based e-mail
- Client-based e-mail

E-mail programs include:

- Folders for organization
- Address books and distribution groups
- Spell checkers
- Delivery notification

NEWSGROUPS AND DISCUSSION GROUPS

Newsgroups

- General in nature and can cover any topic
- Allow people to get together for fun or for business purposes

Discussion groups

- Formed for people to exchange opinions and ideas on a specific topic
- Group members post messages or articles that others in the group can read

INSTANT MESSAGING

Internet Relay Chat (IRC)

 Enables users in chat rooms to exchange text messages with people in other locations in real time

Instant messaging (IM)

- Service for communicating with others via a private chat room on the Internet
- Applications
 - Windows Messenger, Yahoo! Messenger, and Google Chat

INTERNET TELEPHONY

Using the Internet to exchange spoken conversations

Voice over Internet Protocol (VoIP)

- Protocol used for Internet telephony
- Requires high-speed Internet connection and microphone or headset
- Makes international and long-distance calls less expensive
- Used to route traffic starting and ending at conventional PSTN phones
- Lacks call quality

WEB APPLICATIONS

Services and products for a wide range of customers at competitive prices and with increased convenience

Used with minimum costs

TOURISM AND TRAVEL

Benefited from e-commerce Web applications

Travel websites allow customers to book tickets for plane trips and cruises

Examples

 Expedia.com, Travel.com, Travelocity. com, Priceline.com, Hotels.com, Google.com/flights/, and Yahoo! Travel

PUBLISHING

Major publishers in the United States and Europe offer websites with:

- Descriptions of forthcoming books
- Sample chapters
- Online ordering
- Search features

Publishers offer books that can be read online free or enable people to buy e-books

HIGHER EDUCATION

Universities have websites offering:

- Information about departments, programs, faculty, and academic resources
- Virtual tours of the campus

Online degree programs help colleges and universities facing an enrollment decline

Makes it possible for students who cannot attend school otherwise to enroll in classes

Universities with online classes can have renowned experts give lectures or seminars

REAL ESTATE

Provide millions of up-to-date listings of homes

Allows buyers to review neighborhoods, schools, and real estate prices

Helps customers find realtors and brokerage firms, and learn home-buying tips

EMPLOYMENT

Expert advice and tools for managing your career

Resumé assistance

Job search tutorials

Posting and distributing resumes

Job alerts

Searches by company, industry, region, or category

EMPLOYMENT

Announcements of job fairs

Career tests to see what career is right for you

Salary calculators

FINANCIAL INSTITUTIONS

Offer online banking services

Use e-mail to communicate with customers and send account statements and financial reports

• Helps banks to reduce the time and costs of communicating via phone

FINANCIAL INSTITUTIONS

Banking services

- Accessing customer service by e-mail around the clock
- Viewing current and old transactions
- Online mortgage applications
 - Interactive tools
 - Finding loan status and credit card account information online
 - Paying bills and credit card accounts
 - Transferring funds
 - Viewing digital copies of checks

SOFTWARE DISTRIBUTION

Vendors distribute software on the Internet as well as drivers and patches

- Antivirus updates
- Fast, and easy to download

Large programs not distributed via Internet

Provides an inexpensive, convenient, and fast way to sell software

HEALTHCARE

Stores patient records on the Internet

- Helps access patient information from one central location
- Consists of potential problems involving information privacy, accuracy, and currency
- Made finding critical health information is faster and more efficient
- Facilitates telemedicine, telepresence surgery

POLITICS

Political candidates make use of websites in campaigns

- Announcing platforms
- Publicizing voting records
- Posting notices of appearances and debates
- Fundraising

Gives the possibility of legislators voting via online systems

INTRANETS

Network within an organization that uses Internet protocols and technologies for:

• Collecting, storing, and disseminating useful information that supports business activities

Otherwise known as corporate portals

Facilitates internal use by employees

• Companies also allow trusted business partners to access their intranets

INTRANETS

Uses Internet technologies to solve organizational problems

Different from an LAN

Defining and limiting access is important for security reasons

Exhibit 7.3 SIMPLE INTRANET ARCHITECTURE



Table 7.2THE INTERNET VERSUS
INTRANETS

Key feature	Internet	Intranet
User	Anybody	Approved users only
Geographical scope	Unlimited	Limited or unlimited
Speed	Slower than an intranet	Faster than the Internet
Security	Less than an intranet's	More than the Internet's; user access more restricted

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BUSINESS APPLICATIONS OF AN INTRANET

Human resources management

Sales and marketing

Production and operations

Accounting and finance

Helps organizations move from a calendar-based, document-publishing strategy to an event based strategy

Reduces the costs and time of document production

EXTRANETS

Secure network that:

- Uses the Internet and Web technologies to connect intranets of business partners
- Facilitates communication between organizations or between consumers

Considered to be a type of inter-organizational system (IOS)

- Electronic funds transfer (EFT)
- Electronic data interchange (EDI)

EXTRANETS

Allow companies to reduce internetworking costs and give competitive advantage

• Leads to increased profits

Require a comprehensive security system and management control

Exhibit 7.4 SIMPLE EXTRANET ARCHITECTURE



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ADVANTAGES OF EXTRANETS

- Coordination
- Feedback
- Consumer satisfaction
- Cost reduction
- Expedited communication

NEW TRENDS: THE WEB 2.0 AND 3.0 ERAS

Web 2.0

- Trend toward Web applications that are more interactive than traditional Web applications
- Includes e-collaboration as a key component
- Focuses mainly on social networking and collaboration

NEW TRENDS: THE WEB 2.0 AND 3.0 ERAS

Web 3.0

- Otherwise known as the Semantic Web
- Provides personalization that allows users to access the Web more intelligently
- Focuses on intelligent Web applications using applications of artificial intelligent technologies
- Facilitates computers to read websites easily as humans

Table 7.4WEB 1.0 VERSUS WEB 2.0

Web 1.0	Web 2.0
DoubleClick (used for online marketing)	Google AdSense
Ofoto (sharing digital photos)	Flickr
Akamai (streaming media services)	BitTorrent
mp3.com	iTunes
Britannica Online	Wikipedia
Personal Web sites	Blogging
eVite (type of wiki for event planning)	Upcoming.org and Events and Venues Database (EVBD)
Domain name speculation	Search engine optimization
Page views	Cost per click
Content management systems	Wikis
ERoom and Groove (collaboration software)	Collaboration portals, such as IBM Quickr and Microsoft Sharepoint
Posting a movie file on a personal Web page	YouTube
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BLOGS

Journal or newsletter that's updated frequently and intended for the general public

Reflects the authors' personality and includes philosophical thoughts and opinions on social or political issues

Microblogs: Newer version of traditional blogs

• Enable users to create smaller versions of blog posts

WIKIS

Website that allows users to add, delete, and modify content

Includes a feature where information user can also be an information provider

Lacks in quality of information because allowing anyone to modify content affects the accuracy

Corporate wikis were developed to restrict content being edited by others

SOCIAL NETWORKING SITES

Broad class of websites and services that allow users to connect with friends, family, and colleagues online

Popular social networking sites

• Facebook, Twitter

LinkedIn: Professional networking site

Popular for business use

RSS (REALLY SIMPLE SYNDICATION) FEEDS

Fast, easy way to distribute Web content in Extensible Markup Language (XML) format

- Subscription service
- New content selected from websites delivered via a feed reader to one convenient spot

XML

- Flexible method for creating common formats for information
- Tags represent the kind of content being posted and transmitted

PODCASTING

Electronic audio file posted on the Web for users to download to their mobile devices

Consists of a specific URL and is defined with an XML item tag

Collected by an aggregator

• iTunes or iPodder

Users can subscribe to a podcast

Enables users to be subscribed

THE INTERNET2

Collaborative effort involving more than 200 U.S. universities and corporations to develop:

• Advanced Internet technologies and applications for higher education and academic research

Gigapop

- Local connection point-of-presence that connects a variety of high-performance networks
- Exchanges 12 traffic with a specified bandwidth

APPLICATIONS OF INTERNET2

- Learningware
- Digital Library
- Teleimmersion
- Virtual laboratories

INTERNET OF EVERYTHING (IOE)

Web-based development in which people, processes, data, and things are interconnected via the Internet using:

- RFID devices
- Barcodes
- Wireless systems
- QR codes

Internet of things (IoT)

• Physical objects that are connected to the Internet and to all the other physical objects

INTERNET OF EVERYTHING (IOE)

Facilitates

- Automated inventory systems in the retail industry
- Automated and programmable appliances in domestic households
- Road and bridge systems

Helps solve social problems

• Hunger, water pollution, adverse climate change, and increasing energy costs

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