NETWORKING AND THE INTERNET

Lecture slides are adapted/modified from slides provided by the textbook, Computer Science: An Overview by J. Glenn Brookshear and Dennis Brylow
publisher Pearson

KHOA CÔNG NGHỆ THÔNG TIN
TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN

Contents

- Network Fundamentals
- The Internet
- The World Wide Web
- Internet Protocols
- Security
- About Networks and Telecommunications Department

NETWORK FUNDAMENTALS

Networks

- Links multiple computer systems and enables them to share data and resources

Network Fundamentals

- Local Area Network (LAN)
  - Uses cables, radio waves, or infrared signals
  - Links computers in a limited geographic area
- Wide Area Network (WAN)
  - Uses long-distance transmission media
  - Links computer systems a few miles or thousands of miles
  - Internet is the largest WAN
- Metropolitan Area Network (MAN)
  - Designed for a city
  - Larger than a LAN, smaller than a WAN

Network Fundamentals

- Campus Area Network (CAN)
  - Several LANs located in various locations on a college or business campus
  - Smaller than a WAN
  - Use devices such as switches, hubs, and routers
- Personal Area Network (PAN)
  - Network of an individual's own personal devices
  - Usually within a range of 32 feet
  - Usually use wireless technology

Network Fundamentals

- Node
  - Any device connected to a network
- Logical address
  - Unique name assigned to each node on the network
- Physical address
  - Unique numeric that identifies each node on the network built into the hardware
- Network interface card (NIC)
  - Expansion board or adapter that provides a connection between the computer and the network
  - Notebook computers have wireless NICs

Network Fundamentals

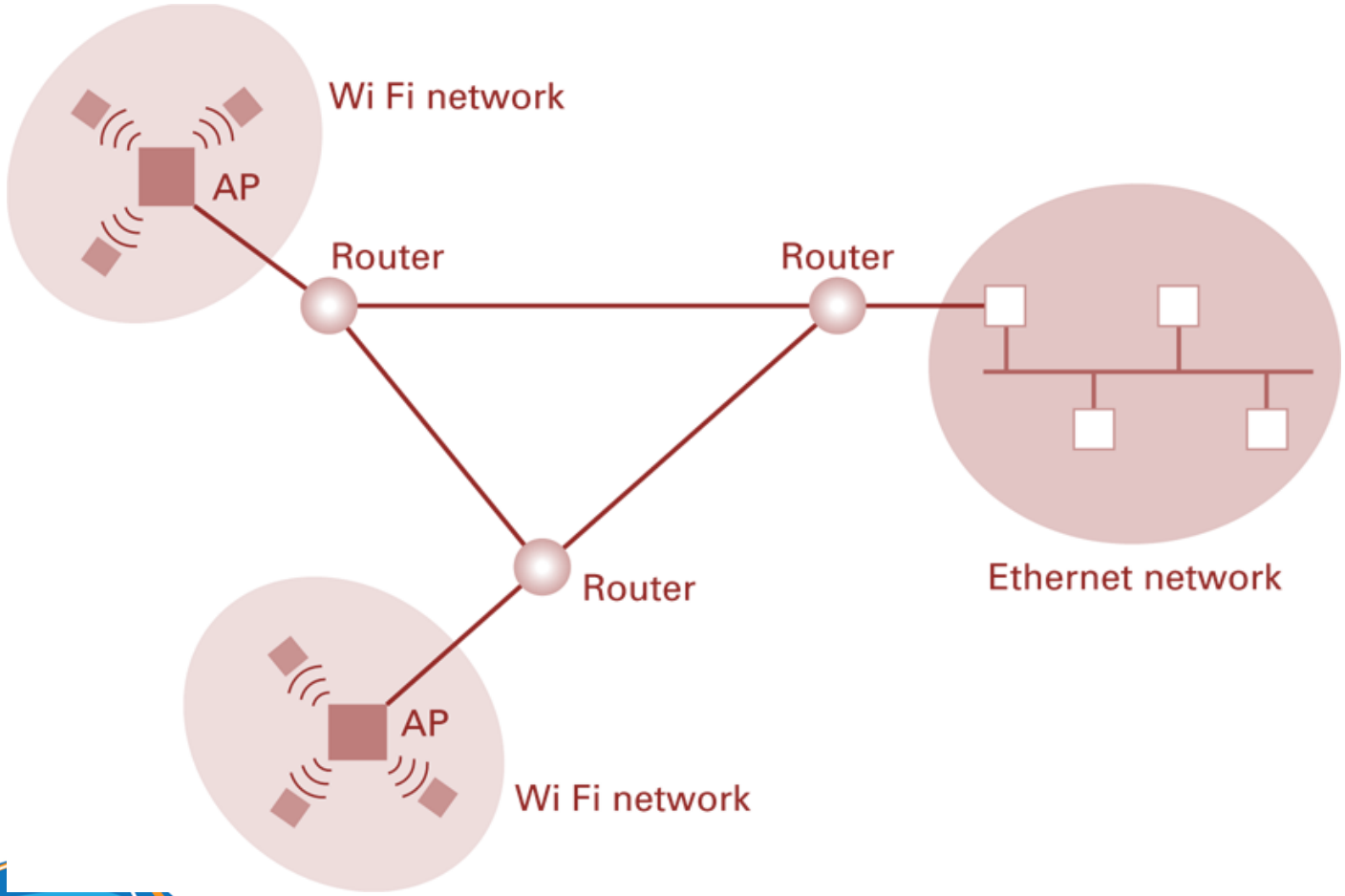
- USB wireless network adapter
  - Plugs into a USB port
  - Usually provides an intuitive graphical user interface (GUI) for easy configuration
- Wireless PC card adapter
  - About the size of a credit card
  - Inserted into a slot on the side of most notebooks and netbooks
  - Has built-in WiFi antenna that provides wireless capability
  - LED lights that indicate whether the computer is connected

Network Fundamentals

- Hub
  - Joins multiple computers together in a single network
  - Does not manage traffic between the connections
- Switches
  - Filter and forward data between nodes
  - Are similar to routers but work within a single network
- Routers
  - Connect two or more networks
  - Inspect the source and target of a data package
  - Determine the best route to transmit data

Network Fundamentals

Routers



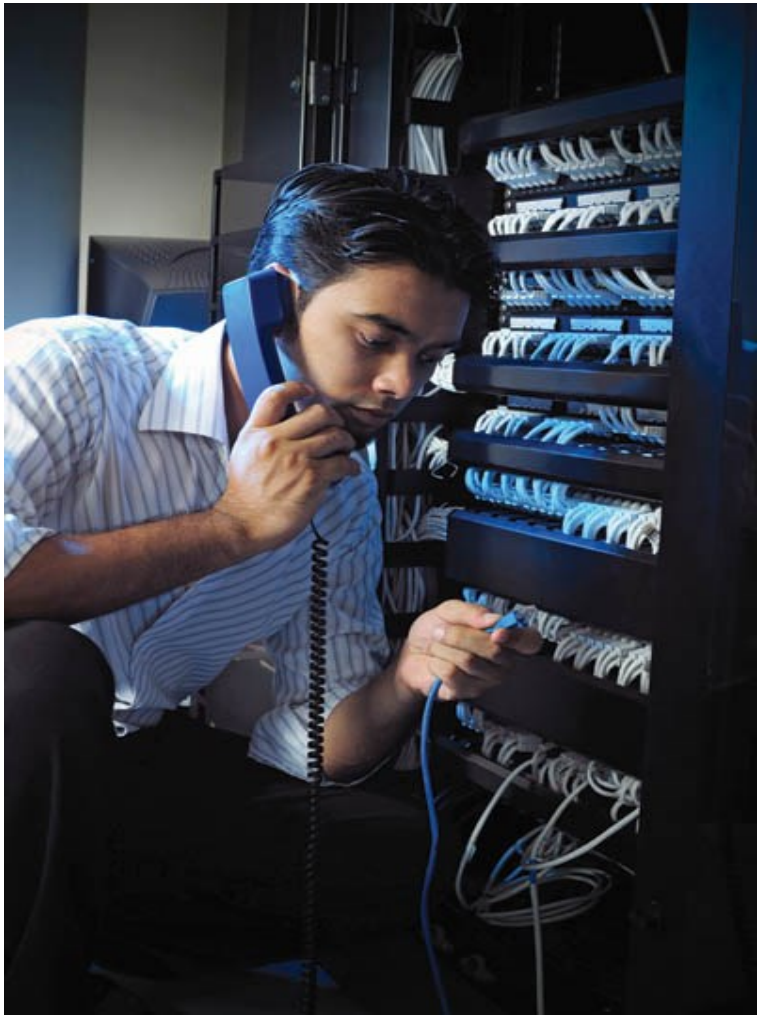
Network Fundamentals

Network Fundamentals

- Server
  - Computer or device with software that manages network resources, such as files, e-mails, printers, databases
- File server
  - Most common type of server
  - High-speed computer that provides program and data files to network users
  - Contains the network operating system (NOS)
    - File directories for file and resource location on the LAN
    - Automated distribution of software updates to desktop computers on the WAN
    - Internet services support
    - Protection of services and data
    - Access to connected hardware by authorized users

Network Fundamentals

- Network administrator
  - Also called network engineer
  - Installs, maintains, supports computer networks
  - Interact with users
  - Handle security
  - Troubleshoot problems



Advantages - Disadvantages

Advantages

- Reduced hardware costs
- Application sharing
- Sharing information resources
- Data management centralization
- Connecting people

disadvantages

- Loss of autonomy
- Lack of privacy
- Security threats
- Loss of productivity

LOCAL AREA NETWORKS

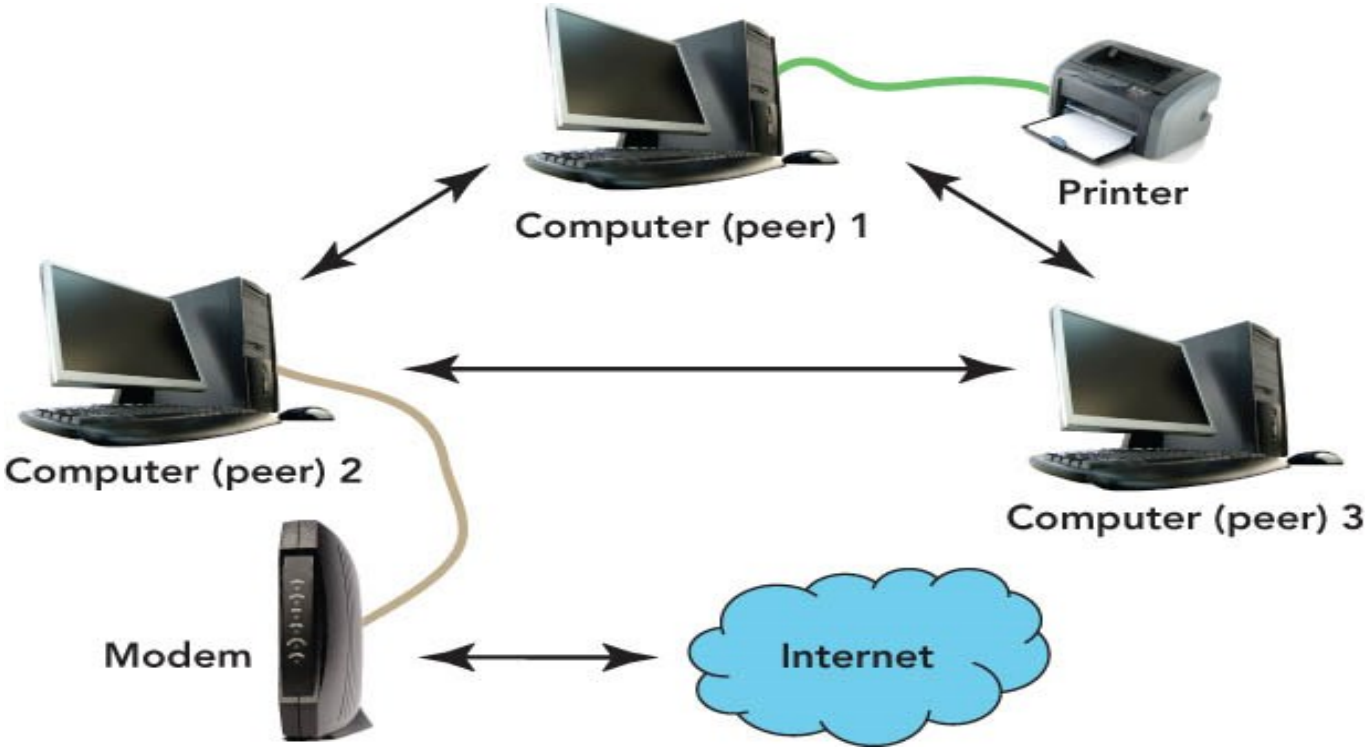
Local Area Networks

- Peer-to-peer networks
- Wireless LAN
- Client/server LAN
- Intranet

Peer-to-peer (P2P) networks

- Share files without a file server
- Easy to set up
- Best used for home or small offices with no more than 10 computers
- Do not require a network operating system
- Can be slow if there are too many users
- Security not strong

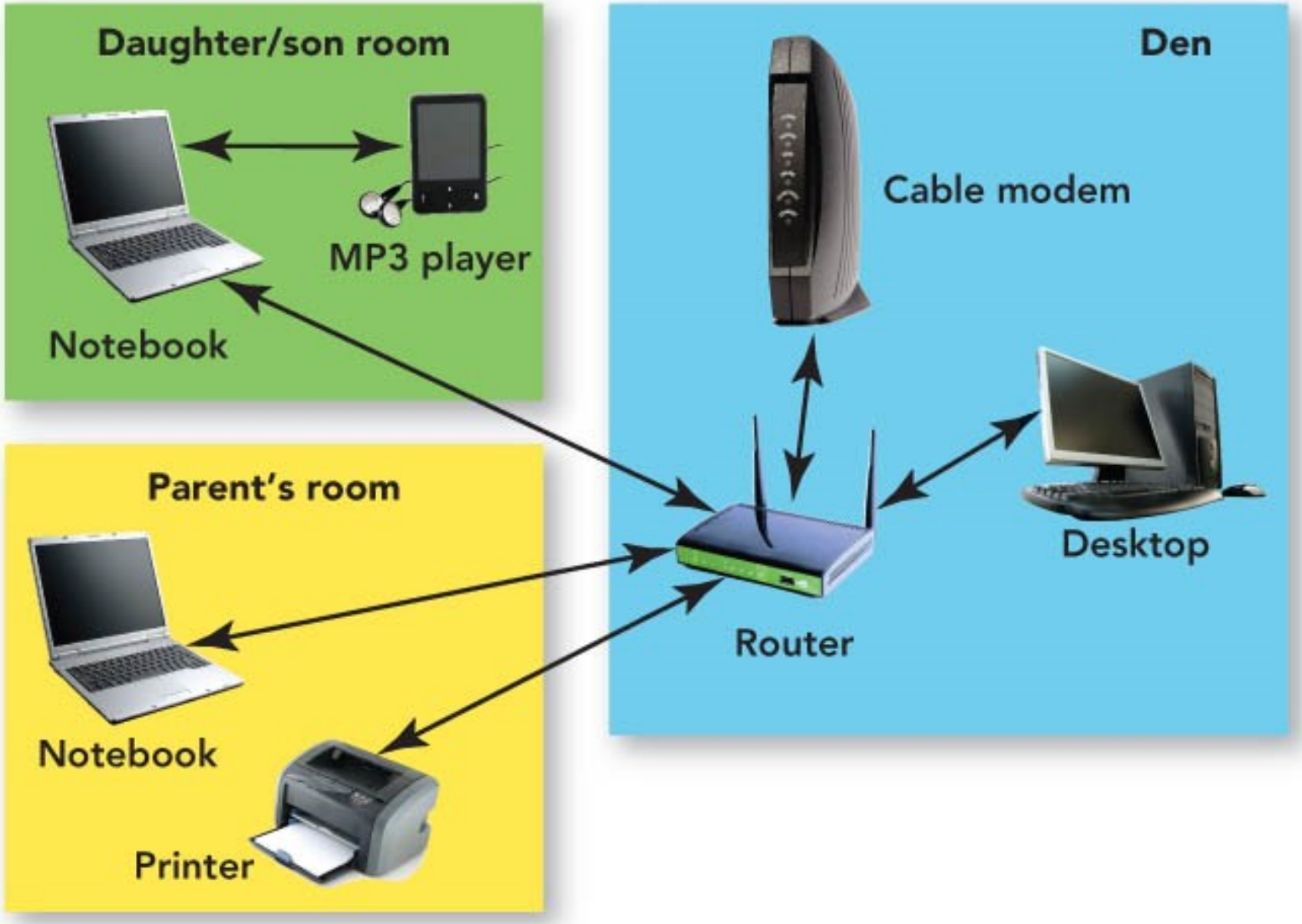
Peer-to-peer (P2P) networks



Wireless LAN

- Connects users through radio waves instead of wires
- Use includes networks in:
  - Homes
  - Hospitals
  - Colleges
- Secured with a radio transmission technique that spreads signals over a seemingly random series of frequencies.
- Effective inside range of between 125 and 300 feet

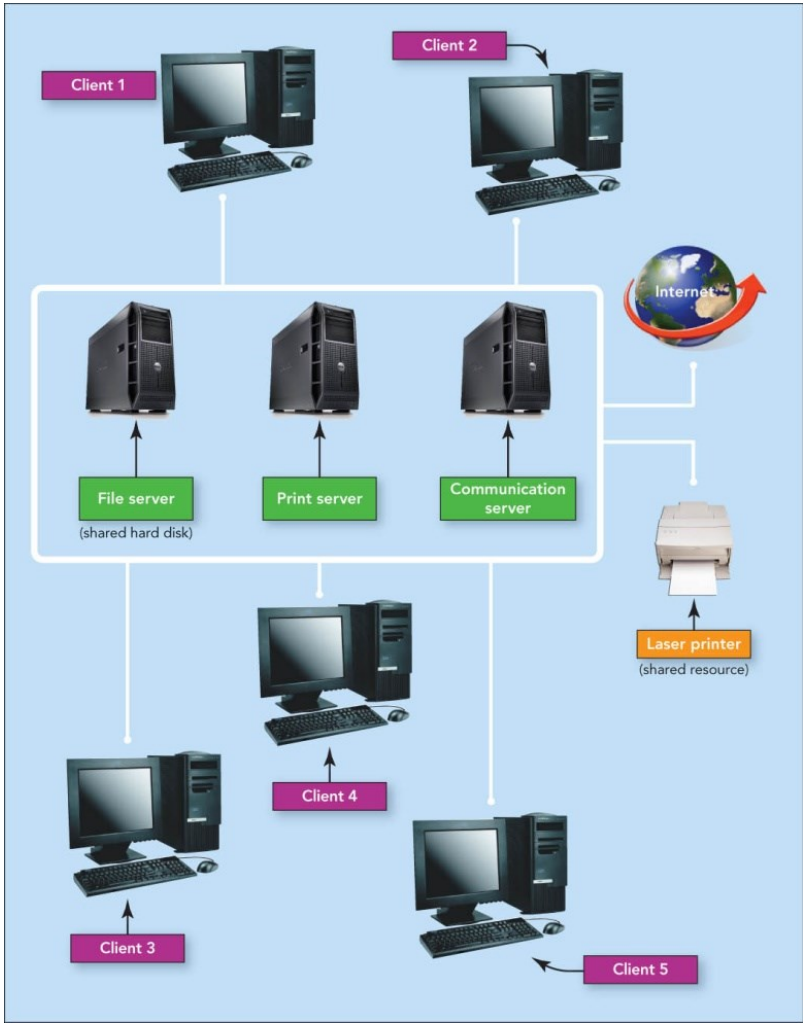
Wireless LAN



Client/server networks

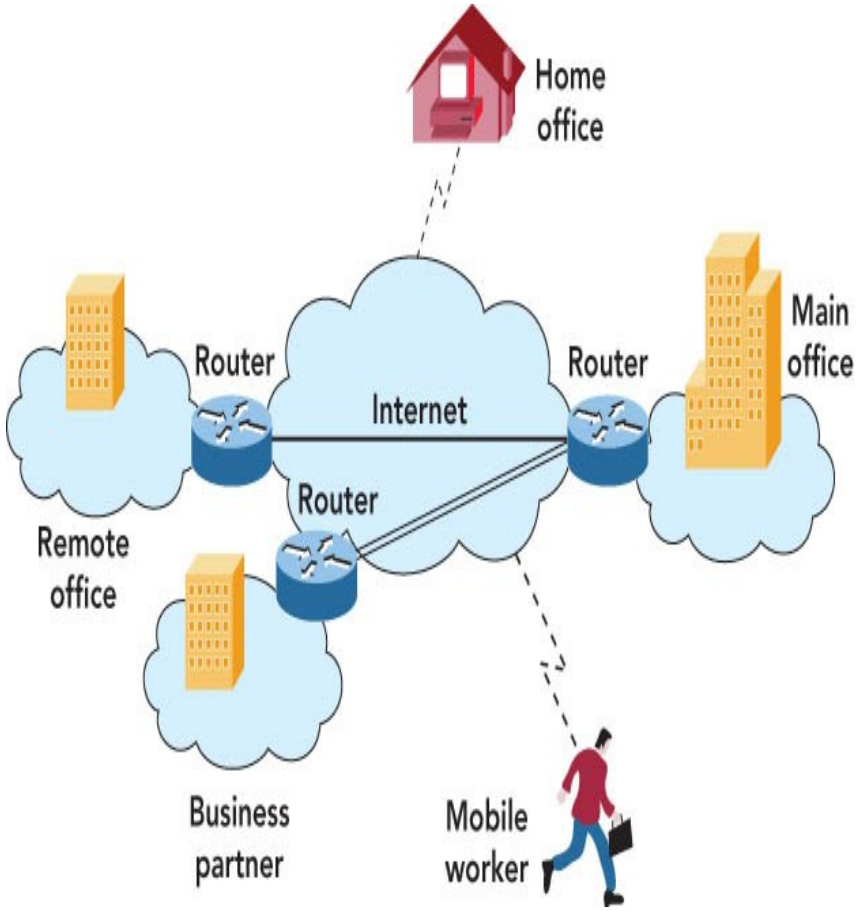
- Client/server networks
  - Made up of one or more file servers and clients (any type of computer)
  - Client software enables requests to be sent to the server
  - Wired or wireless connections
  - Do not slow down with heavy use

Client/server networks



Intranet

- Intranet
  - Password-protected network controlled by the company
  - Accessed only by employees
- Virtual private network
  - Operates over the Internet
  - Accessible by authorized users for quick access to corporate information
  - Uses secure, encrypted connections and special software



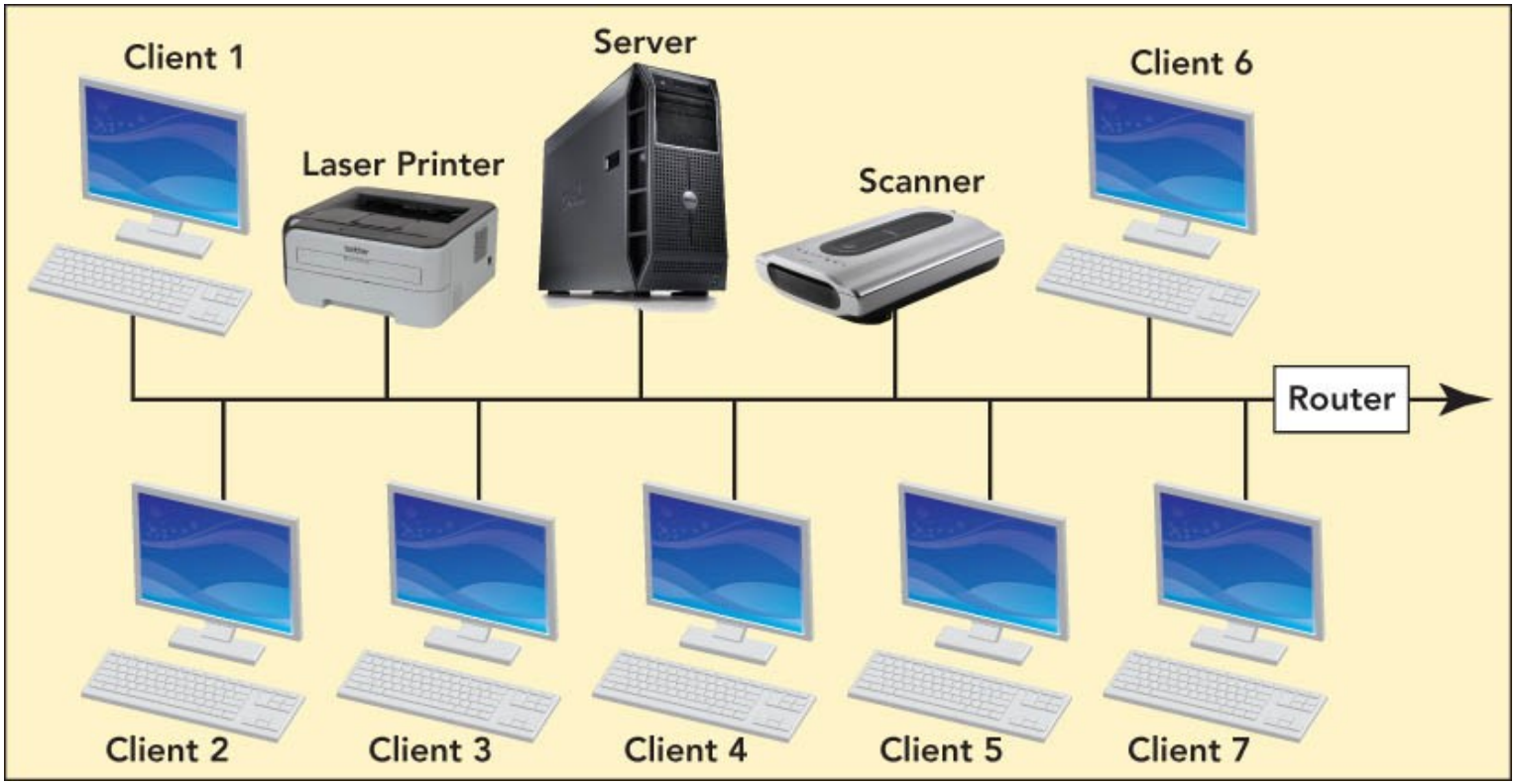
LAN topologies

- Network topology
  - Physical design of a LAN
- Topology resolves contention—conflict that occurs when two or more computers on the network attempt to transmit at the same time
- Contention sometimes results in collisions—corruption of network data caused when two computers transmit at the same time

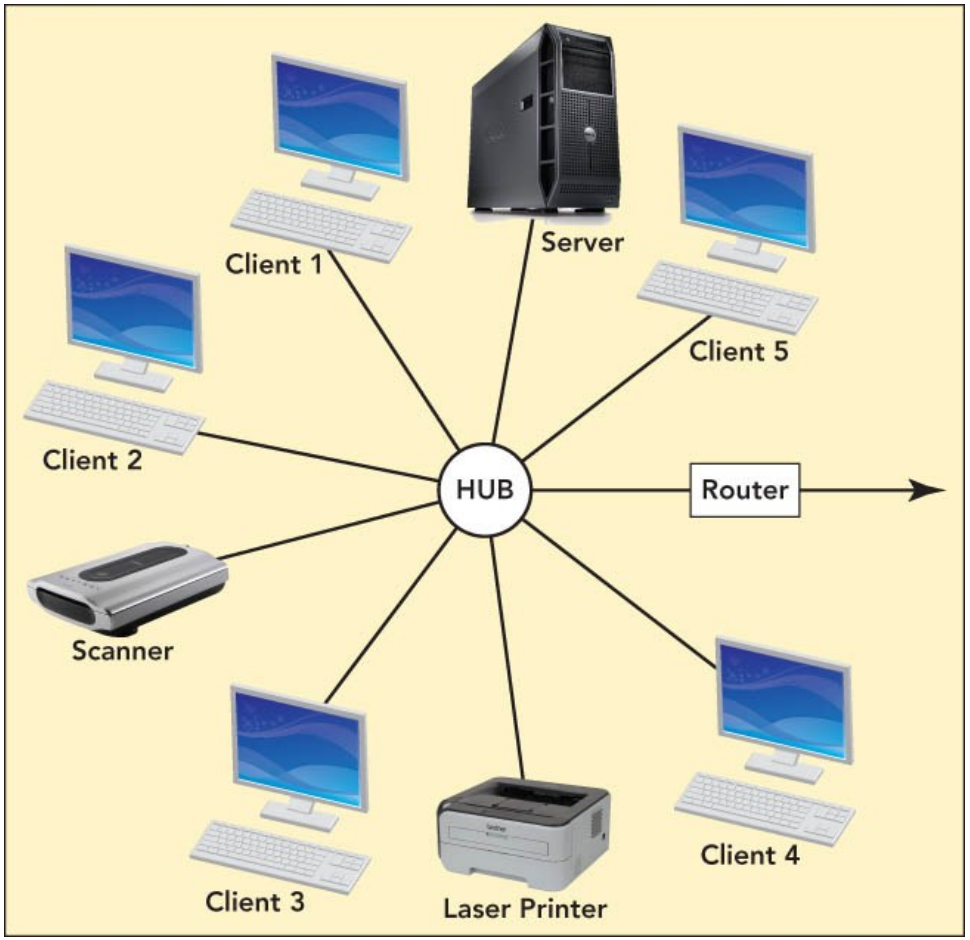
LAN topologies

- Bus topology
  - Practical for home or small office
  - One node transmits at a time
  - Terminators signify the end of the circuit
  - Uses contention management—technique that specifies what happens when a collision occurs
- Star topology
  - For office buildings, computer labs, and WANs
  - Easy to add users
- Ring topology
  - For a division of a company or one floor
  - Not in common use today
  - Node can transmit only when it has the token—special unit of data that travels around the ring

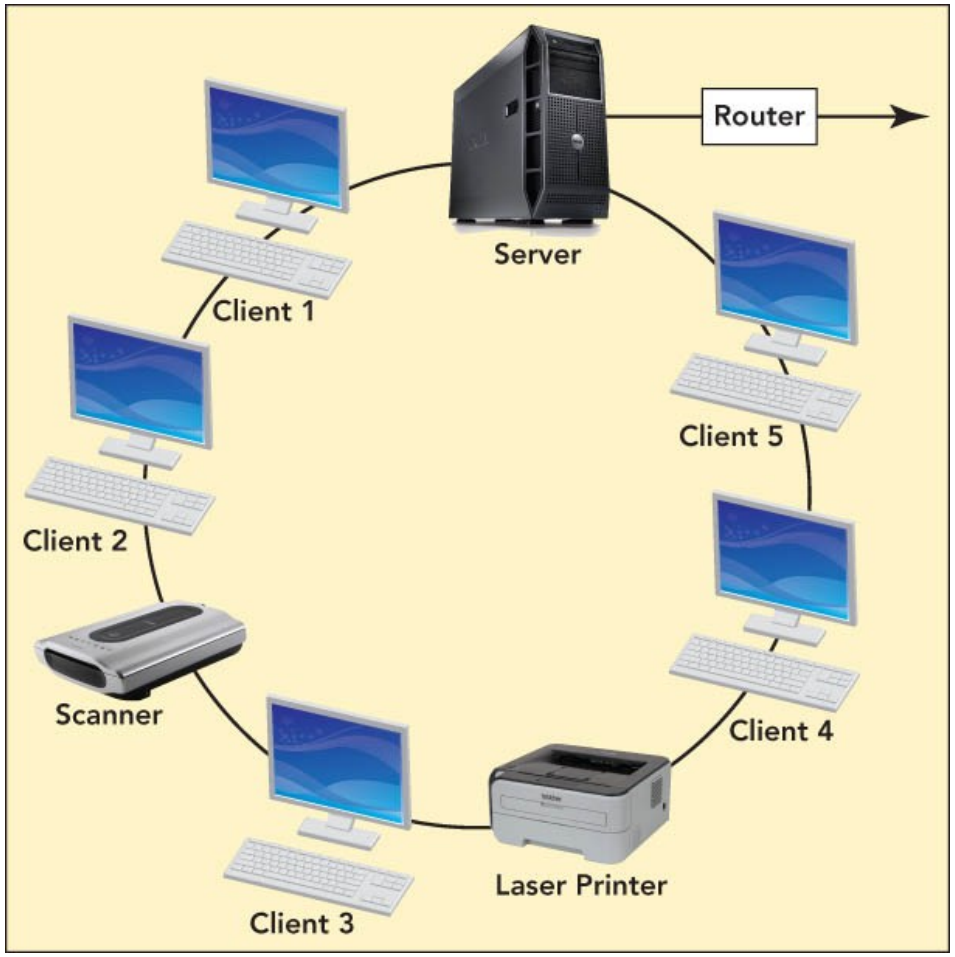
Local Area Networks



LAN topologies



LAN topologies



LAN technologies

- Ethernet—most-used LAN protocol
  - Ethernet star networks
    - Most popular versions—use twisted-pair wiring and switches
  - Sends data in a fixed-size unit called a packet
- WiFi
  - Uses radio waves to provide a wireless LAN standard at Ethernet speeds
  - Needs a central access point—could be a wireless router

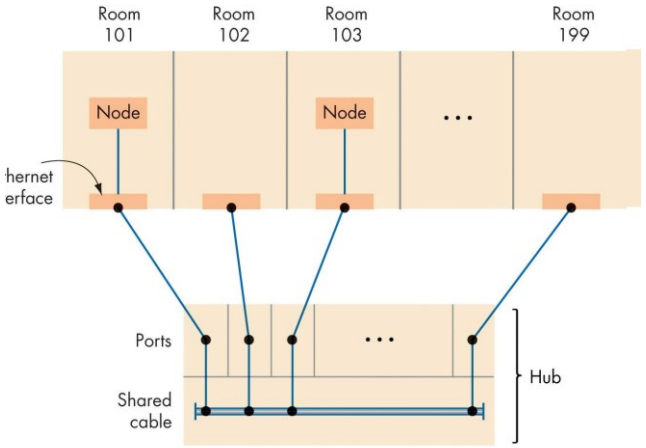
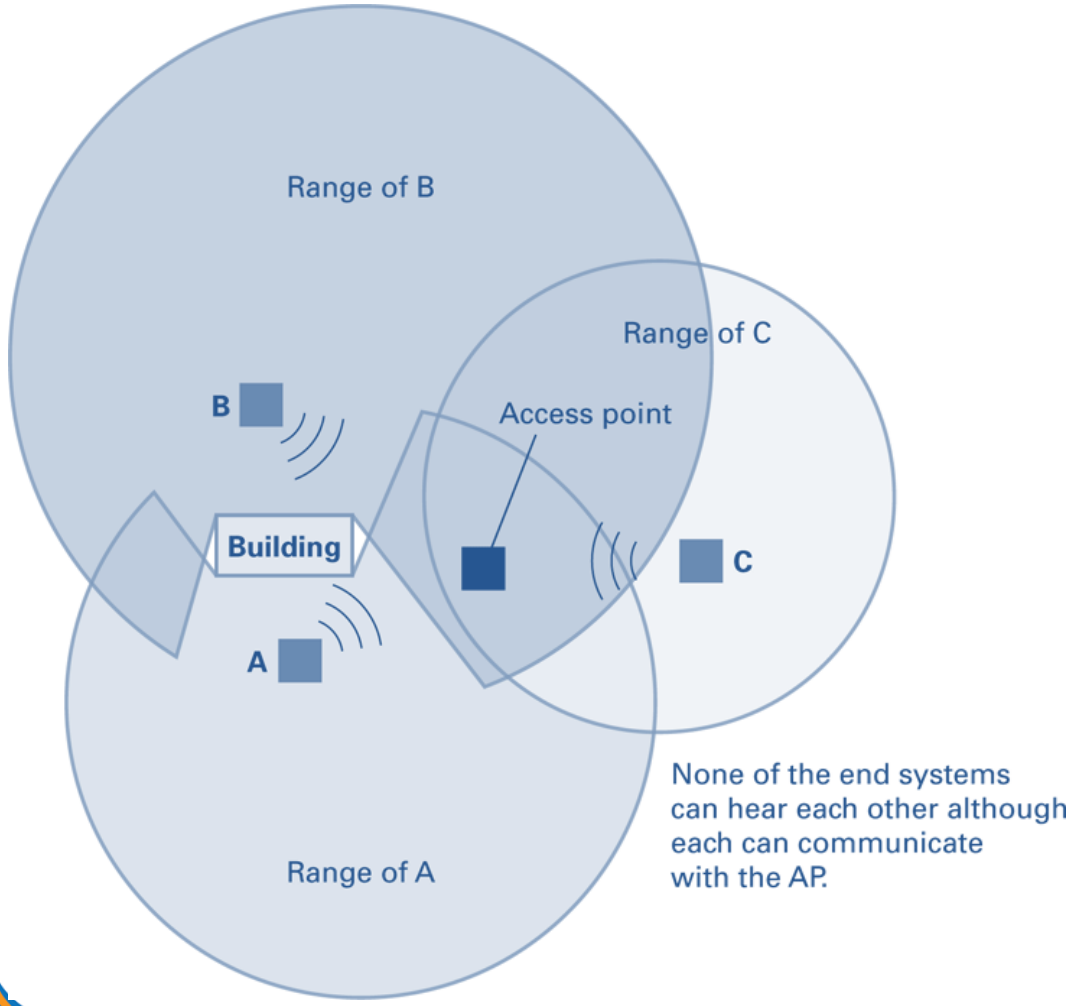


Figure 7.6
An Ethernet LAN Implemented Using a Hub

Protocols

- CSMA/CD (Carrier Sense, Multiple Access with Collision Detection)
  - Used in Ethernet
  - Silent bus provides right to introduce new message
- CSMA/CA (Carrier Sense, Multiple Access with Collision Avoidance)
  - Used in WiFi
  - Hidden terminal problem

The hidden terminal problem



WIDE AREA NETWORKS

Wide Area Networks

- Wide area networks (WANs)
  - Connect devices that are across town, across the country, or across the ocean
  - Users must purchase telecommunications services from an external provider
  - Dedicated point-to-point lines
  - Most use a store-and-forward, packet-switched technology to deliver messages

Wide Area Networks

1 An outgoing message is divided into data units of a fixed size called packets.

1 Dear Christine,

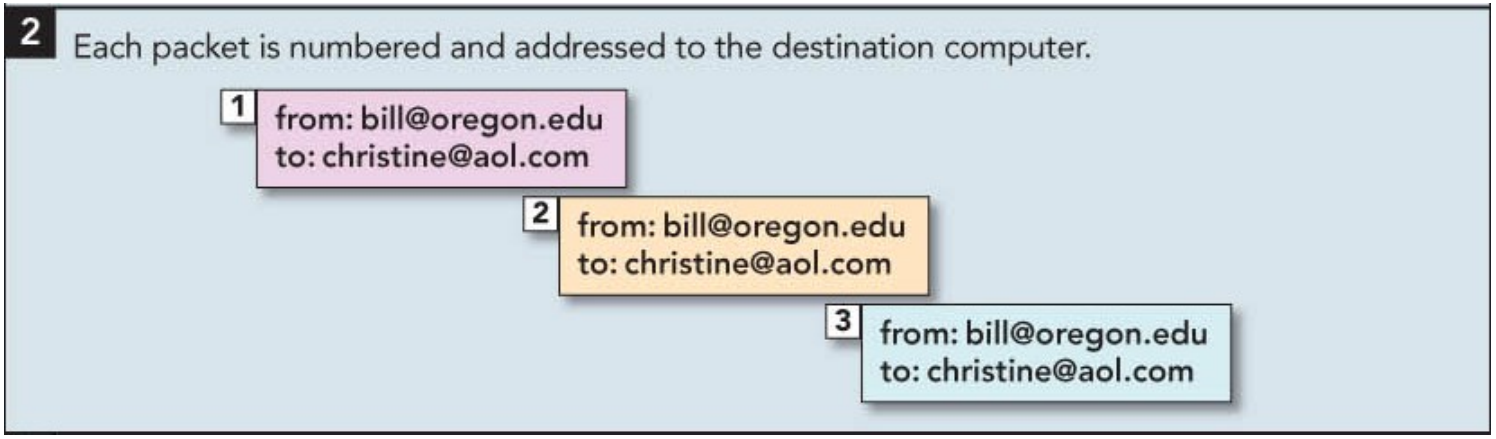
Mike and I would like to meet with you.

2 We'll be in Boston next week on unrelated business.

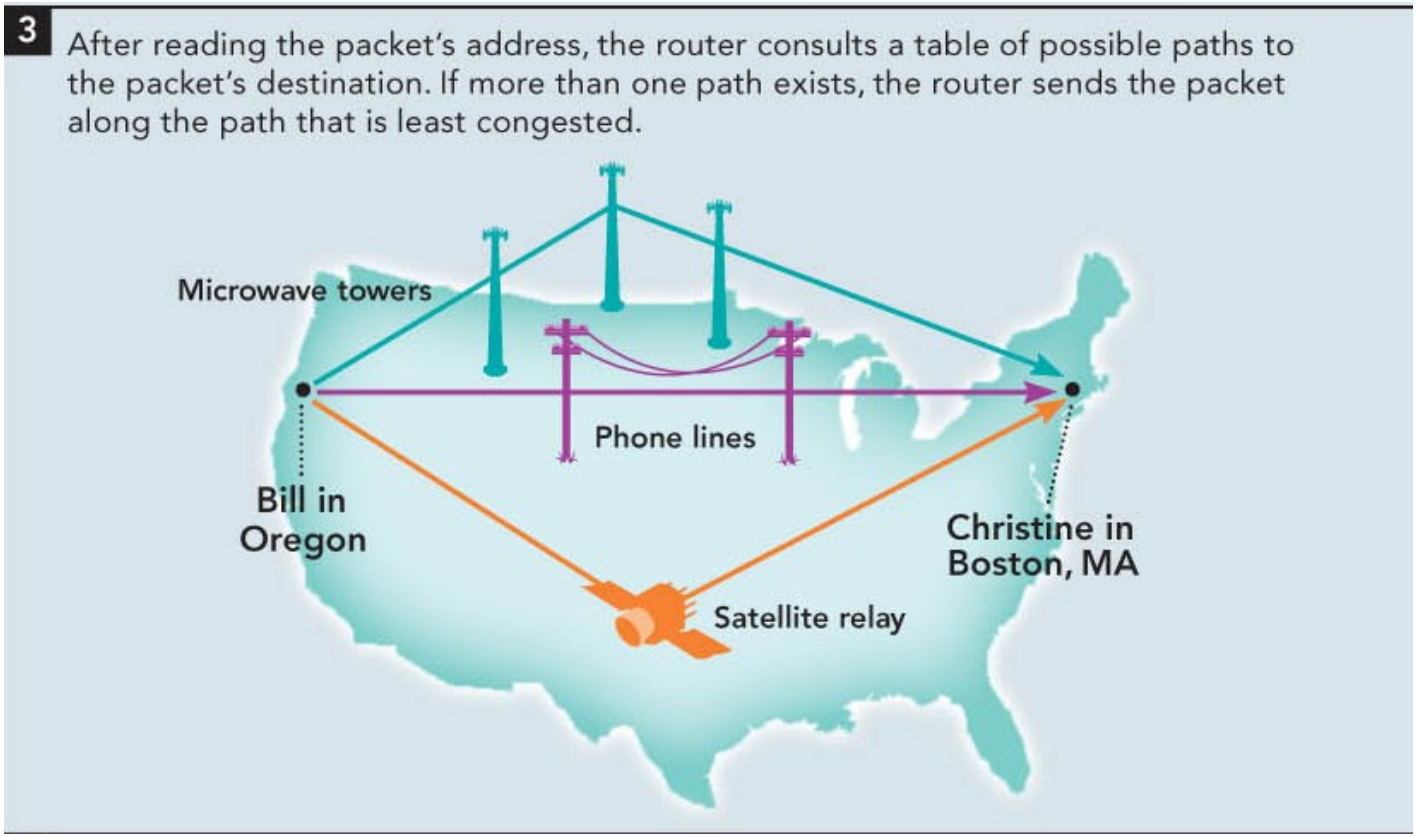
3 I'll have Jodi B. set up a place and time. I'm looking forward to a productive meeting.

Sincerely,
Bill

Wide Area Networks

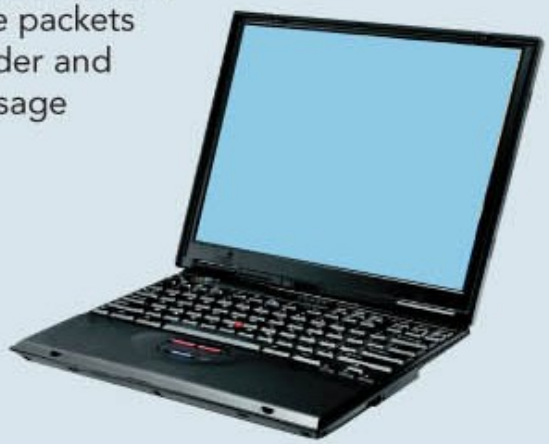


Wide Area Networks



Wide Area Networks

4 On the receiving computer, protocols put the packets in the correct order and decode the message they contain.



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WAN applications

- E-mail, conferencing, document exchange, remote database access
- LAN to LAN connections connect two or more geographically separate locations
- Transaction acquisition—the instant relay of transaction information from a point-of-purchase sale.

Distributed Systems

- Systems with parts that run on different computers
  - Cluster computing
  - Grid computing
  - Cloud computing
    - Amazon's Elastic Compute Cloud
    - Google Drive

THE INTERNET

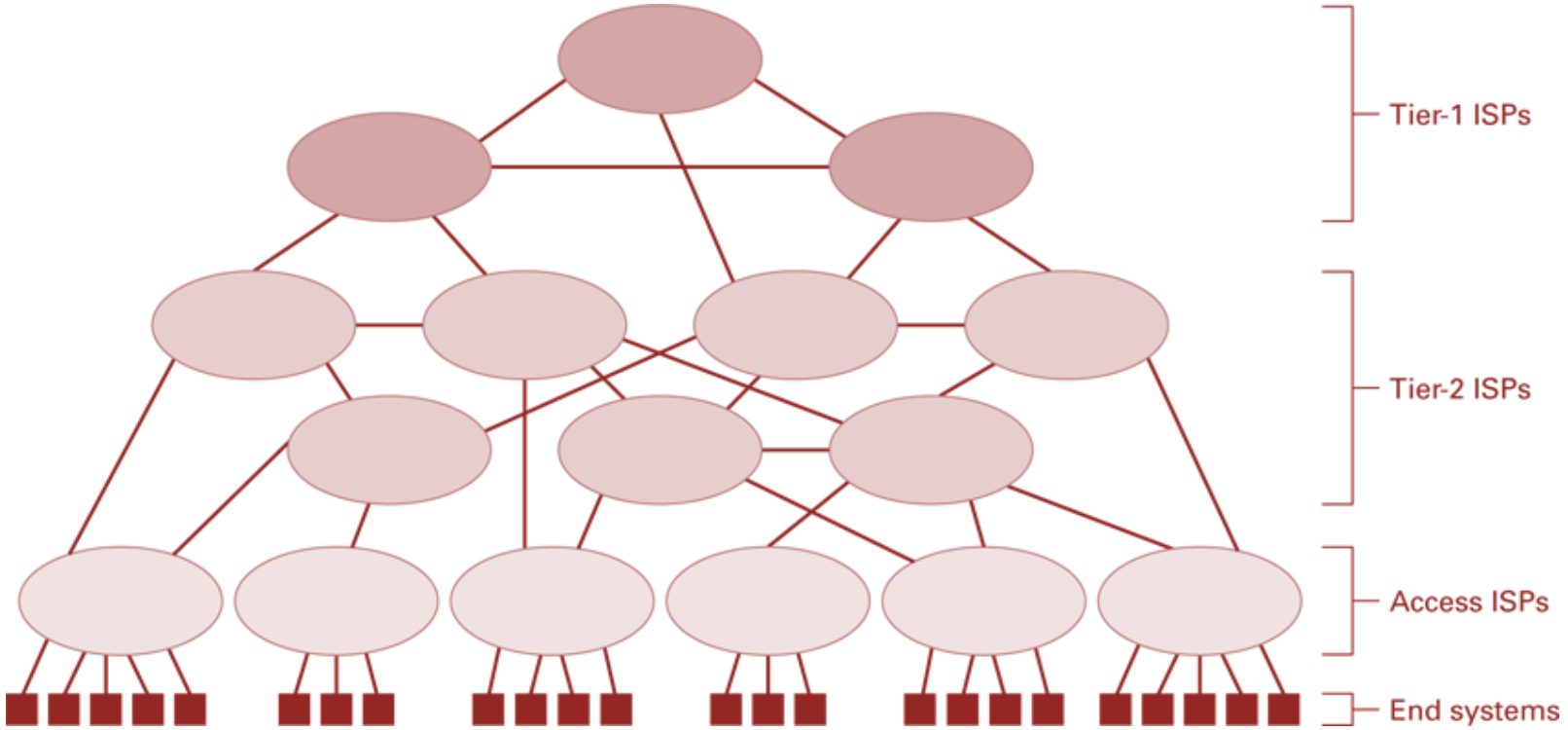
The Internet

- The Internet: An internet that spans the world
  - Original goal was to develop a means of connecting networks that would not be disrupted by local disasters
  - Today a commercial undertaking that links a worldwide combination of PANs, LANs, MANs, and WANs involving millions of computers

Internet Architecture

- Internet Service Provider (ISP)
  - Tier-1
  - Tier-2
- Access or tier-3 ISP: Provides connectivity to the Internet
  - Hot spot (wireless)
  - Telephone lines
  - Cable/Satellite systems DSL
  - Fiber optics

Internet Composition



Internet Addressing

- IP address: pattern of 32 or 128 bits often represented in dotted decimal notation
- Mnemonic address:
  - Domain names
  - Top-Level Domains
- Domain name system (DNS)
  - Name servers
  - DNS lookup

ICANN

- Internet Corporation for Assigned Names & Numbers (ICANN)
- Allocates IP addresses to ISPs who then assign those addresses within their regions.
- Oversees the registration of domains and domain names.

Early Internet Applications

- Network News Transfer Protocol (NNTP)
- File Transfer Protocol (FTP)
- Telnet and SSH (Secured Shell)
- Hypertext Transfer Protocol (HTTP)
- Electronic Mail (email)
  - Domain mail server collects incoming mail and transmits outing mail
  - Mail server delivers collected incoming mail to clients via POP3 (Post Office Protocol version 3) or IMAP (Internet Mail Access Protocol)

SMTP Simple Mail Transfer Protocol

220 mail.tardis.edu SMTP Sendmail Gallifrey-1.0; Fri, 23 Aug 2413 14:34:10
HELO mail.skaro.gov
250 mail.tardis.edu Hello mail.skaro.gov, pleased to meet you
MAIL From: dalek@skaro.gov
250 2.1.0 dalek@skaro.gov... Sender ok
RCPT To: doctor@tardis.edu
250 2.1.5 doctor@tardis.edu... Recipient ok
DATA
354 Enter mail, end with "." on a line by itself
Subject: Extermination.
EXTERMINATE!
Regards, Dalek
.
250 2.0.0 r7NJYAEl028071 Message accepted for delivery
QUIT
221 2.0.0 mail.tardis.edu closing connection

More Recent Applications

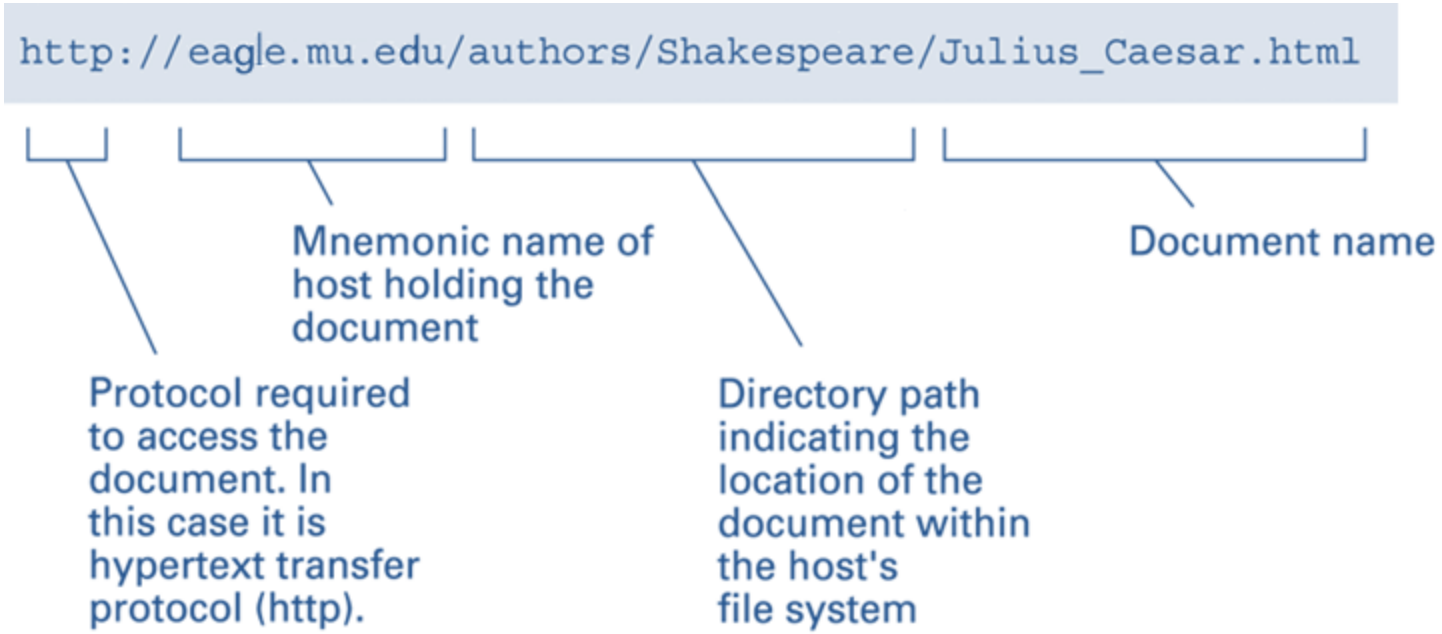
- Voice Over IP (VoIP)
- Internet Multimedia Streaming
  - N-unicast
  - Multicast
  - On-demand streaming
  - Content delivery networks (CDNs)

WORLD WIDE WEB

World Wide Web

- Hypertext combines internet technology with concept of linked-documents
  - Embeds hyperlinks to other documents
- Browsers present materials to the user
- Webservers provide access to documents
- Documents are identified by URLs and transferred using HTTP

A typical URL



Hypertext Markup Language (HTML)

- Encoded as text file
- Contains tags to communicate with browser
  - Appearance
    - <h1> to start a level one heading
    - <p> to start a new paragraph
  - Links to other documents and content
    - <a href = . . . >
  - Insert images
    - <img src = . . . >

A simple webpage

a. The page encoded using HTML.

A simple webpage

b. The page as it would appear on a computer screen.

An enhanced simple webpage

a. The page encoded using HTML.

```
<html>
<head>
<title>demonstration page</title>
</head>
<body>
<h1>My Web Page</h1>
<p>Click
   <a href="http://crafty.com/demo.html">
   here
   </a>
   for another page.</p>
</body>
</html>
```

Anchor tag containing parameter

Closing anchor tag

An enhanced simple Web page

b. The page as it would appear on a computer screen.

Extensible Markup Language (XML)

- XML: A language for constructing markup languages similar to HTML
  - A descendant of SGML
  - Opens door to a World Wide *Semantic* Web

Using XML

<staff clef = "treble"> <key>C minor</key>

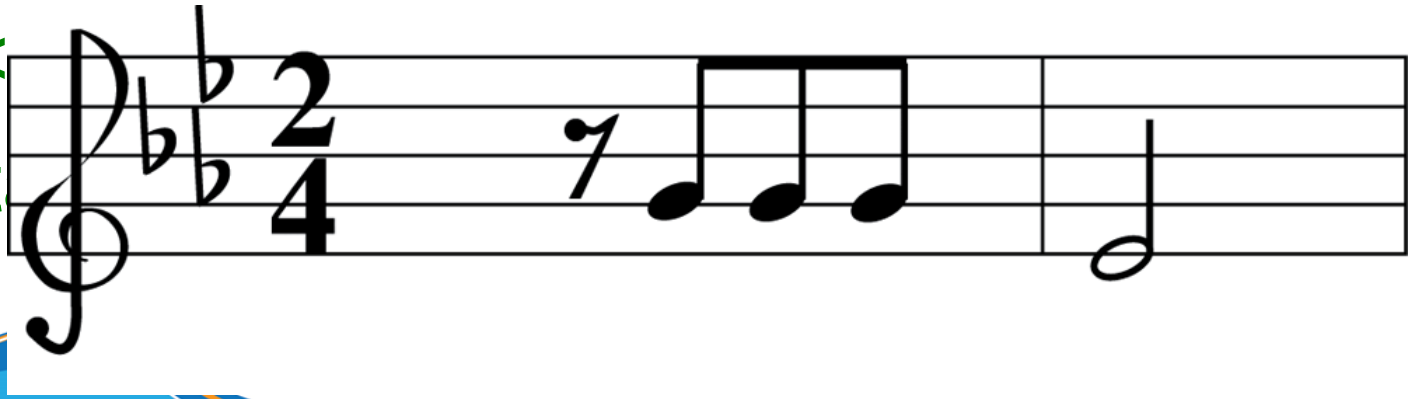
<time> 2/4 </time>

<measure> <rest> egth </rest> <notes>
egth G, egth G, egth G
</notes></measure>

<measure> <notes> hlf E

<

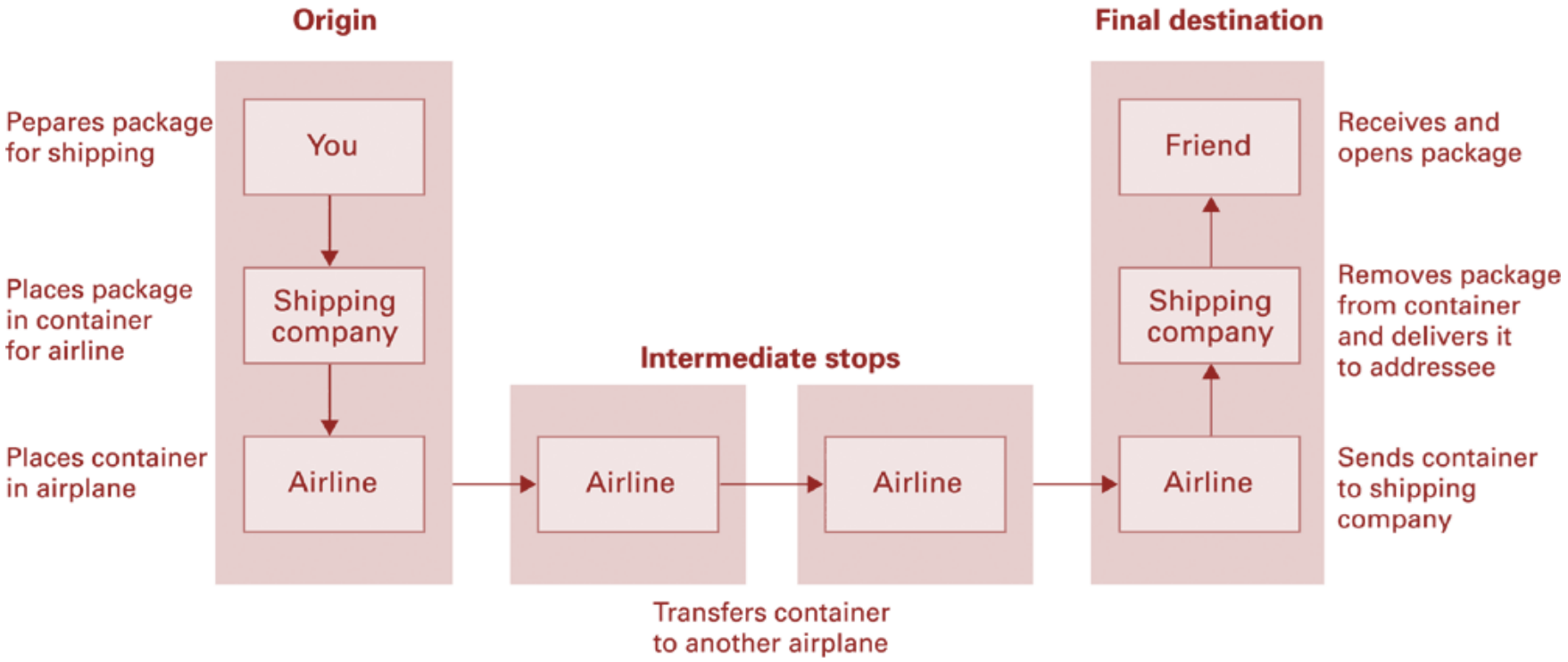
</st



Client Side Versus Server Side

- Client-side activities
  - Javascript
  - Macromedia Flash
- Server-side activities
  - Common Gateway Interface (CGI)
  - Servlets
  - JavaServer Pages (JSP) / Active Server Pages (ASP)
  - PHP

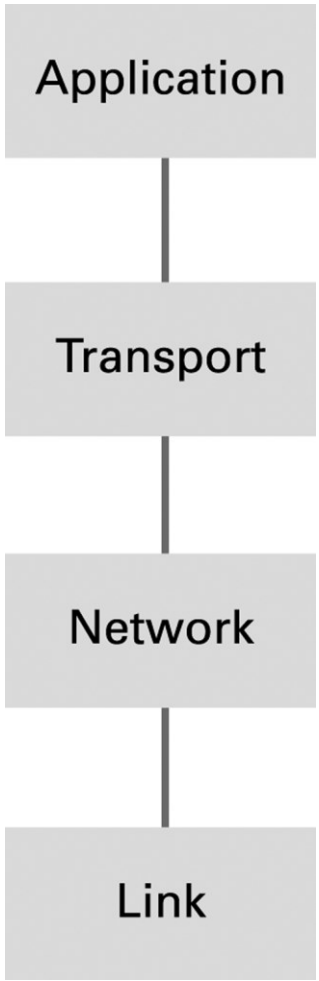
Package-shipping example



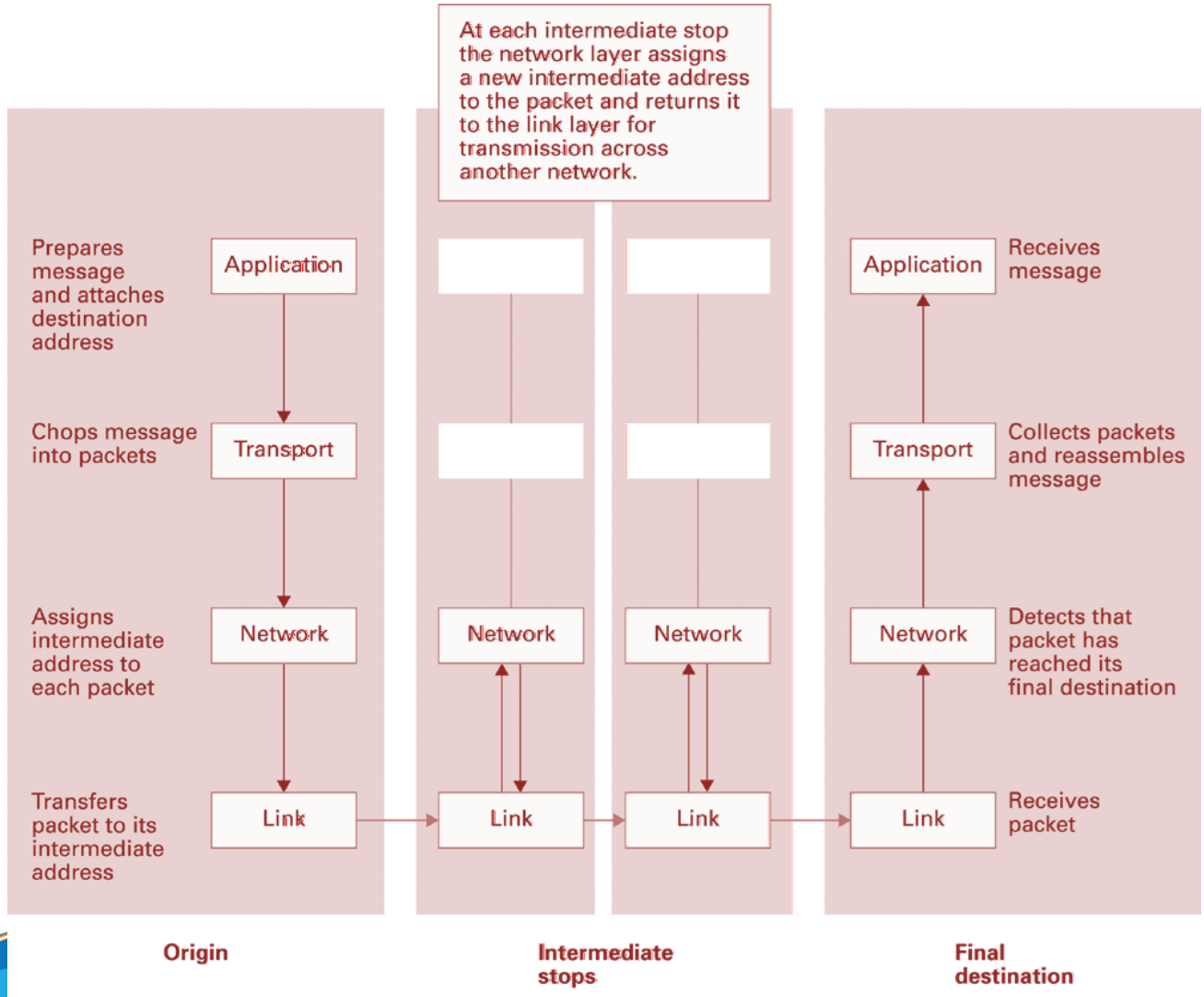
Internet Software Layers

- **Application:** Constructs message with address
- **Transport:** Chops message into packets
- **Network:** Handles routing through the Internet
- **Link:** Handles actual transmission of packets

The Internet software layers



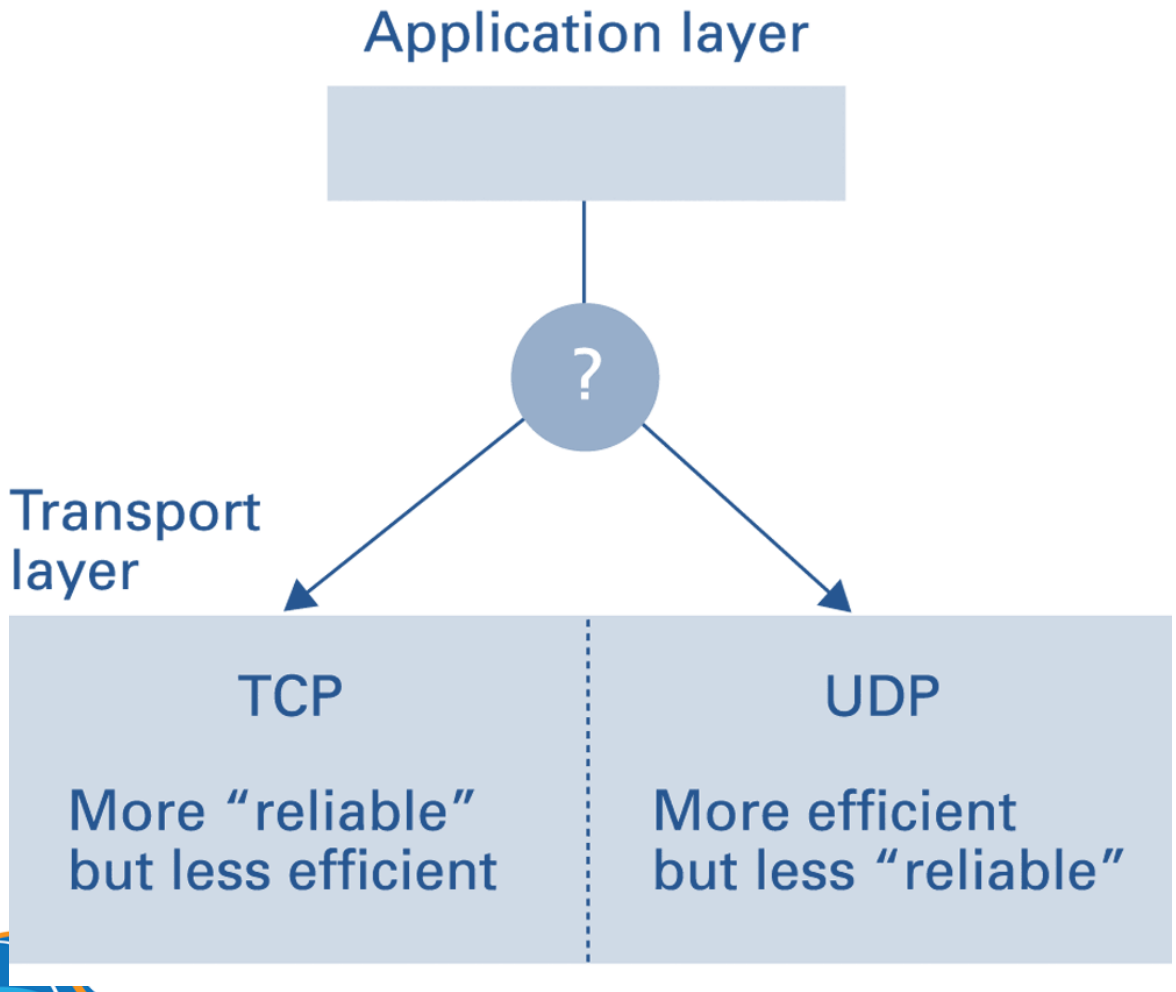
A message through the Internet



TCP/IP Protocol Suite

- Transport Layer
  - Transmission Control Protocol (TCP): break down messages or files into smaller pieces (called packets). When receiving, reassembles the data into a complete file or message. provide error-checking if an error is found TCP retransmits the packet(s).
  - User Datagram Protocol (UDP): UDP does not divide each transmission into packets, which allows for a faster transmission. does not provide error checking.
- Network Layer
  - Internet Protocol (IP)
    - IPv4
    - IPv6

Choosing between TCP and UDP



SECURITY

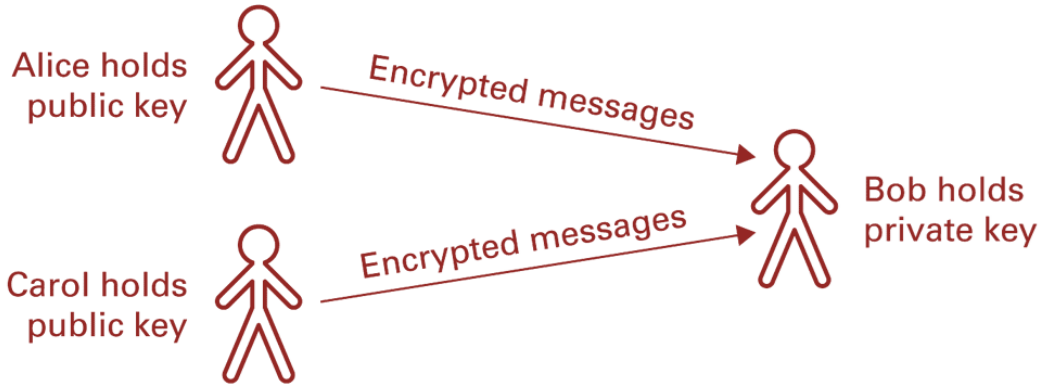
Security

- Attacks
  - Malware (viruses, worms, Trojan horses, spyware, phishing software)
  - Denial of service (DoS)
  - Spam
- Protection
  - Firewalls
  - Spam filters
  - Proxy Servers
  - Antivirus software

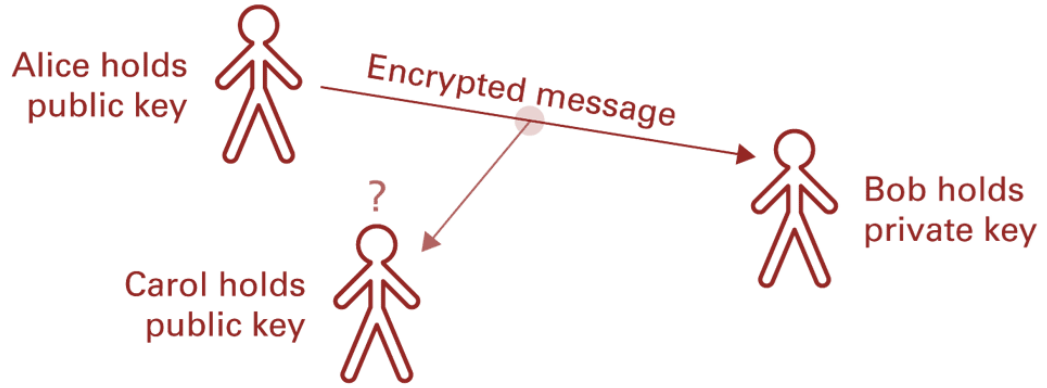
Encryption

- HTTPS and SSL
- Public-key Encryption
  - Public key: Used to encrypt messages
  - Private key: Used to decrypt messages
- Certificates and Digital Signatures
  - Certificate authorities

Public-key encryption



Both Alice and Carol can send encrypted messages to Bob.



Carol cannot decrypt Alice's message even though she knows how Alice encrypted it.

COMPUTER CRIME

Computer Crime

- cyber crime, e-crime, electronic crime, or hi-tech crime.
- Computer crime is an act performed by a knowledgeable computer user, sometimes referred to as a hacker that illegally browses or steals a company's or individual's private information.
- In some cases, this person or group of individuals may be malicious and destroy or otherwise corrupt the computer or data files.

Computer crime

- **Child pornography** - Making or distributing child pornography.
- **Copyright violation** - Stealing or using another person's copyrighted material without permission.
- **Cracking** - Breaking or deciphering codes that are being used to protect data.
- **Cyber terrorism** - Hacking, threats, and blackmailing towards a business or person.
- **Cyberbully** or **Cyberstalking** - Harassing or stalking others online.
- **Cybersquatting** - Setting up a domain of another person or company with the sole intentions of selling it to them later at a premium price.
- **Creating Malware** - Writing, creating, or distributing malware (e.g., viruses and spyware.)
- **Denial of Service attack** - Overloading a system with so many requests it cannot serve normal requests.
- **Espionage** - Spying on a person or business.

Computer crime

- Fraud - Manipulating data, e.g., changing banking records to transfer money to an account or participating in credit card fraud.
- Harvesting - Collect account or other account related information on other people.
- Human trafficking - Participating in the illegal act of buying or selling other humans.
- Identity theft - Pretending to be someone you are not.
- Illegal sales - Buying or selling illicit goods online including drugs, guns, and psychotropic substances.
- Intellectual property theft - Stealing practical or conceptual information developed by another person or company.
- IPR violation - An intellectual property rights violation is any infringement of another's copyright, patent, or trademark.
- Phishing - Deceiving individuals to gain private or personal information about that person.

Computer crime

- **Salami slicing** - Stealing tiny amounts of money from each transaction.
- **Scam** - Tricking people into believing something that is not true.
- Slander - Posting libel or slander against another person or company.
- Software piracy - Copying, distributing, or using software that is copyrighted that you did not purchase.
- Spamming - Distributed unsolicited e-mail to dozens or hundreds of different addresses.
- **Spoofing** - Deceiving a system into thinking you are someone you really are not.
- **Typosquatting** - Setting up a domain that is a misspelling of another domain.
- Unauthorized access - Gaining access to systems you have no permission to access.
- **Wiretapping** - Connecting a device to a phone line to listen to conversations.

Cyberbully

- Alternatively referred to as a cyberstalker, a cyberbully is someone who posts inappropriate or unwanted things about another person, or otherwise harasses them in e-mails, IMs, or SMS.

Spyware

- Spyware or **snoopware**
  - a software program that is intentionally installed on a computer by to monitor what other users of the same computer are doing.
  - a program designed to gather information about a user's activity secretly. Spyware programs are often used to track users' habits to target them with advertisements better.

Computer fraud

- Computer fraud
  - any act using computers, the Internet, Internet devices, and Internet services to defraud people, companies, or government agencies of money, revenue, or Internet access.
  - Illegal computer activities include **phishing**, **social engineering,** viruses, and DDoS attacks are some examples used to disrupt service or gain access to another's funds.

Identity theft

- Identity theft is the act of a person obtaining information illegally about someone else.
- Thieves try to find such information as full name, maiden name, address, date of birth, social security number, passwords, phone number, e-mail, and credit card numbers.
- The thief can then use this information to gain access to bank accounts, e-mail, cell phones, identify themselves as you, or sells your information.

Phishing

- describe a malicious individual or group of individuals who scam users.
- They do so by sending e-mails or creating web pages that are designed to collect an individual's online bank, credit card, or other login information. Because these e-mails and web pages look like legitimate companies users trust them and enter their personal information.

DEPARTMENT OF NETWORKS AND TELECOMMUNICATIONS

Overview

- Since 1998
- Room: I.74
- Tel: (028) 38.324.467 (ext: 711)
- Head: Prof. Tran Trung Dung
- Vice Head: Msc. Huynh Thuy Bao Tran

GOALs

Bachelor in Computer Networks and Telecommunications (CN&T)

- Provide a strong background in computer networking
- This program focuses on providing knowledge and skill regarding to design, implementation, installation, operation and maintenance computer network & telecommunication systems.

GOALs

- Research methodology in CN&T field
- Be able to self learning new technologies as well as applying them in real life problems.
- After graduated, students are able to work in worldwide environment.

Career orientation- Future career

- Computer Systems & Networking administration, Design and consulting of Computer networks & telecommunications systems
- Computer networking programming
- Computer & computer networks securities
- Internet of Things

Required courses

Students accumulate at least 5 courses

STT	MÃ SỐ	TÊN HỌC PHẦN	TC	LT	TH
1	CTT601	Hệ điều hành nâng cao	4	45	30
2	CTT602	Hệ thống viễn thông	4	45	30
3	CTT603	Lập trình mạng	4	45	30
4	CTT604	Mạng máy tính nâng cao	4	45	30
5	CTT605	Thực tập mạng máy tính	4	45	30

Optional courses

Students accumulate at least 5 courses, which contain at least 2 courses (8 credits) of CN&T department

STT	MÃ SỐ	TÊN HỌC PHẦN	TC	LT	TH
11	*CTT124*	*Kiến tập nghề nghiệp*	*2*	*15*	*30*
12	*CTT125*	*Khởi nghiệp*	*3*	*30*	*30*
13	CTT621	An ninh mạng	4	45	30
14	CTT622	An ninh mạng nâng cao	4	45	30
15	CTT623	Chuyên đề Hệ điều hành Linux	4	45	30
16	CTT624	Kiến trúc máy tính nâng cao	4	45	30
17	CTT625	Mạng cảm ứng không dây	4	45	30
18	CTT626	Mô hình hóa và mô phỏng mạng	4	45	30
19	CTT627	Seminar mạng máy tính	4	45	30
20	CTT628	Thiết kế mạng	4	45	30

Optional courses

STT	MÃ SỐ	TÊN HỌC PHẦN	TC	LT	TH
21	CTT629	Thực tập hệ điều hành mạng	4	45	30
22	CTT630	Thực tập hệ thống viễn thông	4	45	30
23	CTT631	Truyền thông không dây	4	45	30
24	CTT631	Truyền thông kỹ thuật quang	4	45	30
25	CTT633	Truyền thông kỹ thuật số	4	45	30
26	CTT634	Xử lý và tính toán song song	4	45	30

Courses & Career orientation

Mã MH	Tên môn học	Môn học trước	QTM	TKM	Tư vấn	PMM	NC & GD
CTT601	Hệ điều hành nâng cao	HĐH		*	*		*
CTT602	Hệ thống viễn thông	MMT	*	*	**	*	**
CTT603	Lập trình mạng	HĐH	*	*	*	**	**
CTT604	Mạng máy tính nâng cao	HĐH	**	*	**	**	**
CTT605	Thực tập mạng máy tính	MMT nâng cao	**	*	**	*	**
CTT621	An ninh mạng	MMT nâng cao	**	*	*		*
CTT622	An ninh mạng nâng cao	An ninh mạng	**	*	*		*
CTT623	CĐề Hệ điều hành Linux	HĐH, MMT	**		*	*	*
CTT624	Kiến trúc MT nâng cao	KTMT và h.ngữ			**		*
CTT625	Mạng cảm ứng không dây	MMT		*	*		*

Courses & Career orientation

Mã MH	Tên môn học	Môn học trước	QTM	TKM	Tư vấn	PMM	NC & GD
CTT625	Mạng cảm ứng không dây	MMT		*	*		*
CTT626	Mô hình hóa và mô phỏng mạng	XS thống kê B, MMT NC		*	*		**
CTT627	Seminar mạng máy tính	MMT nâng cao	*	*	*	*	*
CTT628	Thiết kế mạng	MMT nâng cao	*	**	*		*
CTT629	Thực tập HĐH mạng	HĐH	**	*	*	*	*
CTT630	Thực tập HT viễn thông	HĐH, HT VT	**				*
CTT631	Truyền thông không dây	MMT	**	*	*	*	*
CTT632	Tr.thông kỹ thuật quang	MMT	*		**		*
CTT633	Truyền thông kỹ thuật số	MMT	*	*	**		*
CTT634	Xử lý và tính toán s.song	MMT			*	**	*

QUIZ

Quiz

- Which of the following best describes the Internet?

A. A network of interlinked computers

B. A communications network

C. An information network

D. All of the above

Quiz

- When was the first Internet network started?

A. 1969

B. 1983

C. 1987

D. 1996

Quiz

☐ The Internet was originally developed by whom?

A. computer hackers

B. corporation

C. the U.S. Department of Defense

D. the University of Michigan

Quiz

☐ Where do files live on the Internet?

A. On your computer

B. On one massive computer - the www

C. On individual computers, often known as servers

D. On a network of routers

Quiz

☐ Who writes the rules for the Internet?

A. No-one

B. The government of the country in which the Internet is being used

C. The Internet Society

D. Your parents

Quiz

☐ Which of the following is a TRUE statement?

A. You are free to copy information you find on the Web and include it in your research report.

B. You do not have to cite the Web sources you use in your research report.

C. You should never consult Web sources when you are doing a research report.

D. Just like print sources, Web sources must be cited in your research report. You are

Quiz

☐ What is the World Wide Web?

A. computer game

B. software program

C. the part of the Internet that enables information-sharing via interconnected pages

D. another name for the Internet

Quiz

☐ What does URL stand for?

A. Unique Records List

B. Uniform Resource Locator

C. Undefined Restricted Learner

D. Universal Robot Location

Quiz

- Which of the following is used to translate between IP addresses and mnemonic addresses?

A. File server

B. Mail server

C. Name server

D. FTP server

Quiz

- Which of the following is not a means of connecting networks?

A. Switch

B. Server

C. Router

D. Bridge

Quiz

☐ Which of the following is not an email related protocol?

A. HTTP

B. POP3

C. IMAP

D. SMTP