

Telecommunications and Networks

Network Concepts

- A network is an interconnected or interrelated chain, group, or system

Telecommunication Trends

Industry trends

Toward more competitive vendors, carriers, alliances, and network services, accelerated by deregulation and the growth of the Internet and the World Wide Web.

Technology trends

Toward extensive use of Internet, digital fiber-optic, and wireless technologies to create high-speed local and global internetworks for voice, data, images, audio, and videocommunications.

Application trends

Toward the pervasive use of the Internet, enterprise intranets, and interorganizational extranets to support electronic business and commerce, enterprise collaboration, and strategic advantage in local and global markets.

Telecommunications-Based Services

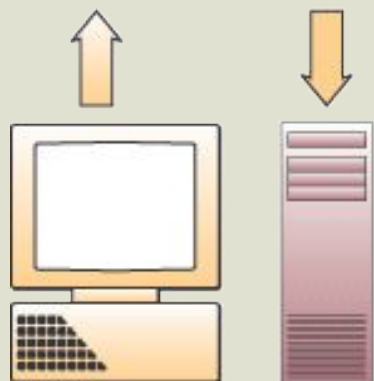
Categories



Entertainment

Full Service Spectrum

- Broadcast TV
- High-definition TV
- Enhanced pay-per-view
- Video-on-demand
- Interactive TV
- Interactive video games
- Video catalog shopping
- Distance learning
- Multimedia services
- Image networking
- Transaction services
- Internet access
- Telecommuting
- Videoconferencing
- Video telephony
- Wireless access
- Cellular/PCS systems
- POTS—Plain old telephone service



Information
Transactions



Communications

Internet Networking Technologies

- Internet networking technologies are being used as technology platform
 - Web browser suites
 - HTML Web page editors
 - Network management software
 - Firewalls
- Being applied in Internet, intranet, and extranet applications
- Reinforces previous move toward client/server networks based on open-systems architecture

Open Systems

- Open systems use common standards for hardware, software, applications, and networks
 - Internet networking technologies are a common standard for open systems
- Connectivity
 - Open systems provide greater connectivity and network interoperability
 - Middleware may be needed to help diverse systems work together

Middleware

- Middleware
 - A general term for any programming that mediates between two separate programs
 - Allows a particular database to access other databases without custom programming
- Commonly known as the “plumbing” of an information system
 - It routes data and information between back-end data sources and end user applications
 - An essential component of any IT infrastructure

Wireless Technologies

- Fiber-optic
 - Uses pulses of laser-generated light
 - Reduced size and installation effort
 - Vastly greater communication capacity
 - Faster transmission speeds
 - Freedom from electrical interference
- Satellite Transmission
 - Can move massive quantities of data, audio, and video over global networks
 - Especially useful in isolated areas

Business Application Trends

- Telecommunications networks now play a vital and pervasive role in Web-enabled...
 - E-business processes
 - Electronic commerce
 - Enterprise collaboration
 - Other applications that support operations, management, and strategic objectives

Internet2

- Next generation of the Internet
 - High-performance
 - Different infrastructure than the current Internet
 - Infinite bandwidth

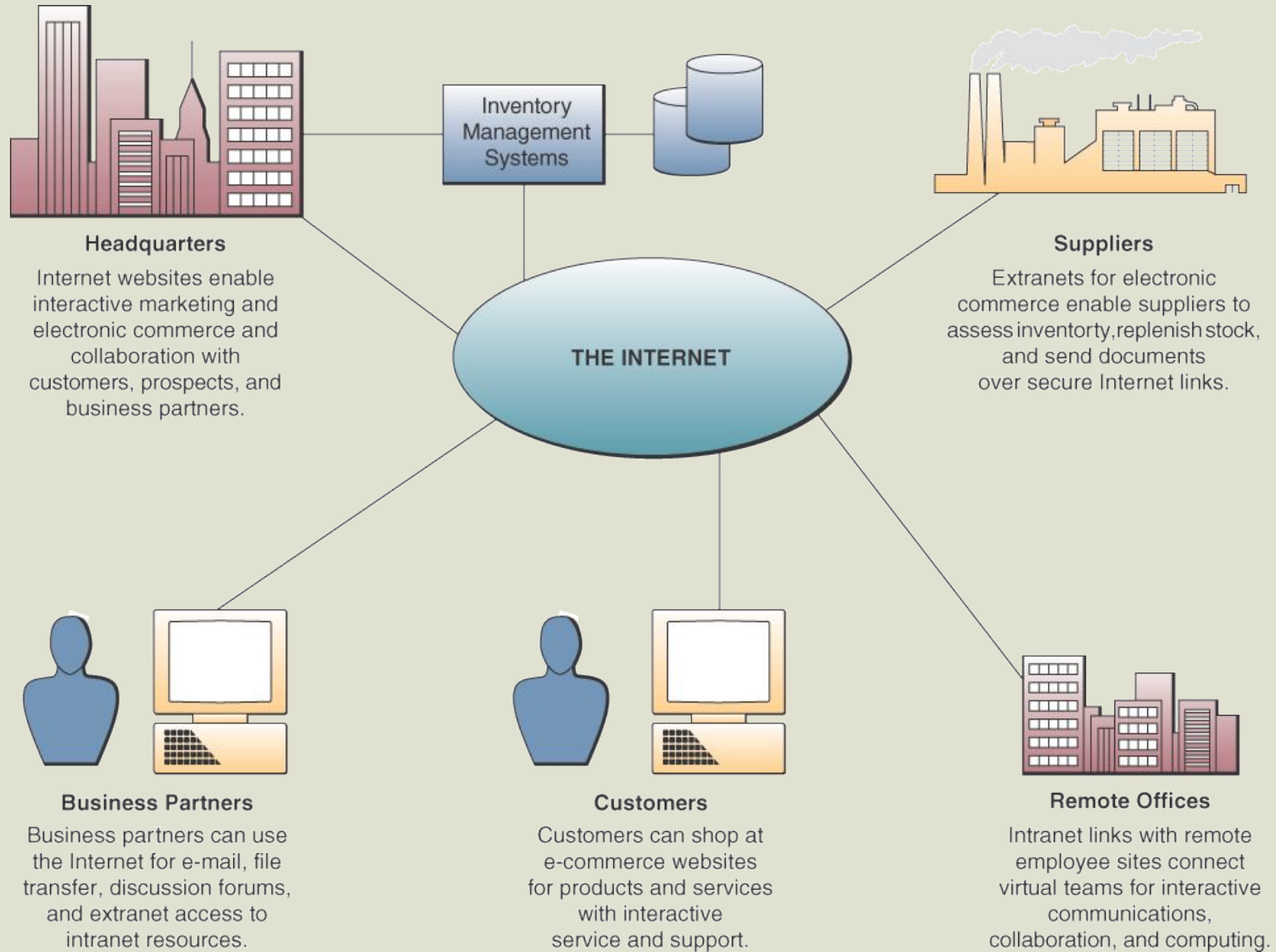
Value of Telecommunications Networks

Strategic Capabilities	e-Business Examples	Business Value
Overcome geographic barriers: Capture information about business transactions from remote locations	Use the Internet and extranets to transmit customer orders from traveling salespeople to a corporate data center for order processing and inventory control	Provides better customer service by reducing delay in filling orders and improves cash flow by speeding up the billing of customers
Overcome time barriers: Provide information to remote locations immediately after it is requested	Credit authorization at the point of sale using online POS networks	Credit inquiries can be made and answered in seconds
Overcome cost barriers: Reduce the cost of more traditional means of communication	Desktop videoconferencing between a company and its business partners using the Internet, intranets, and extranets	Reduces expensive business trips; allows customers, suppliers, and employees to collaborate, thus improving the quality of decisions reached
Overcome structural barriers: Support linkages for competitive advantage	Business-to-business electronic commerce websites for transactions with suppliers and customers using the Internet and extranets	Fast, convenient services lock in customers and suppliers

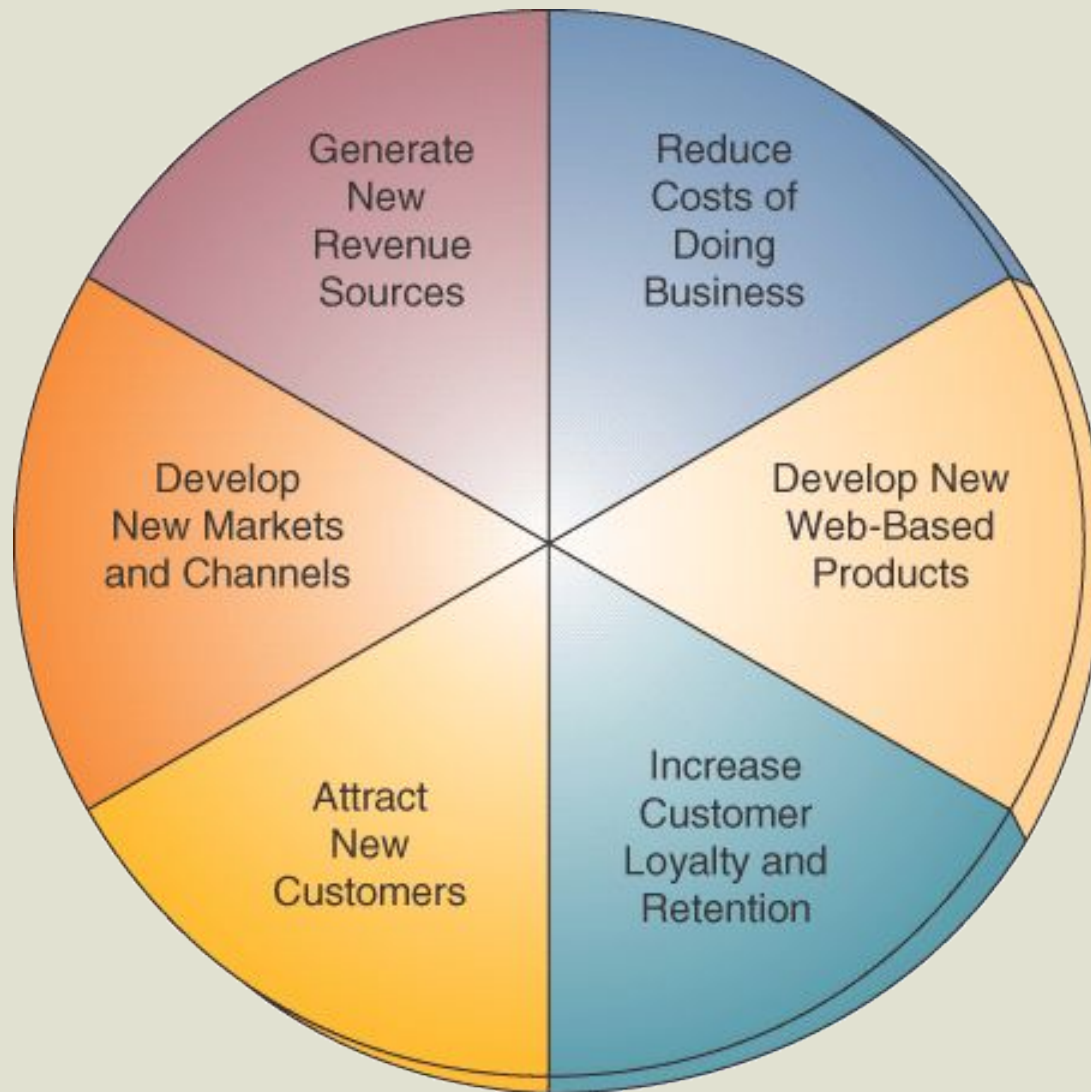
Internet Service Providers

- ISP
 - A company that specializes in providing easy access to the Internet
 - For a monthly fee, provides software, user name, password, and Internet access
- ISPs themselves are connected to one another through network access points
 - One ISP can easily connect to another to obtain addresses of websites or user nodes

Business Use of the Internet



Business Value of the Internet



The Role of Intranets

- Many companies have sophisticated and widespread intranets, offering...
 - Detailed data retrieval
 - Collaboration
 - Personalized customer profiles
 - Links to the Internet
- Intranets use Internet technologies
 - Web browsers and servers
 - TCP/IP network protocols
 - HTML publishing and databases

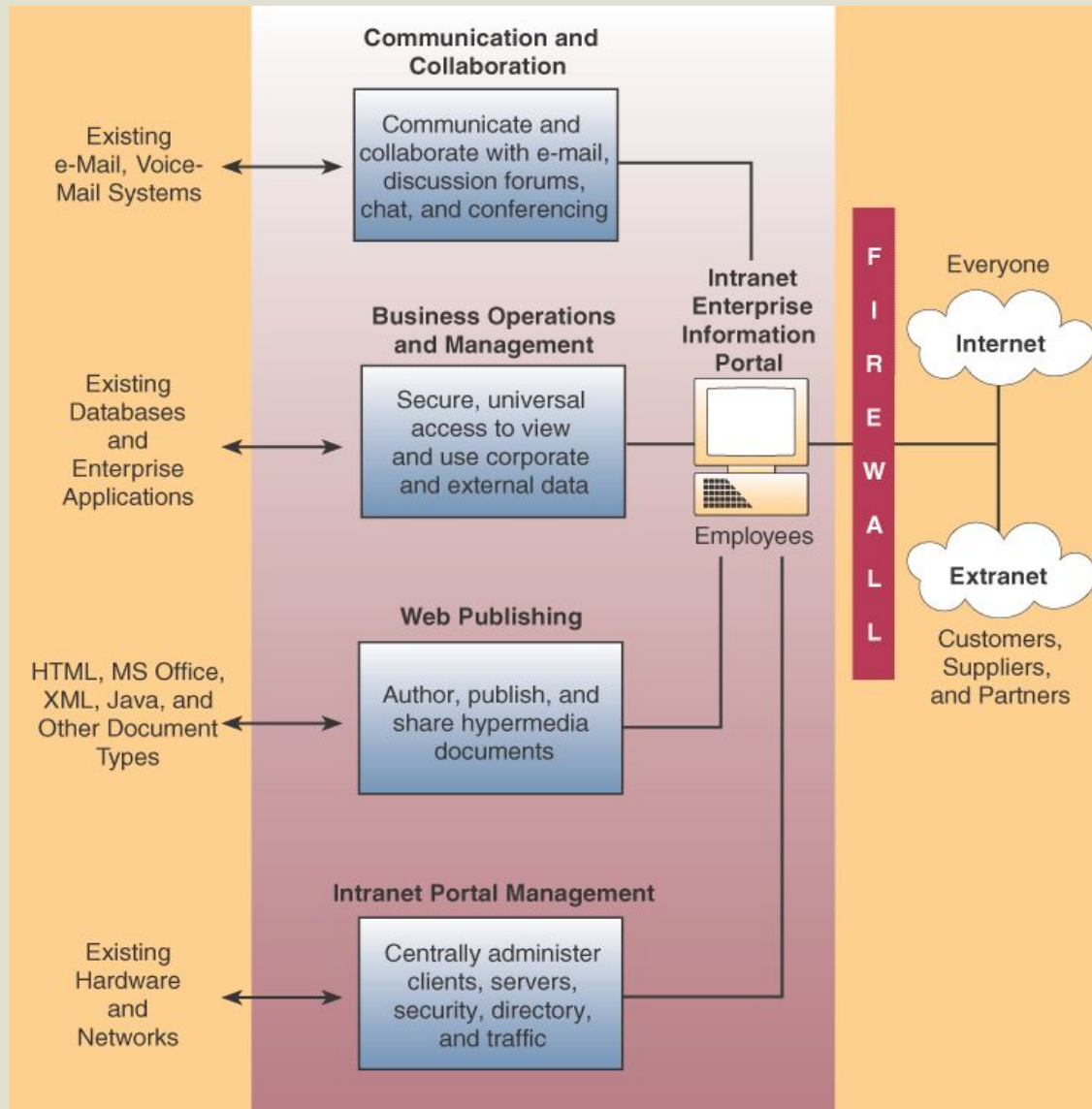
Intranets

- Intranets are protected by...
 - Passwords
 - Encryption
 - Firewalls
- Customers, suppliers, and other business partners can access an intranet via extranet links

Business Value of Intranets

- Intranets support
 - Communications and collaboration
 - Business operations and management
 - Web publishing
 - Intranet portal management

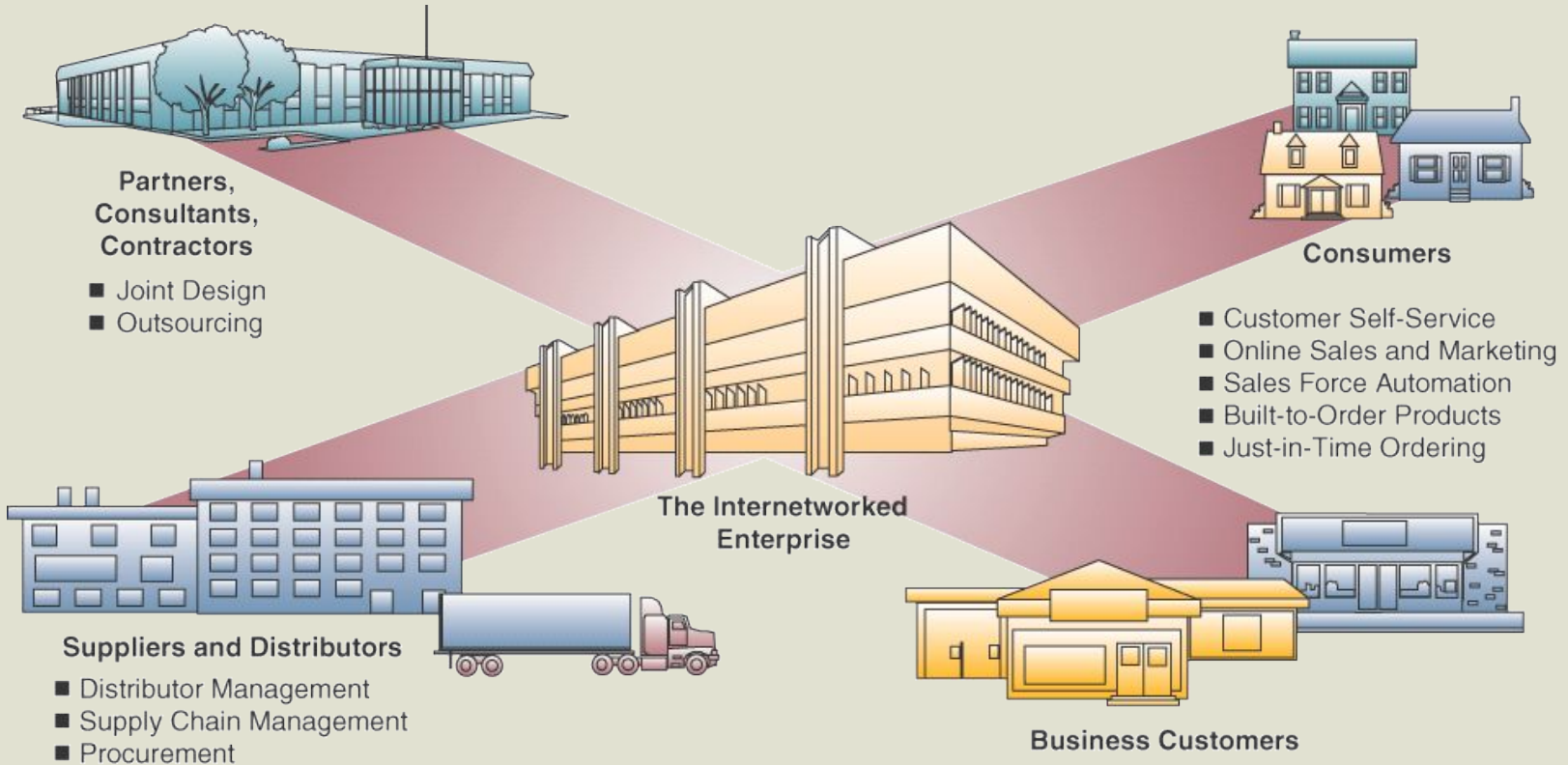
Intranets as Information Portals



Extranets

- Network links that use Internet technologies to connect the intranet of a business to the intranets of another
- Virtual Private Networks
 - Direct private network links, or private secure Internet links between companies
- Unsecured Extranet
 - Link between a company and others via the Internet, relying on encryption of sensitive data and firewall security systems

Extranet Connectivity



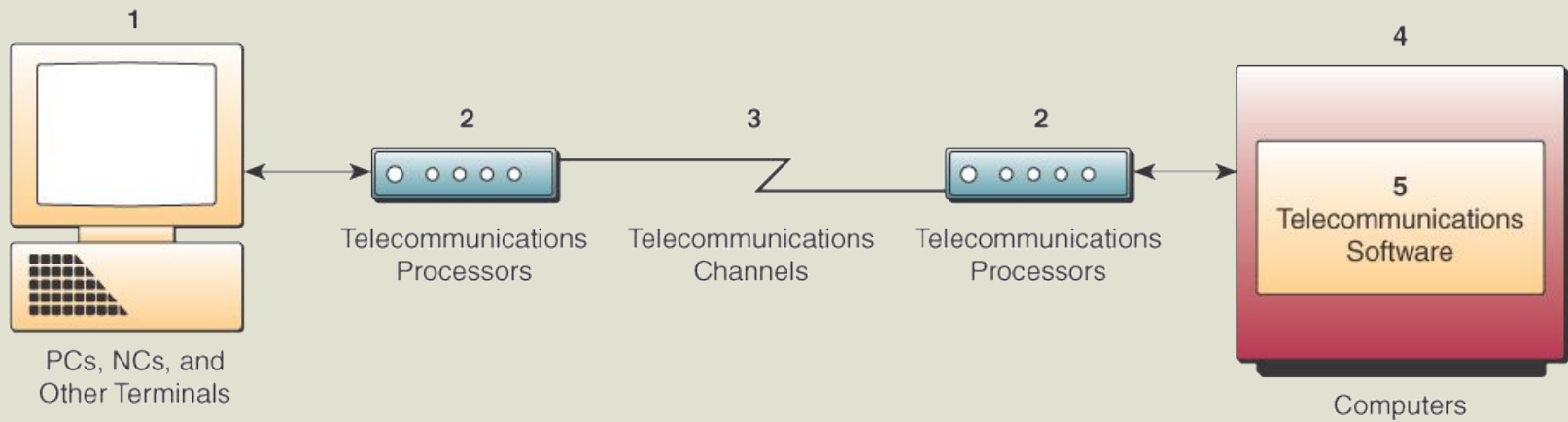
Business Value of Extranets

- Web browser technology makes customer and supplier access to intranets easier and faster
- Another way to build and strengthen strategic relationships
- Enables and improves collaboration between a business, customers, and partners
- Facilitates online, interactive product development and marketing

Telecommunications Network Model

- A telecommunications network is any arrangement where
 - A **sender** transmits a message
 - To a **receiver**
 - Over a **channel**
 - Consisting of some sort of **medium**

Telecommunications Network Model



Telecommunications Network Components

- Terminals
 - Any input/output device that uses networks to transmit or receive data
- Telecommunications processors
 - Devices that support data transmission, reception
- Telecommunications channels
 - Media over which data are transmitted, received
- Computers
 - All sizes and types

Telecommunications Network Components

- Telecommunications control software
 - Controls telecommunications activities
 - Manages the functions of telecommunications networks
- Includes network management programs of all kinds
 - Telecommunications monitors (mainframes)
 - Network operating systems (network servers)
 - Web browsers (microcomputers)

Network Component Alternatives

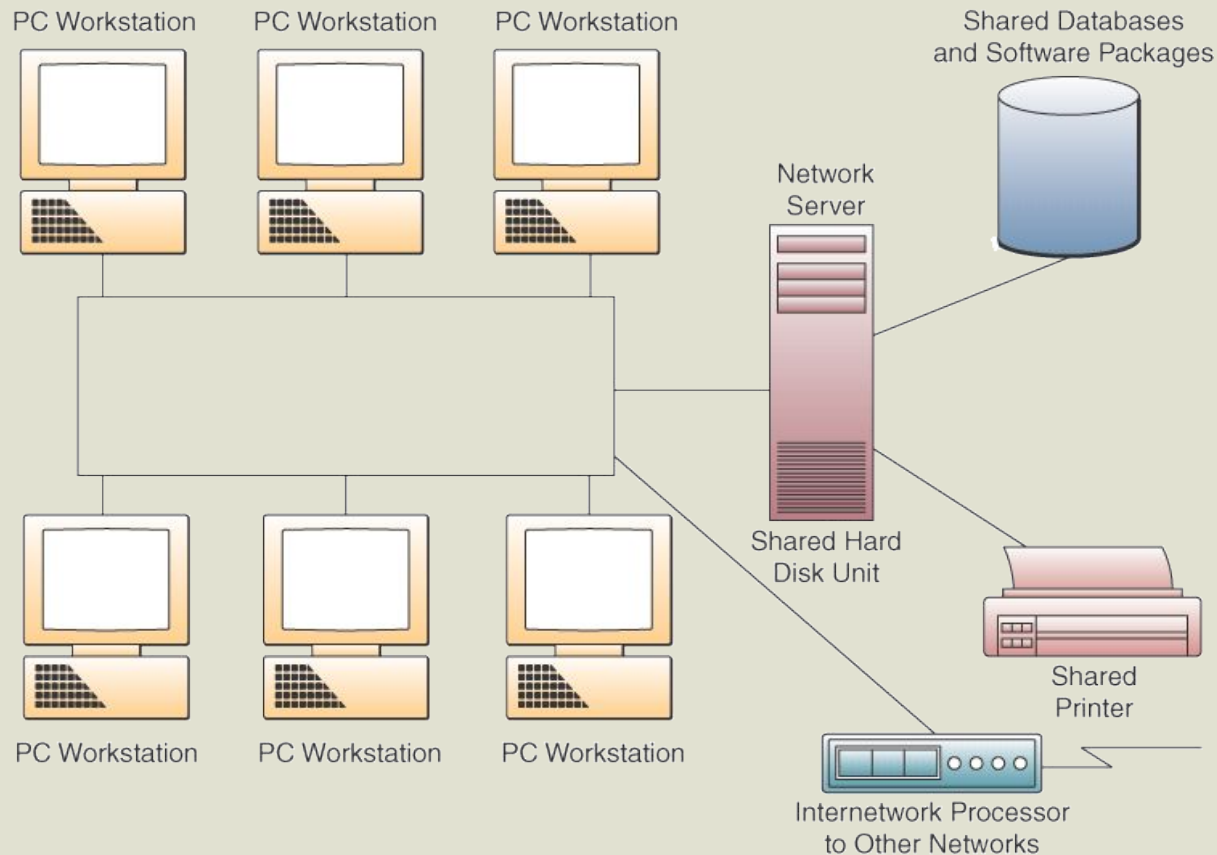
Network Alternative	Examples of Alternatives
Networks	Internet, intranet, extranet, wide area, local area, client/server, network computing, peer-to-peer
Media	Twisted-pair wire, coaxial cable, fiber optics, microwave radio, communications satellites, cellular and PCS systems, wireless mobile and LAN systems
Processors	Modems, multiplexers, switches, routers, hubs, gateways, front-end processors, private branch exchanges
Software	Network operating systems, telecommunications monitors, Web browsers, middleware
Channels	Analog/digital, switched/nonswitched, circuit/message/packet/cell switching, bandwidth alternatives
Topology/architecture	Star, ring, and bus topologies, OSI and TCP/IP architectures and protocols

Types of Communications Networks

- Primary types of communications networks
 - Wide Area
 - Local Area
 - Virtual Private
 - Client/Server
 - Peer-to-peer

Local Area Network (LAN)

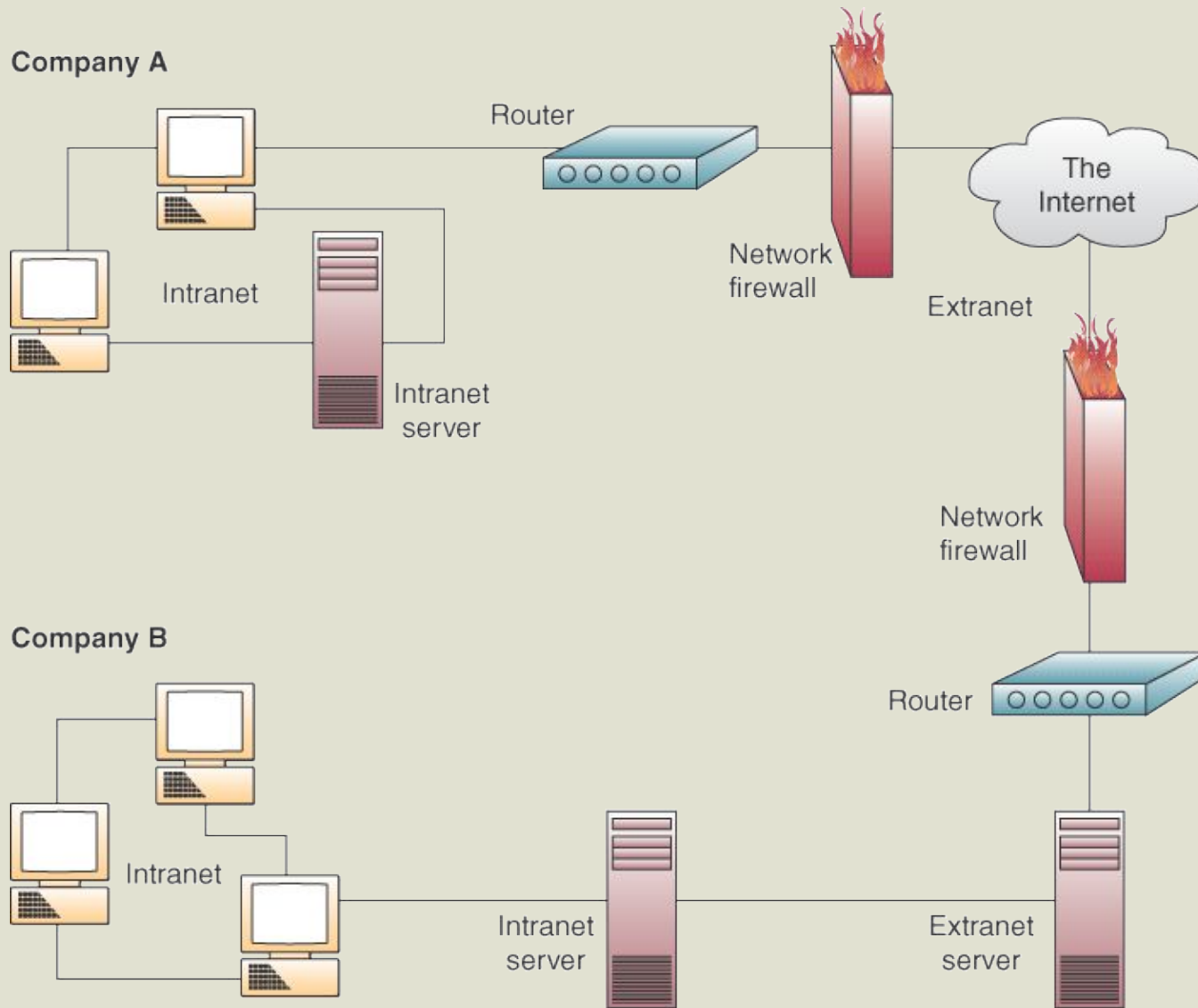
- Connects computers within a limited physical area, such as an office, classroom, or building



Virtual Private Networks (VPN)

- Used to establish secure intranets and extranets
 - The Internet is the main backbone network
 - Relies on network firewalls, encryption, and other security features to build a “pipe” through the Internet
 - Creates a private network without the high cost of a separate proprietary connection

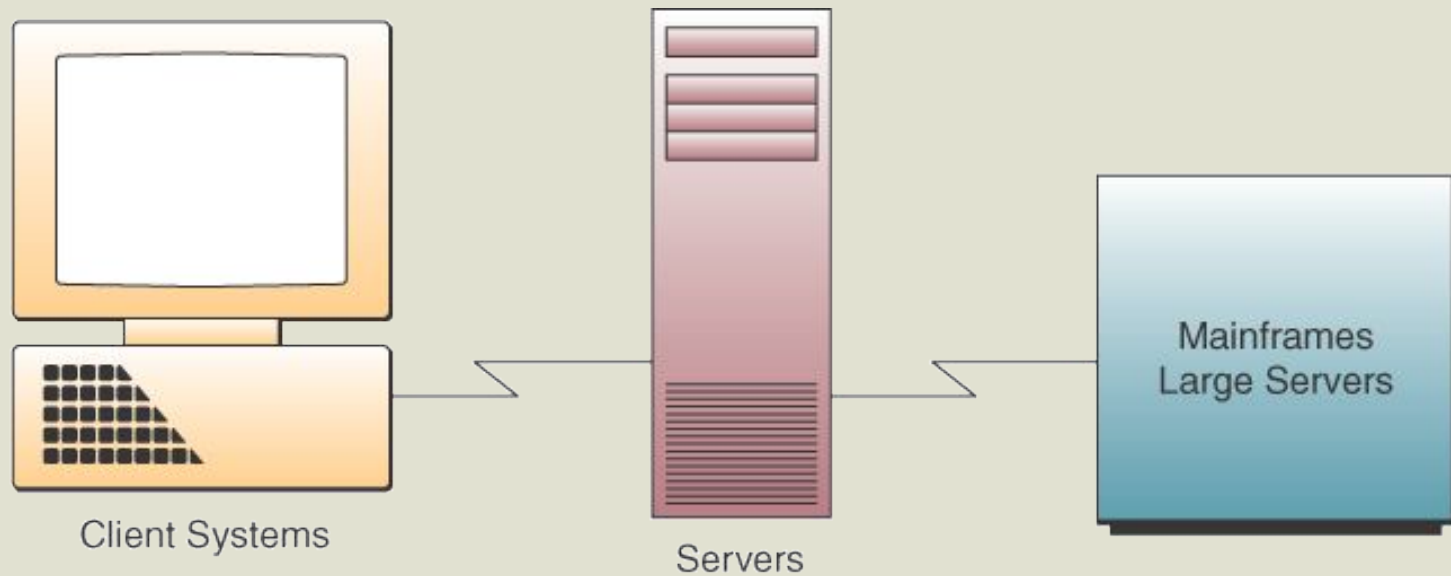
Virtual Private Network



Client/Server Networks

- Clients
 - End user personal computers or networked computers
- Servers
 - Used to manage the networks
- Processing
 - Shared between the clients and servers
 - Sometimes called a two-tier architecture
- Larger computer systems are being replaced with multiple client/server networks

Client/Server Network



- Functions: Provide user interface, perform some/most processing on an application.

- Functions: Shared computation, application control, distributed databases.

- Functions: Central database control, security, directory management, heavy-duty processing.

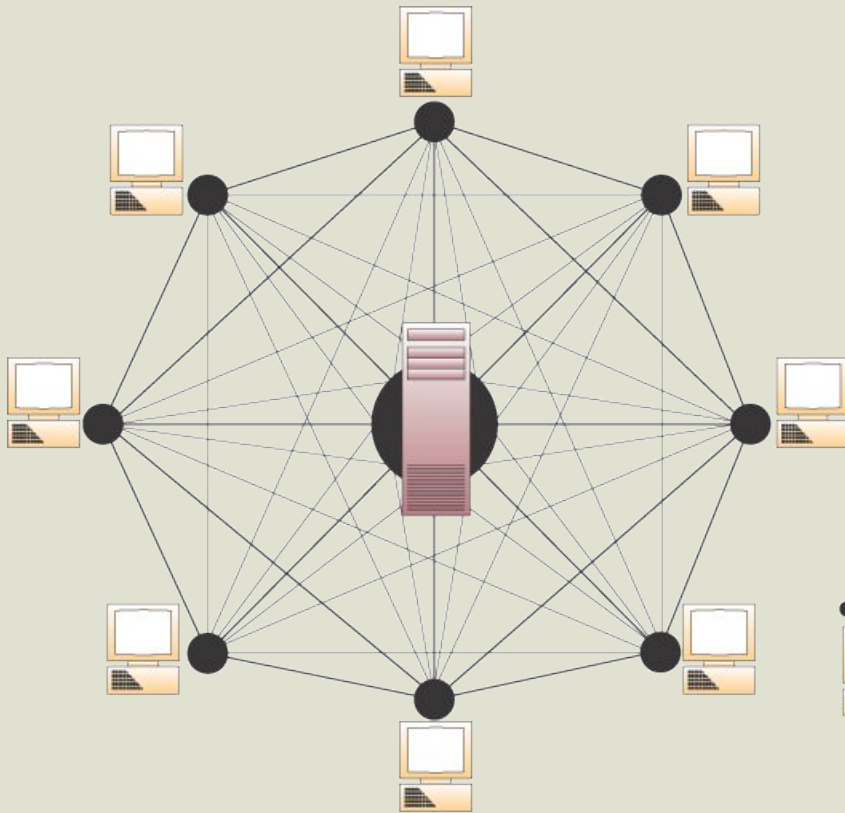
Peer-to-Peer Networks

- Central Server Architecture
 - P2P file-sharing software connects all PCs to a central server
 - When a PC requests a file, the server searches all active peers on the network
 - The server sends the requesting PC a list of links to all active peers who have the file
 - Clicking a link connects the two PCs and automatically transfers the file to the requesting PC

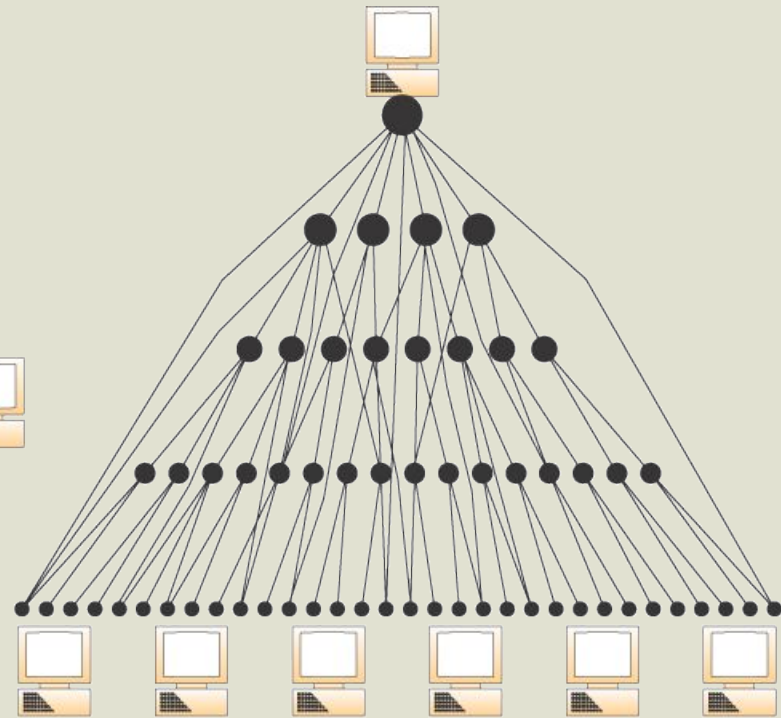
Peer-to-Peer Networks

- Pure Peer-to-Peer Architecture
 - No central directory or server
 - File-sharing software connects one PC to another online user
 - When you request a file, the software searches every online user and sends you a list of active file names
 - Clicking a link automatically transfers the file from that user's hard drive to yours

Peer-to-Peer Network Diagrams



- A peer-to-peer network architecture with a directory of all peers on a central server



- A pure peer-to-peer network architecture with no central directory server

Wireless Technologies

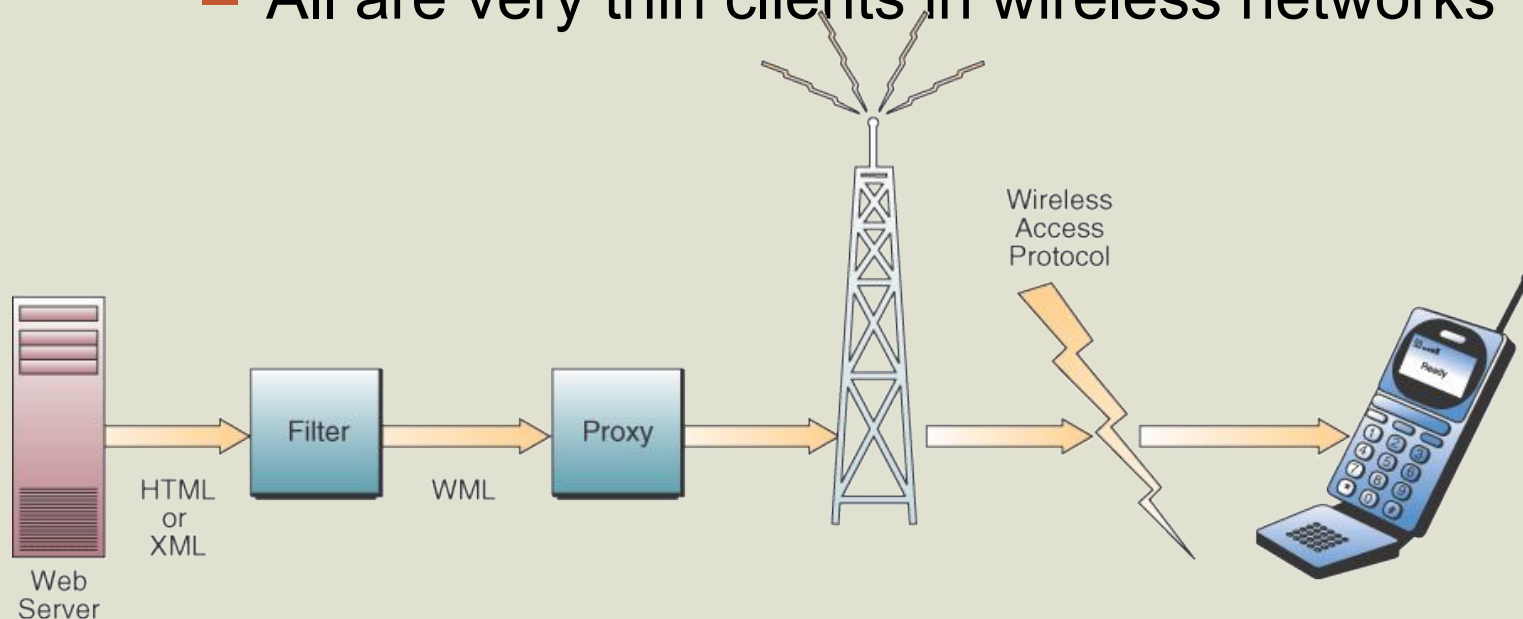
- Wireless LANS
 - Uses wireless radio-wave technology to connect PCs within an office or a building
 - Can be high-frequency, similar to digital cellular, or low frequency (spread spectrum)
- Bluetooth
 - Short-range wireless technology
 - Connects PCs to devices, such as a printer
 - Fairly low cost to implement

Wireless Technologies

- Other Wireless Systems
 - Cellular phones
 - Mobile radio
 - PDAs
- Telecommunications networks now play vital and pervasive roles in
 - Web-enabled e-business processes
 - Electronic commerce
 - Enterprise collaboration
 - Other applications that support business operations, management, and strategic objectives

The Wireless Web

- Wireless Internet access is growing as Web-enabled information appliances proliferate
 - Smart telephones, pagers, PDAs
 - All are very thin clients in wireless networks



Telecommunications Processors

- Modems
 - The most common type of communications processor
 - Converts a digital signal to an analog frequency that can be transmitted over phone lines, then back into a digital signal
 - Modulation and demodulation

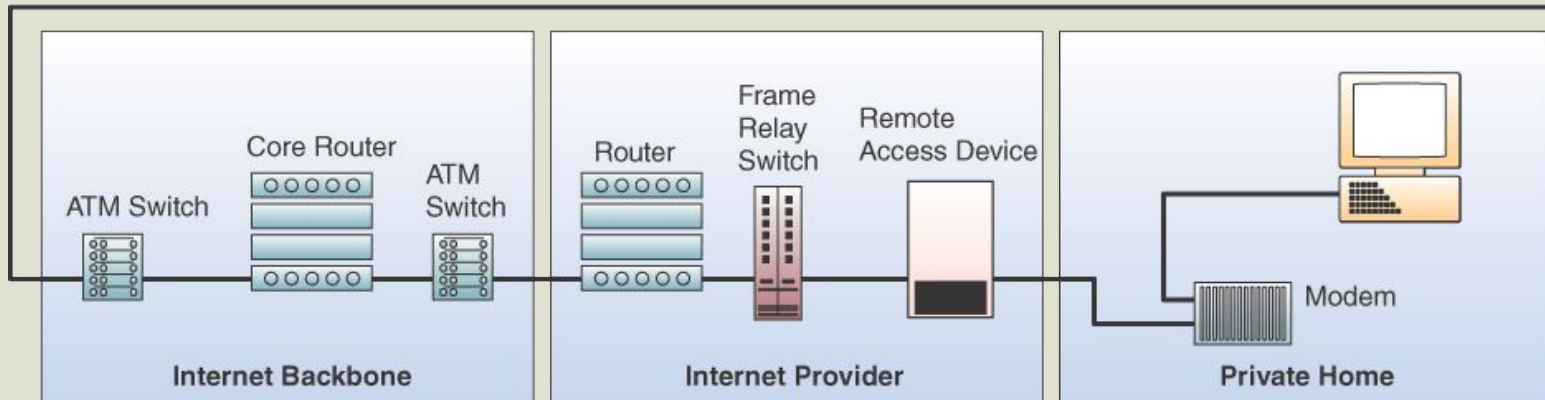
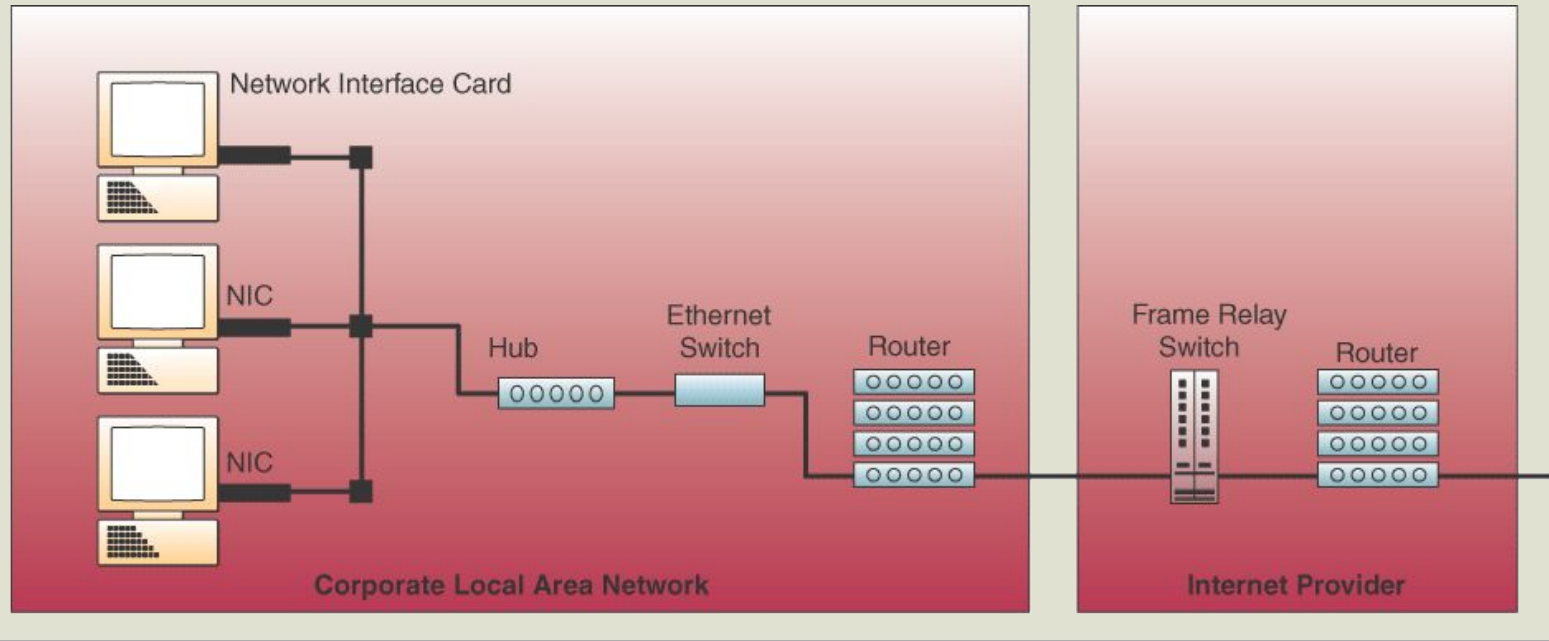
Comparing Technologies

Modem (56 Kbps)	DSL (Digital Subscriber Line) Modem
<ul style="list-style-type: none">• Receives at 56 Kbps• Sends at 33.6 Kbps• Slowest technology	<ul style="list-style-type: none">• Receives at 1.5 Mbps to 5.0 Mbps• Sends at 128 Kbps to 640 Kbps• Users must be near switching centers
ISDN (Integrated Services Digital Network)	Cable Modem
<ul style="list-style-type: none">• Sends and receives at 128 Kbps• Users need extra lines• Becoming obsolete	<ul style="list-style-type: none">• Receives at 1.5 Mbps to 5 Mbps• Sends at 128 Kbps to 2.5 Mbps• Speed degrades with many local users
Home Satellite	Local Microwave
<ul style="list-style-type: none">• Receives at 400 Kbps• Sends via phone modem• Slow sending, higher cost	<ul style="list-style-type: none">• Sends and receives at 512 Kbps to 1.4 Mbps• Higher cost alternative• May require line of sight to base antenna

Inter-Network Processors

- **Switch**... makes connections between telecommunications circuits in a network
- **Router**... intelligent communications processor that interconnects networks based on different protocols
- **Hub**... a port-switching communications processor
- **Gateway**... connects networks with different communications architectures

Communications Processors



Communications Processors

- **Multiplexer...** allows a single communications channel to carry simultaneous data transmissions from many terminals
 - In time division multiplexing (TDM), the multiplexer divides the time each terminal can use the high-speed into short time slots
- Multiplexers increase the number of transmissions possible
 - Does not increase the number of physical data channels

Telecommunications Software

- May reside in PCs, servers, mainframes, and communications processors
 - Vital part of all telecommunications networks
 - Used to manage network performance
 - WANs often use **telecommunications monitors** or **teleprocessing monitors**
 - Other networks use **operating system** software
 - **Middleware** helps diverse networks communicate with each other

Network Management Functions

- Traffic Management
 - Manage network resources and traffic to avoid congestion and optimize service levels
- Security
 - Provide authentication, encryption, firewall, auditing, and enforcement
- Network Monitoring
 - Troubleshoot and watch over the network, alerting administrators of potential problems

Network Management Functions

- Capacity Planning
 - Survey network resources, traffic patterns, and users' needs
 - Determine the best way to accommodate the needs of the network as it grows and changes

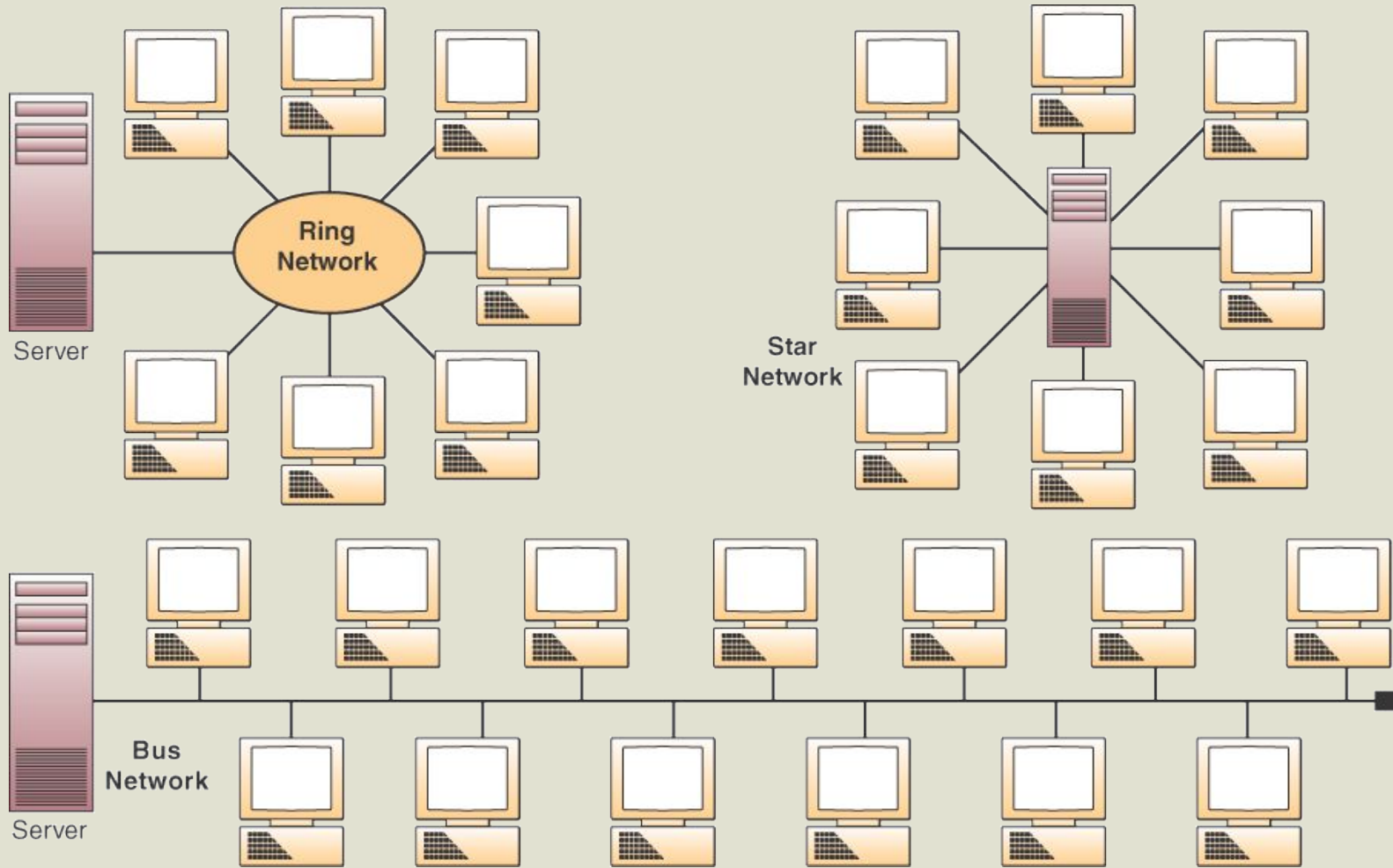
Network Topologies

- Topology
 - The structure of a network
- Star Network
 - Ties end user computers to a central computer
- Ring Network
 - Ties local computer processors together in a ring on a relatively equal basis
- Bus Network
 - Local processors share the same communications channel

Network Topologies

- Mesh Network
 - Uses direct communications lines to connect some or all of the computers in the ring to each other
- Switch
 - A message-switching computer that handles data communication between autonomous local computers

Network Topologies



Network Architectures and Protocols

- Protocol
 - A standard set of rules and procedures for the control of communications in a network
- Handshaking
 - The process of exchanging predetermined signals and characters
 - Establishes a telecommunications session between terminals and computers

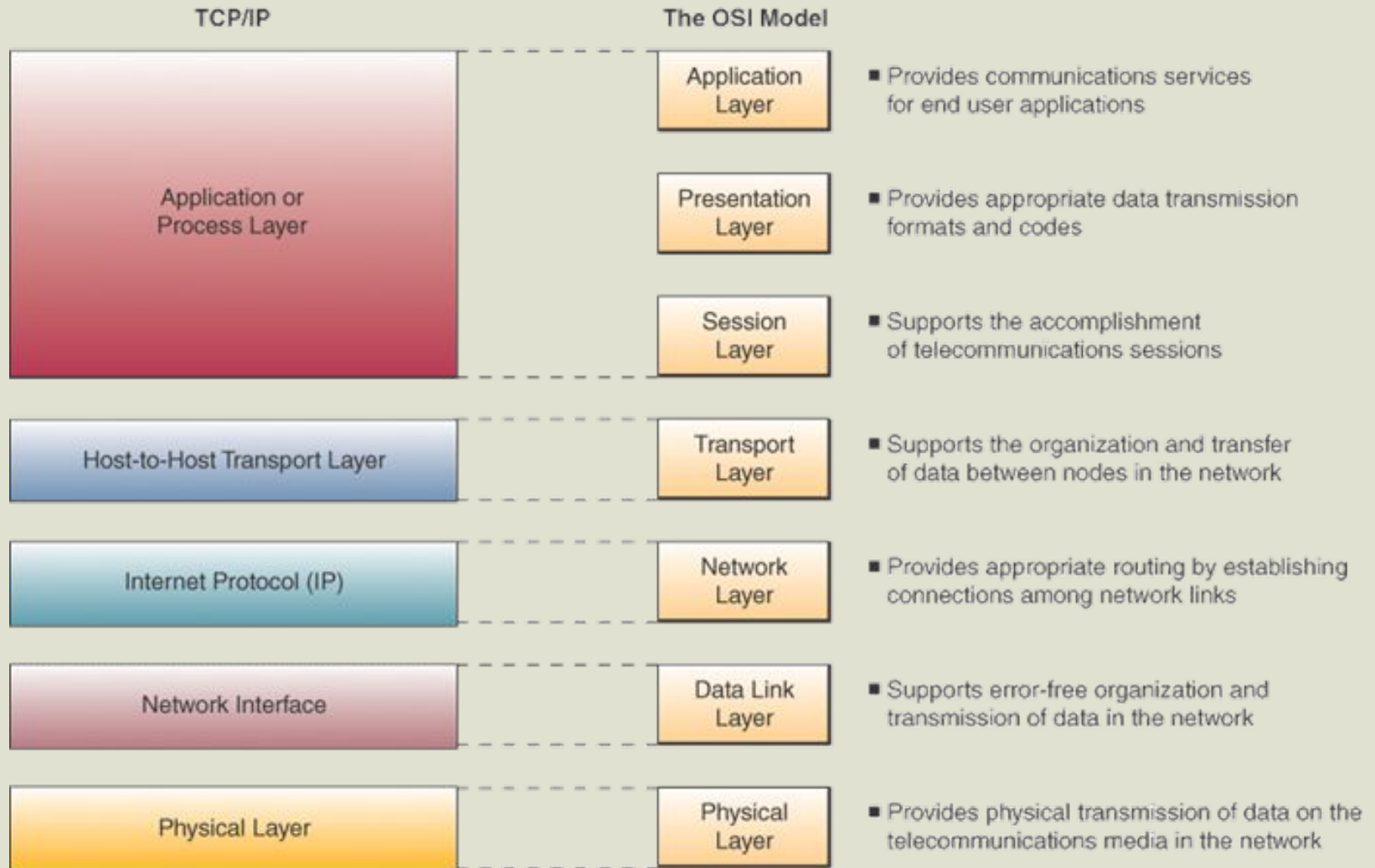
Network Architectures and Protocols

- Network Architecture
 - Master plan of standard protocols, hardware, software, and interfaces between end users and computer systems
 - Goal is to promote an open, simple, flexible, and efficient telecommunications environment

OSI and TCP/IP Models

- Open Systems Interconnection (OSI) Model
 - A seven-layer model that serves as a standard model for network architectures
 - Model for how messages should be transmitted between two points in a network
 - Each layer adds functions
- Transmission Control Protocol/Internet Protocol (TCP/IP)
 - A five-layer telecommunications protocol used by the Internet

OSI and TCP/IP Models



Voice Over IP

- Internet Telephony
 - Using an Internet connection to pass voice data using IP instead of a telephone network
 - Often referred to as voice over IP or VoIP
 - Works like a regular phone, but skips long-distance charges
 - Runs over standard network infrastructure
 - Requires a well-configured network to work smoothly

Bandwidth

- Bandwidth
 - The frequency range of a telecommunications channel that determines the maximum transmission rate
 - Speed and capacity typically measured in bits per second (bps)
 - Sometimes call baud rate
- Transmission Rates
 - Narrow-band = low speed
 - Broadband = high speed