# Introduction to Management Information Systems

# Introduction to Networks

Telecommunications and Networks

# Telecommunications and Networks

1. Computer Networks
2. Networks Security

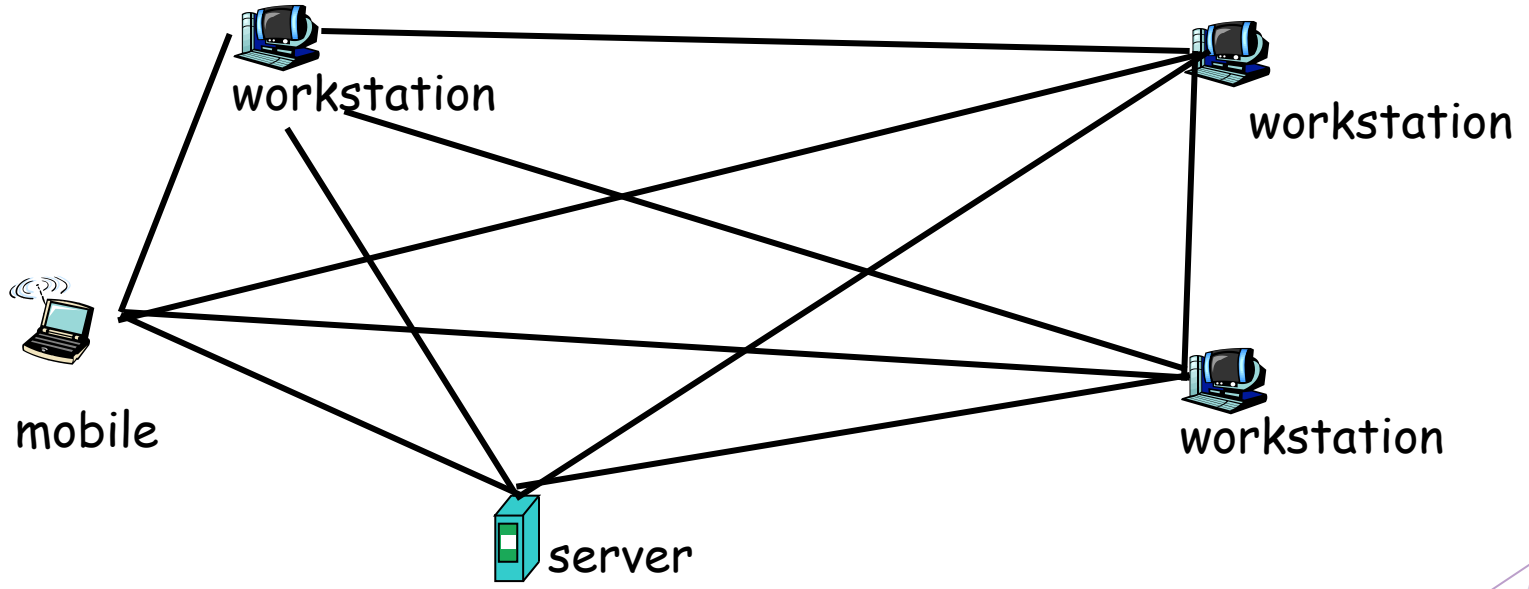
# Learning objectives

- specify which components of a communications system are necessary to exchange information within and between businesses;
- explain the basic components and terminology of networks, including the Internet;
- identify the benefits available through the introduction of computer networks;
- identify the advantages and disadvantages of the client/server architecture in comparison with traditional approaches;

# Lesson 1

# What's a network

- A group of devices that can communicate with one another - *hosts*
- Physical connections between devices are called *links*



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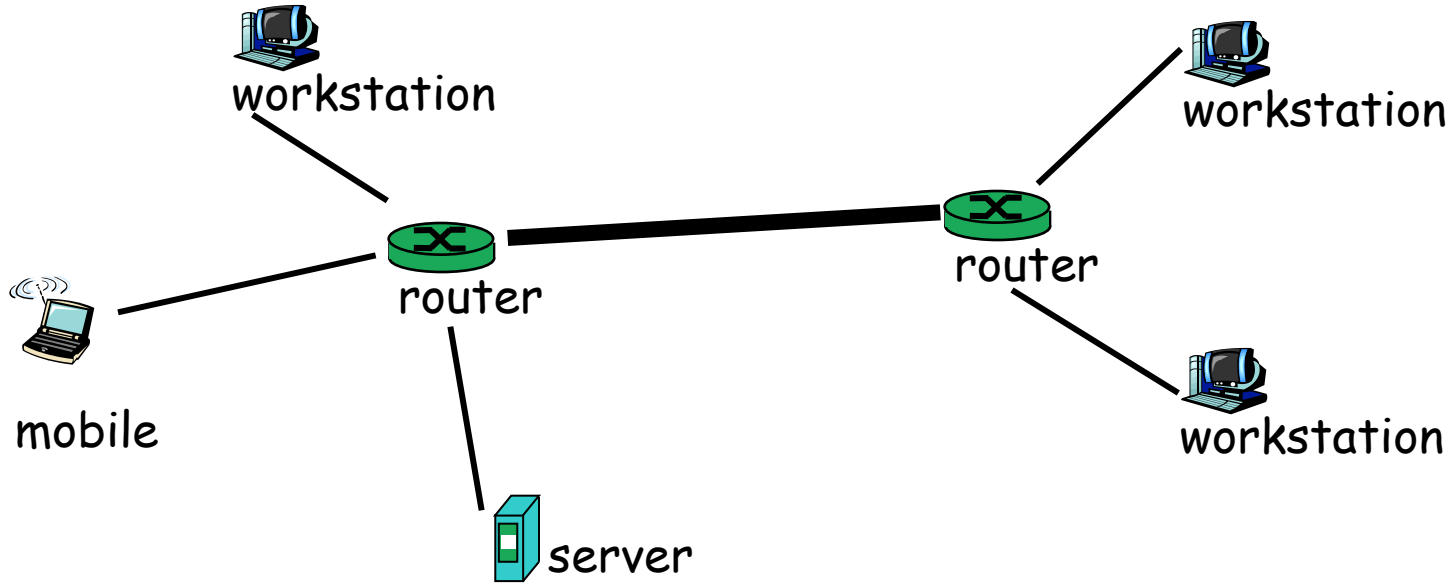
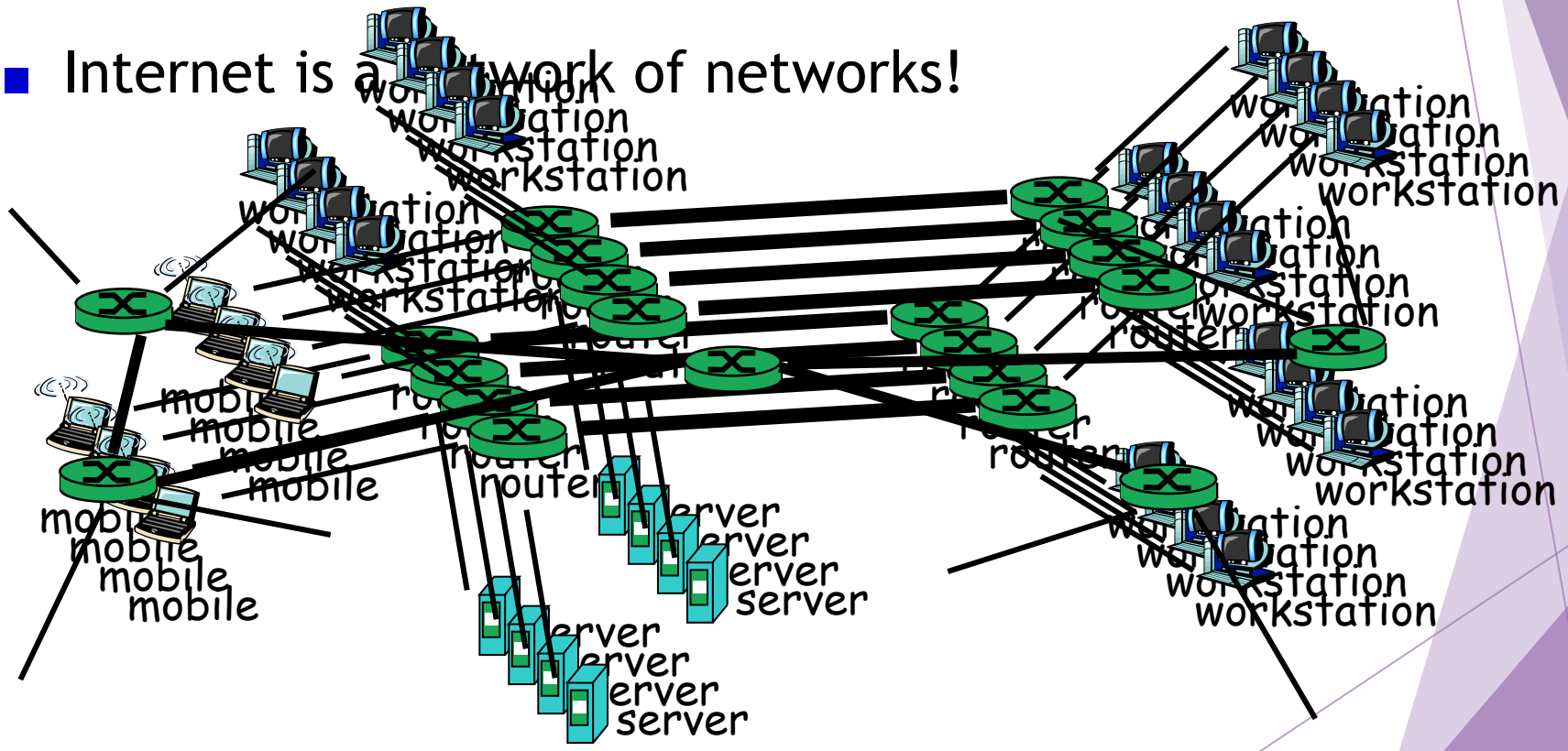


# What's the Internet

- A worldwide, public network connecting millions of devices
- Internet is a network of networks!

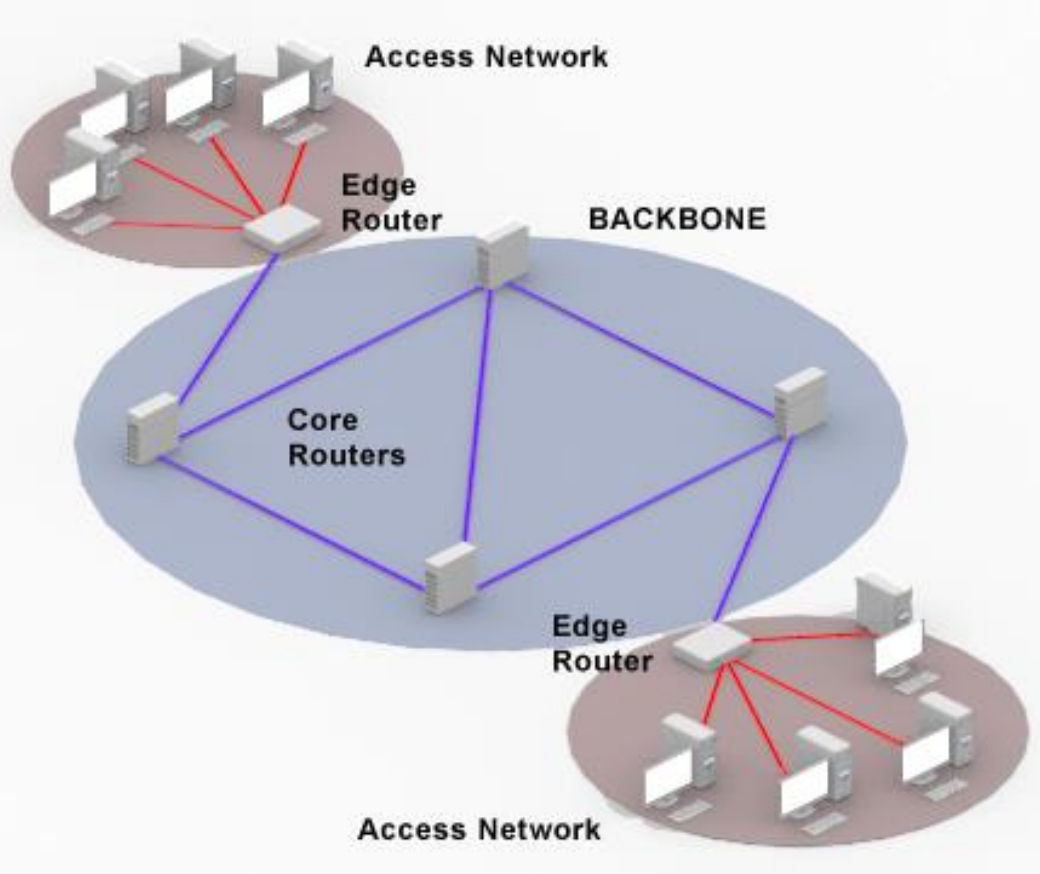


# Introduction to Computer Networks

- End systems are connected by communication links and packet switches
- Network Edge
  - access networks (how you access the Internet)
  - physical media (how the network is physically connected to the Internet)
- Network Core
  - packet switches

# Introduction to Computer Networks

An access network is a network that connects directly to the end user.




*Pcmag http://www.pcmag.com/encyclopedia/term/37391/access-network*

# Internet

# Internet

- The Internet allows communication between millions of connected computers worldwide
- The Internet is a large-scale client/server system
- early 1990s when the web browser adopted , growth of widespread use
- There are 4.72 billion **internet users** in the world today.
- The total number of **internet users** around the world grew by 332 million in the past 12 months (Google)

# ISP

- client PCs are connected via local Internet service providers (ISPs)
- **ISPs** linked to larger ISPs with connection to the major national and international infrastructure or backbones
- multiple **backbones** connect to high-speed links
  - e.g. into Europe and through to the rest of the world
- high-speed links like motorways on the ‘information superhighway’
- many end-user tools e.g. web browsers and e-mail

# world wide web

provides a standard method for exchanging and publishing information on the Internet

based on formats such as HTML (Hypertext Markup Language)

been widely adopted because:

- interactive, user input e.g. forms
- links
- easy to read on different access devices
- graphics and animations

# world wide web

success due to combination of web browsers and HTML

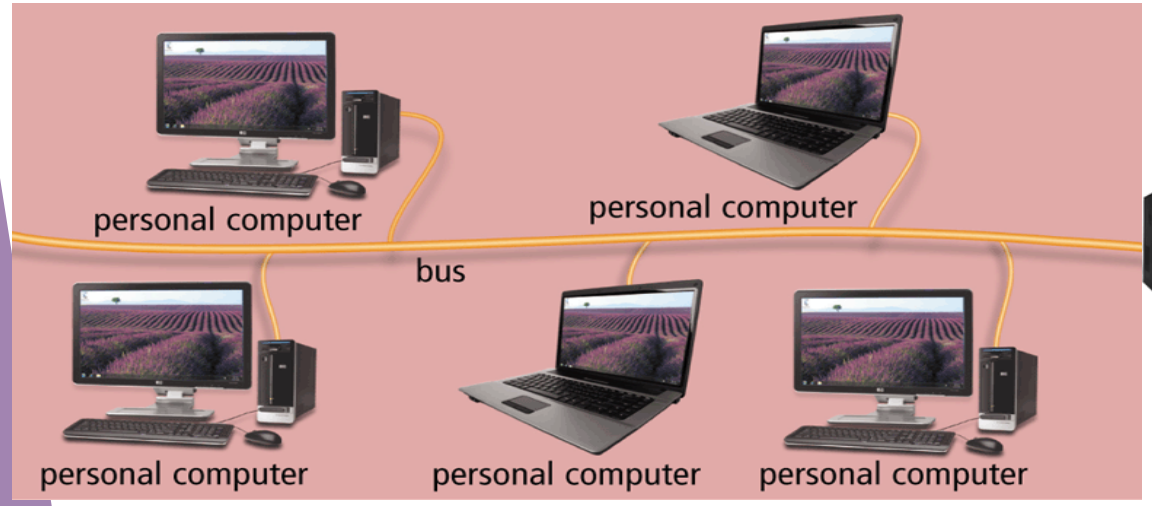
- easy to use
  - navigation via links
- supports multimedia
  - popular with users and advertisers
- able to scale
  - standardization
  - means easy exchange of information

# Topology

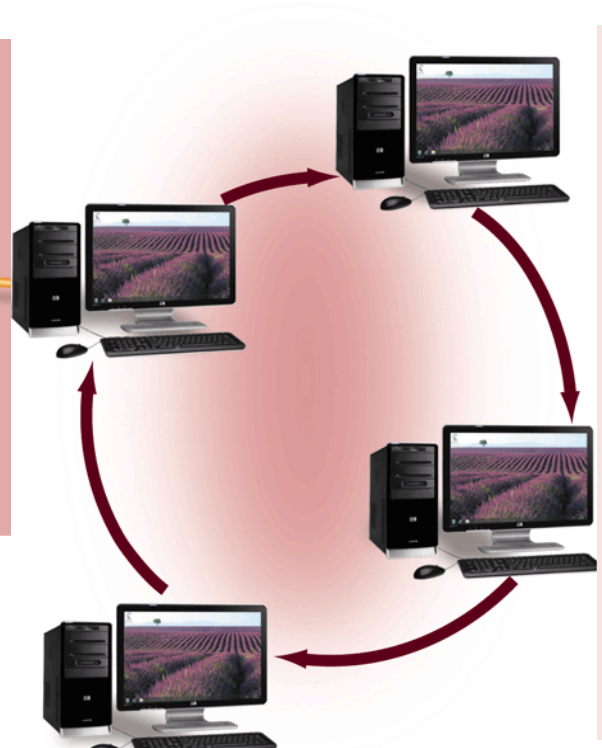
# Networks

A network topology refers to the layout of the computers and devices in a communications network

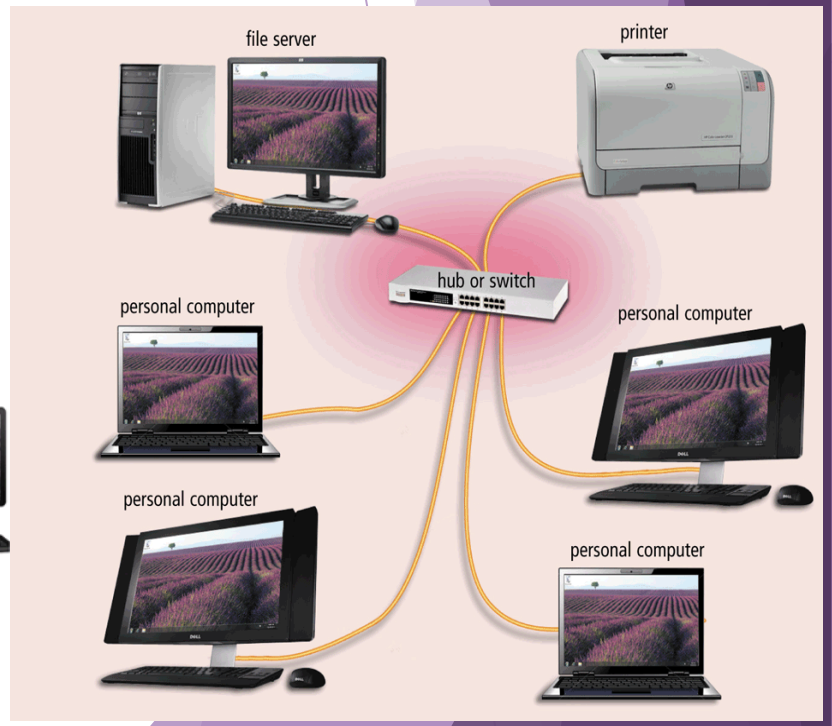
**Bus network**




**Ring network**

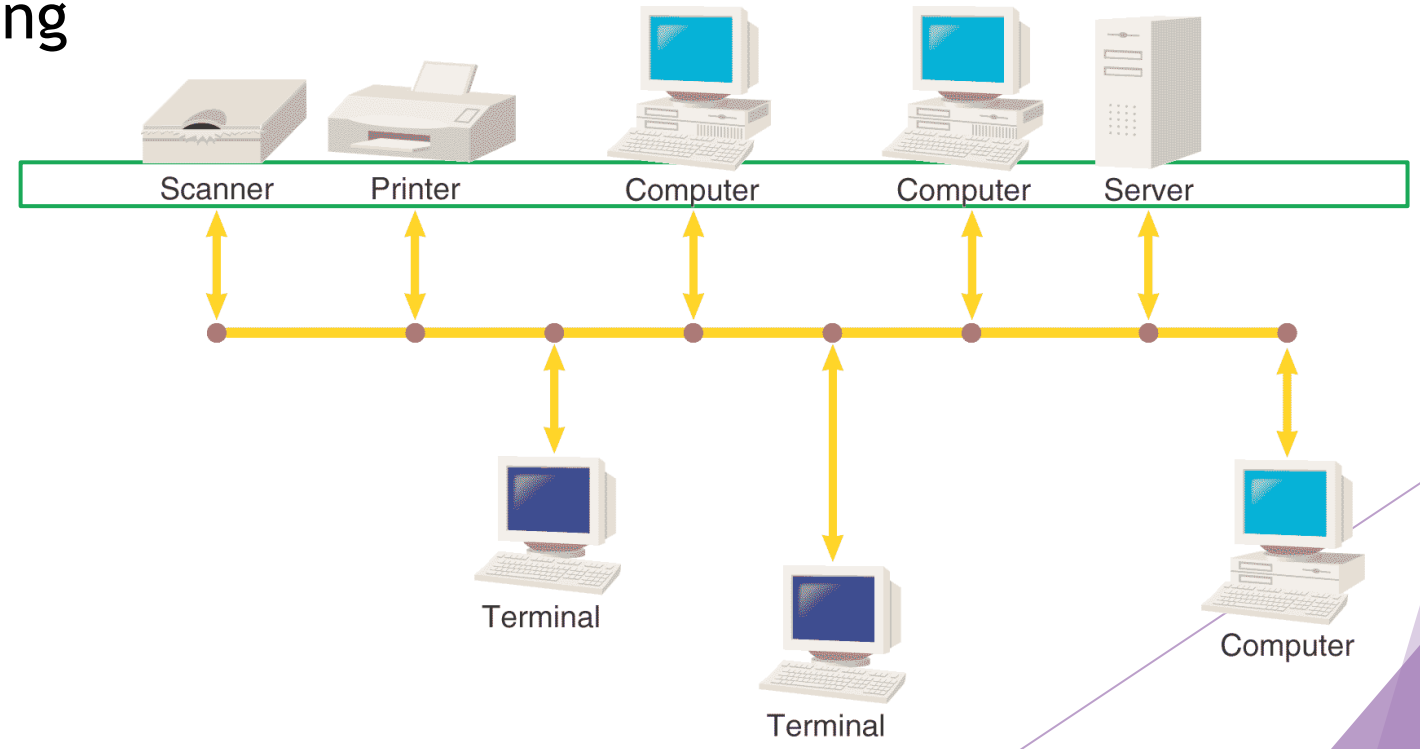


**Star network**



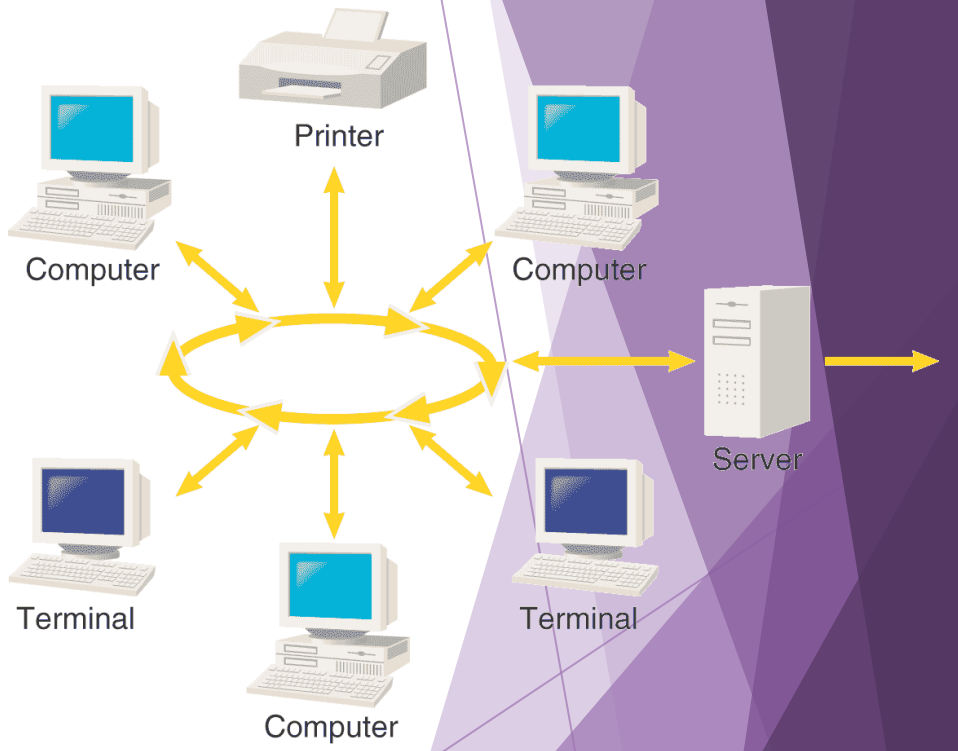
# Bus network

- All nodes are connected to a single wire or cable
- It is easy to implement and extend
- It is less expensive than other topologies
- If a connection in the bus is broken, the entire network may stop working



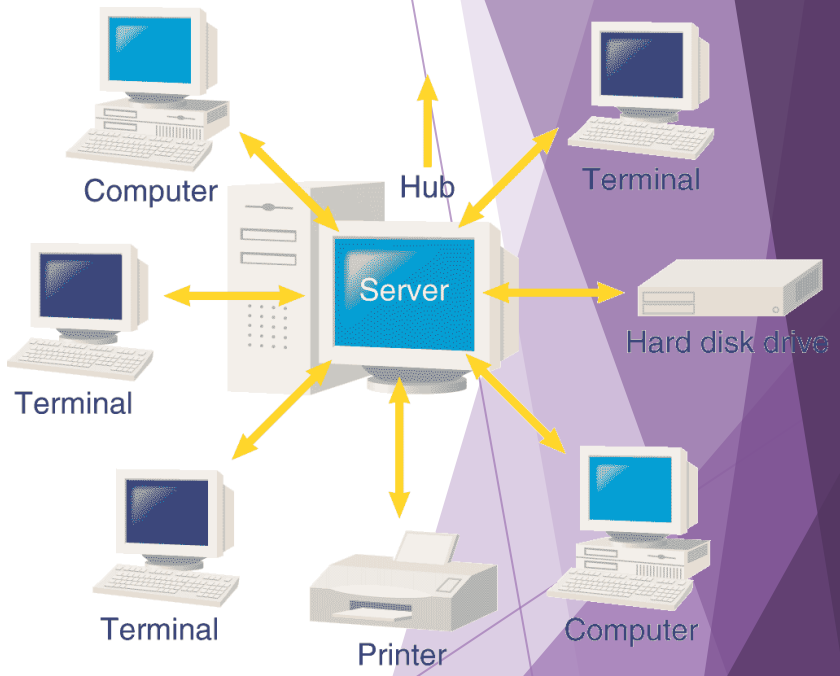
# Ring network

- All nodes are connected in a continuous loop
- It flows in only one direction therefore there is fast and no danger of collisions.
- If a connection is broken, the entire network stops working



# Star network

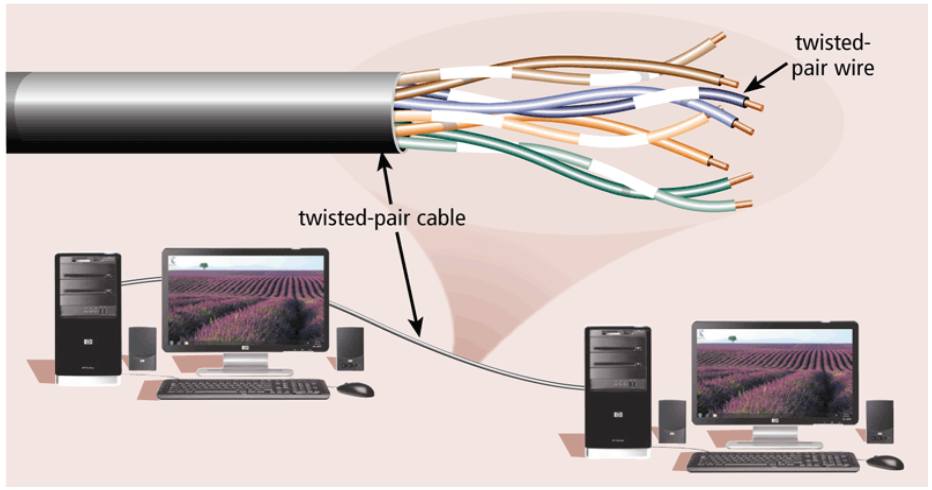
- All nodes are connected through a central host
- If a connection is broken between any communication device and the hub, the rest of the devices on the network will continue operating



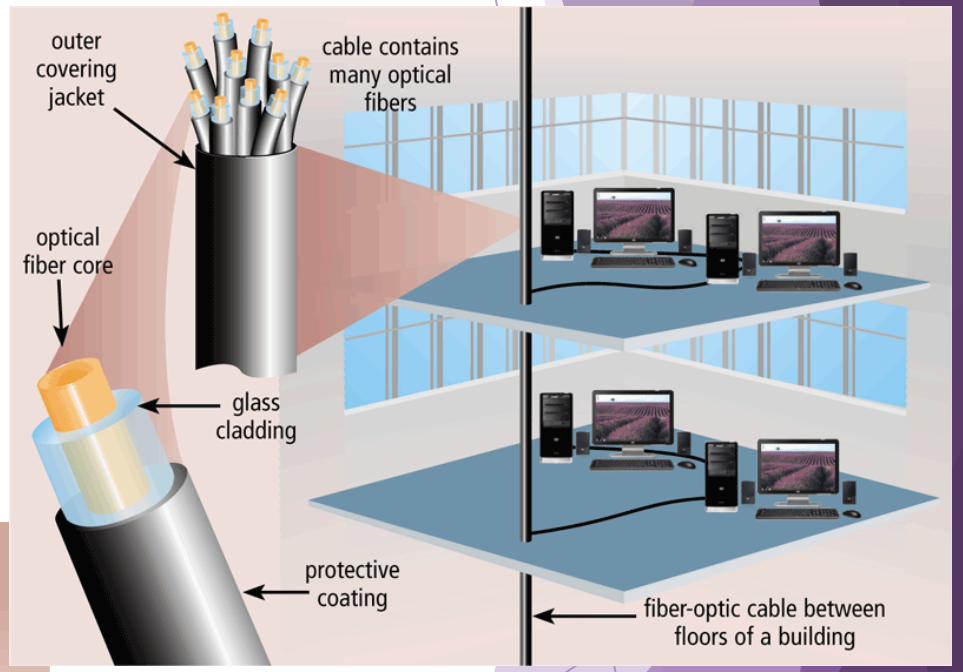
# Physical Media

# Physical Transmission Media

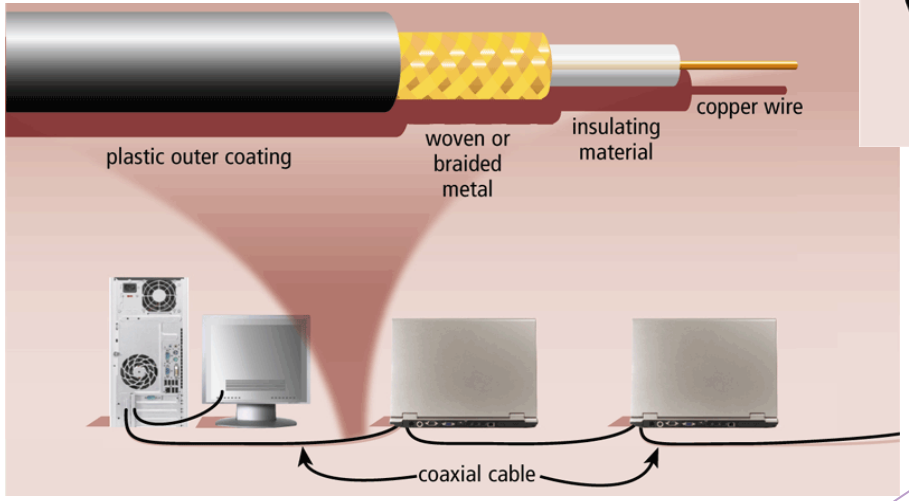
## Twisted-pair cable




## Fiber-optic cable




## Coaxial cable



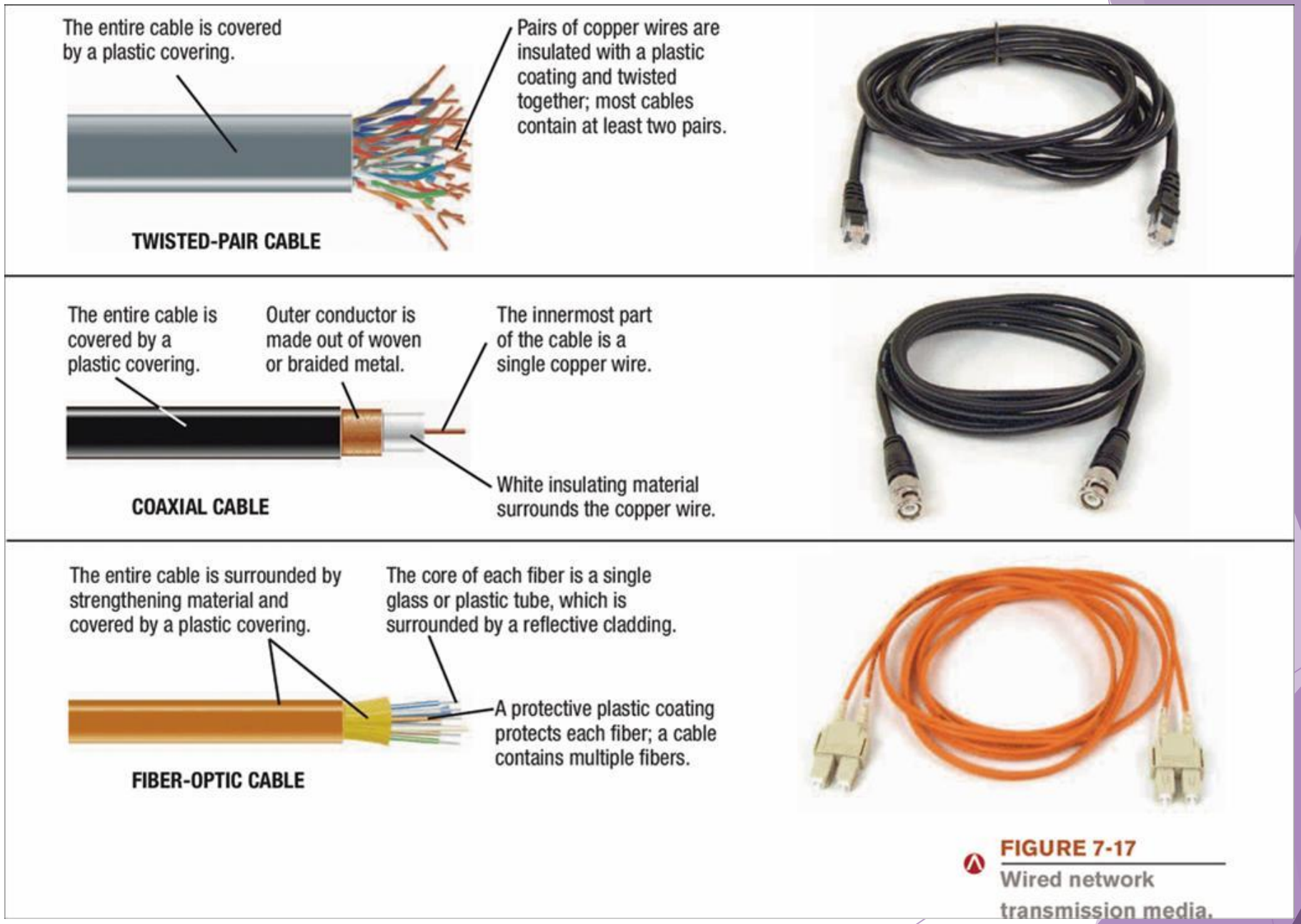
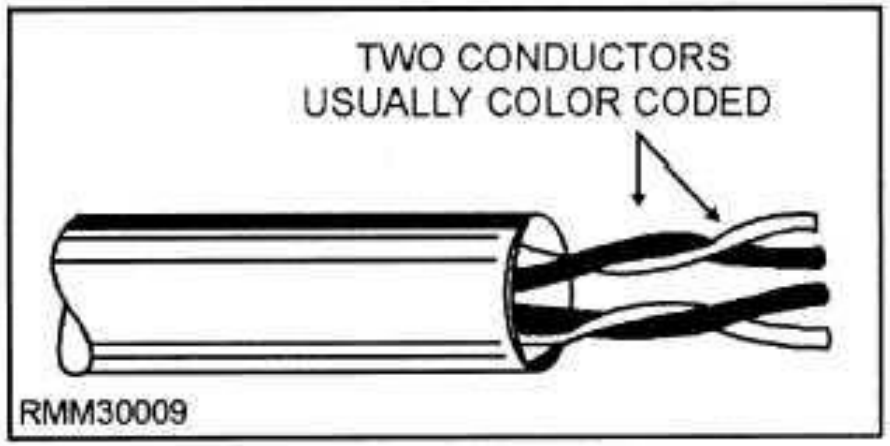



**FIGURE 7-17**
Wired network transmission media.

(Source: Shelly et al.)

# Wired Communications Media

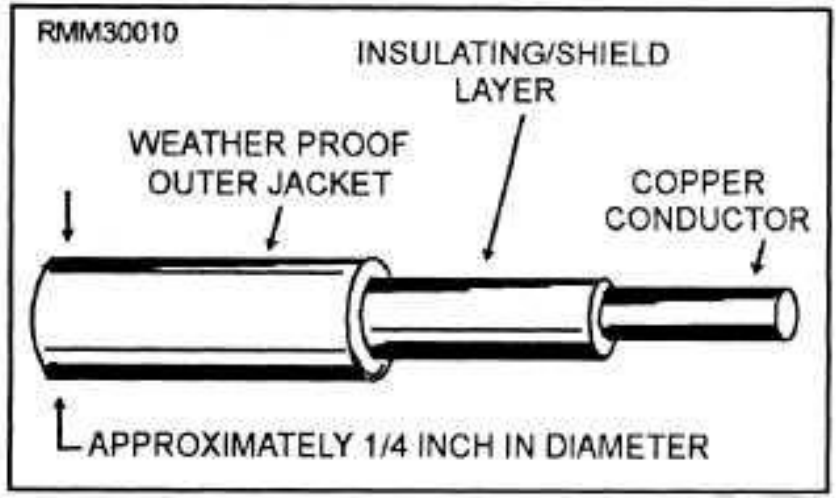
- Twisted-Pair Wire
  - 2 strands of insulated copper wire twisted around each other
  - Twisting reduces interference (crosstalk) from electrical signals
  - Data rates are 1 – 128 megabits per second




(Source: Integrated Publishing)

# Wired Communications Media

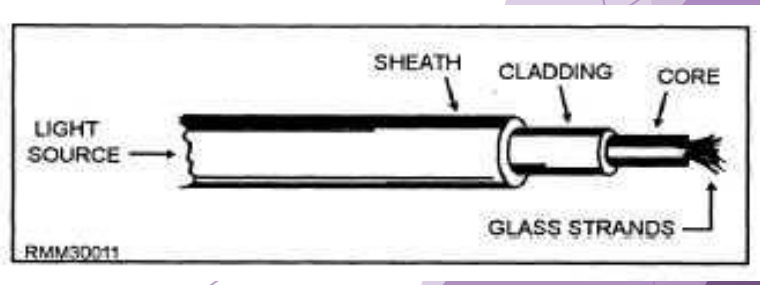
- Coaxial Cable
  - Insulated copper wire wrapped in a metal shield and then in an external plastic cover
  - Used for **cable TV and cable internet** electric signals
  - Carries voice and data up to 200 megabits per second




(Source: Integrated Publishing)

# Wired Communications Media

- Fiber-Optic Cable
  - Dozens or hundreds of thin strands of glass or plastic that transmit beams of light, not electricity
  - Can transmit up to 2 gigabits per second
  - More expensive than twisted-pair or coaxial cable
  - Lighter and more durable than twisted-pair or coaxial cable
  - More difficult to tap into than twisted-pair or coaxial cable




(Source: Integrated Publishing)

## Physical Transmission Media

**Transfer Rates for Various Types of LANs Using Physical Transmission Media**

| Type of Cable and LAN | Maximum Transfer Rate |
|---|---|
| **Twisted-Pair Cable** | |
| • 10Base-T (Ethernet) | 10 Mbps |
| • 100Base-T (Fast Ethernet) | 100 Mbps |
| • 1000Base-T (Gigabit Ethernet) | 1 Gbps |
| • Token ring | 4 Mbps to 16 Mbps |
| **Coaxial Cable** | |
| • 10Base2 (ThinWire Ethernet) | 10 Mbps |
| • 10Base5 (ThickWire Ethernet) | 10 Mbps |
| **Fiber-Optic Cable** | |
| • 10Base-F (Ethernet) | 10 Mbps |
| • 100Base-FX (Fast Ethernet) | 100 Mbps |
| • FDDI (Fiber Distributed Data Interface) token ring | 100 Mbps |
| • Gigabit Ethernet | 1 Gbps |
| • 10-Gigabit Ethernet | 10 Gbps |
| • 40-Gigabit Ethernet | 40 Gbps |
| • 100-Gigabit Ethernet | 100 Gbps |

# Communications Devices

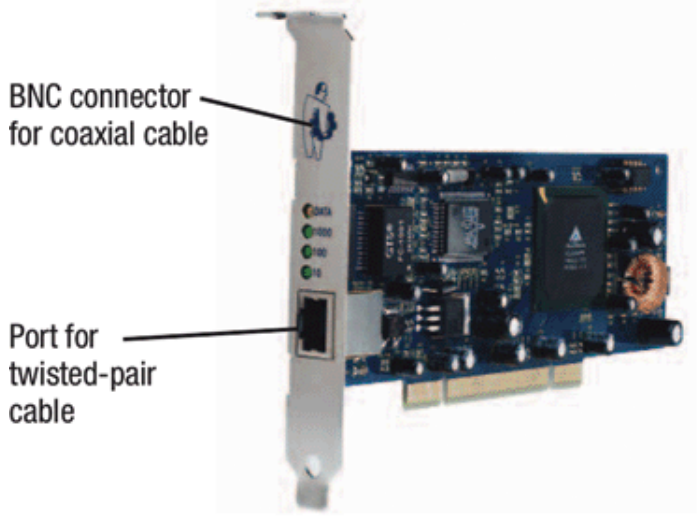
A hub or switch connects several devices in a network together

A router connects multiple computers or other routers together and transmits data to its correct destination on a network

Many are protected by a hardware firewall

# Networking Hardware

- **Network adapters:** use to connect a PC to a network
  - Also called **network interface card** (**NIC**) when in the form of an expansion card
  - Come in a variety of formats
    - PCI (Peripheral Component Interconnect)
    - USB
    - PC Card
  - Adapter must match the type of network being used (Ethernet, Wi-Fi, Bluetooth, etc.)



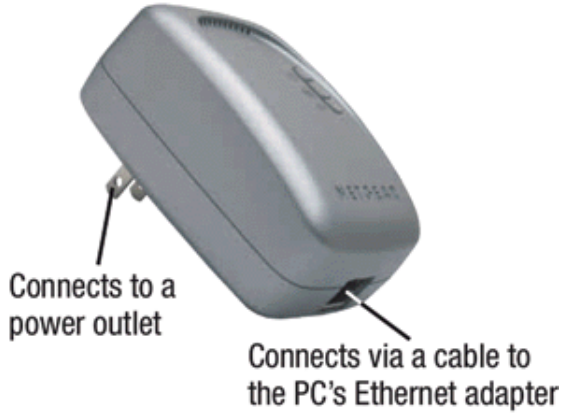

**PCI ETHERNET ADAPTER FOR DESKTOP PC**


**USB BLUETOOTH ADAPTER FOR DESKTOP OR NOTEBOOK PC**


**PHONELINE ADAPTER FOR NOTEBOOK PC**


**USB ETHERNET ADAPTER FOR DESKTOP OR NOTEBOOK PC**


**WI-FI ADAPTER FOR NOTEBOOK PC**



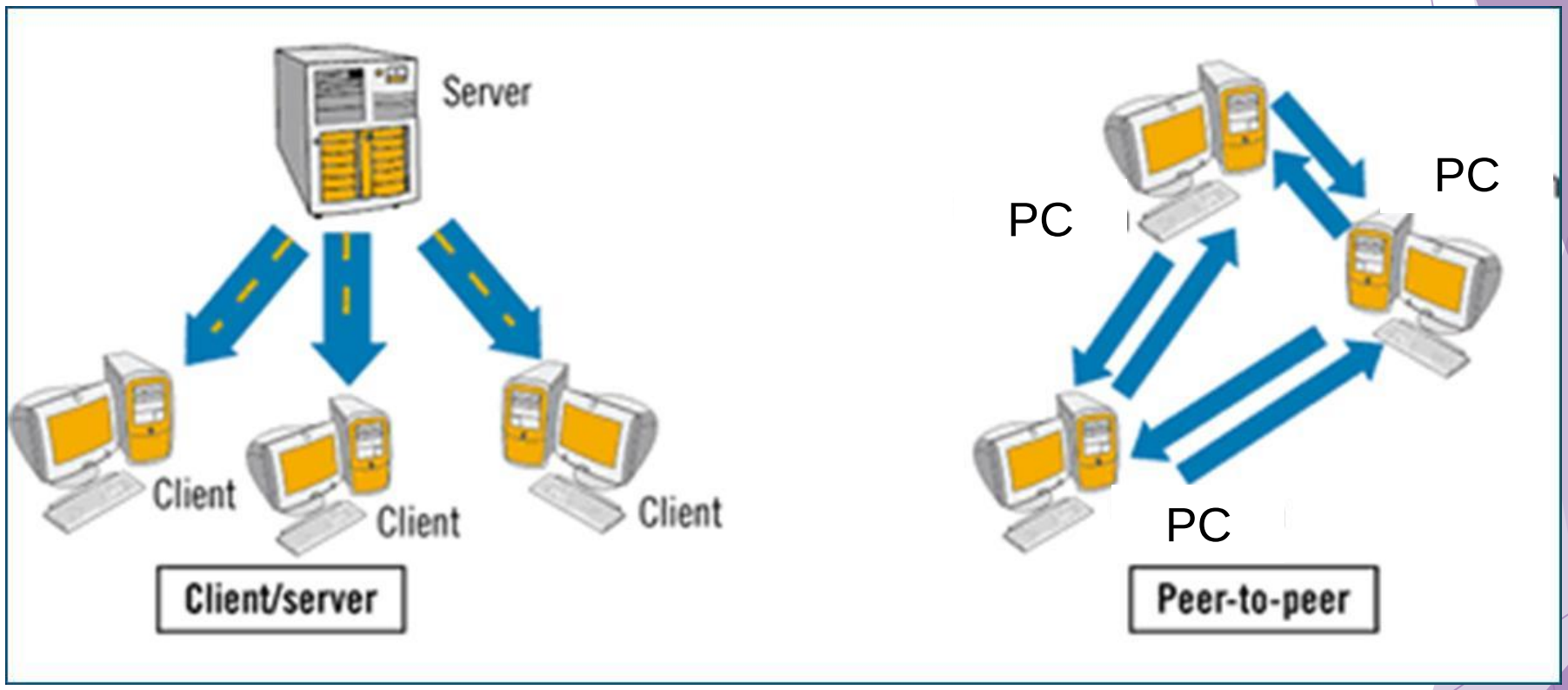

**POWERLINE ETHERNET BRIDGE FOR DESKTOP OR NOTEBOOK PC**

**FIGURE 7-26**
**Network adapters.** Network adapters are available in a variety of configurations.

(Source: Shelly et al.)

# Architecture

# Network Architecture




(Source: Shelly et al.)

# Networks (Structures)

## Client/Server

- Consists of clients, which are computers that request data, and servers, which are computers that supply data
- File servers act like a network-based shared disk drive
- Database servers store data but don't store programs

## Peer-to-Peer (P2P)

- All computers on the network communicate directly with each other without relying on a server

# Networks (Structures)

## Client/Server

- Clients - request data
- Servers - supply data

## Peer-to-Peer (P2P)

- All computers on the network communicate directly with each other without relying on a server

# Client & server architecture

- Client
  - Sends requests to servers (for a service)
  - Don’t communicate with other clients
    - web browsers don’t communicate with each other
- Server
  - Always on
  - Awaits requests for services
  - Fixed IP address
    - E.g. 192.168.1.2

# why use client / server ?

- 1970s and 1980s large mainframes used terminals with limited functionality
- client/server gives the opportunity for shared operations
- faster execution & cost savings with distributed processing
- although client PCs more expensive, PC-based servers were much cheaper
- easier to use with new graphical user interfaces & customization
  - develop their own applications and view data to their preference
  - graphics improved analysis of business data
- Centralised user administration, archiving and data security remained

# Peer to peer (P2P) architecture

- Direct communication between hosts/end systems called peers
- No server reliance
- Peers request & provide information
- Cost effective because:
  - No server infrastructure
  - No server bandwidth

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# client / server disadvantages

## system management problems

## High cost of ownership

- more that can go wrong
  - running different applications and modifications by end-users
  - more support staff

## Instability

- complex and involves integrating different hardware and software
- less reliable

# client / server disadvantages

## Performance

- processing graphics cause delays at the client end
- less power
  - e.g. travel agency = longer queues & poorer customer service.
  - many banks and travel agents have retained their mainframe-based systems where performance is critical

## Lack of worker focus

- the freedom of choice can lead to non-productive time-wasting

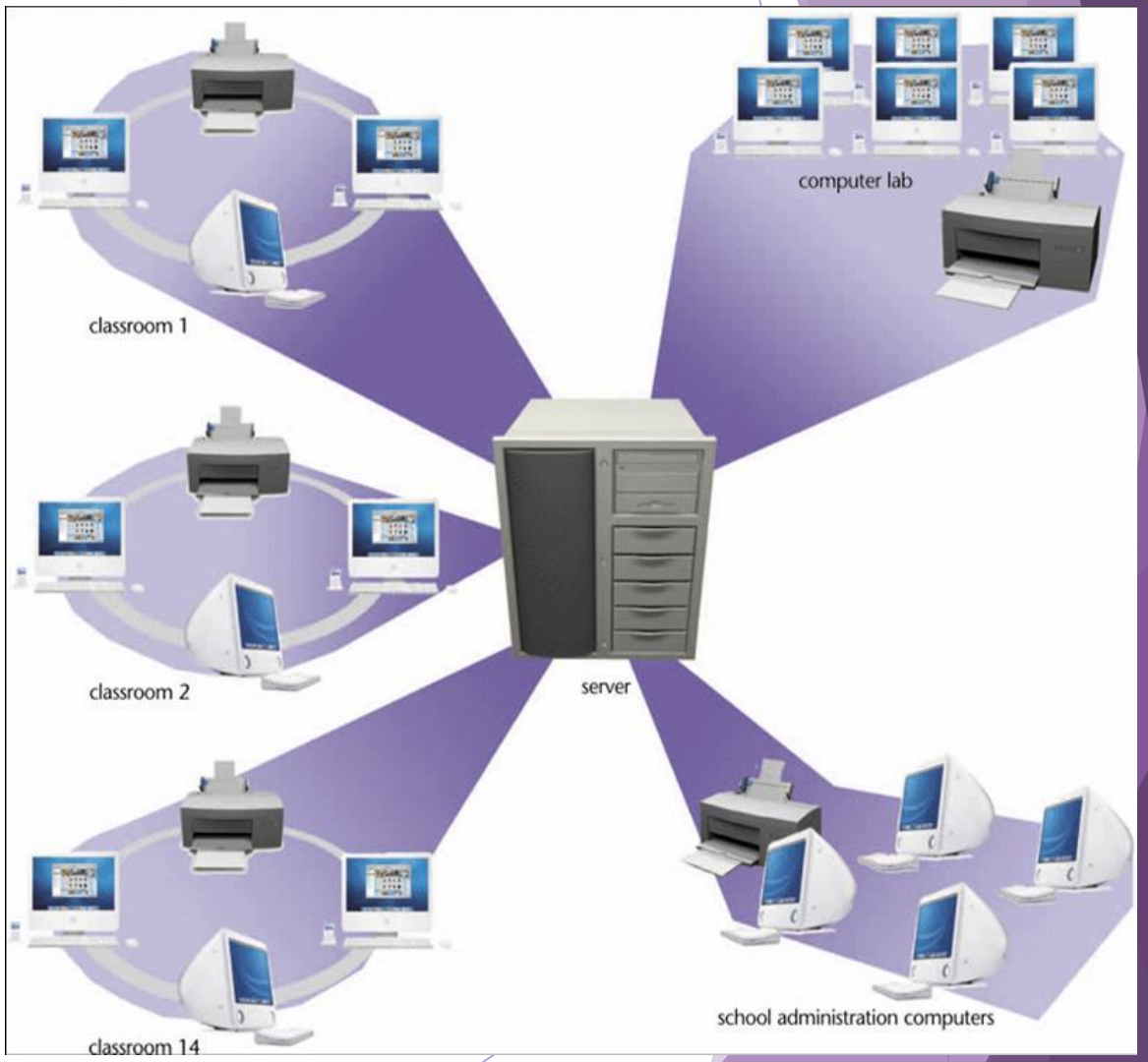
# WAN – Wide Area Network

Covers a wide geographic area, such as a country or the world

(Source: Shelly et al.)

# LAN – Local Area Network

Connects computers and devices in a limited geographic area such as an office, building, or group of nearby buildings




(Source: Shelly et al.)

# Types of Networks (other)

- MAN (Metropolitan Area Network)
  - Covers a city or a suburb
- HAN (Home Area Network)
  - Uses wired, cable, or wireless connections to link a household's digital devices
- PAN (Personal Area Network)
  - Uses short-range wireless technology to connect an individual's personal electronics like cellphone, PDA, MP3 player, notebook PC, tablet, and printer

# Networks

## Intranets

- An organization's private network that uses the infrastructure and standards of the Internet and the web

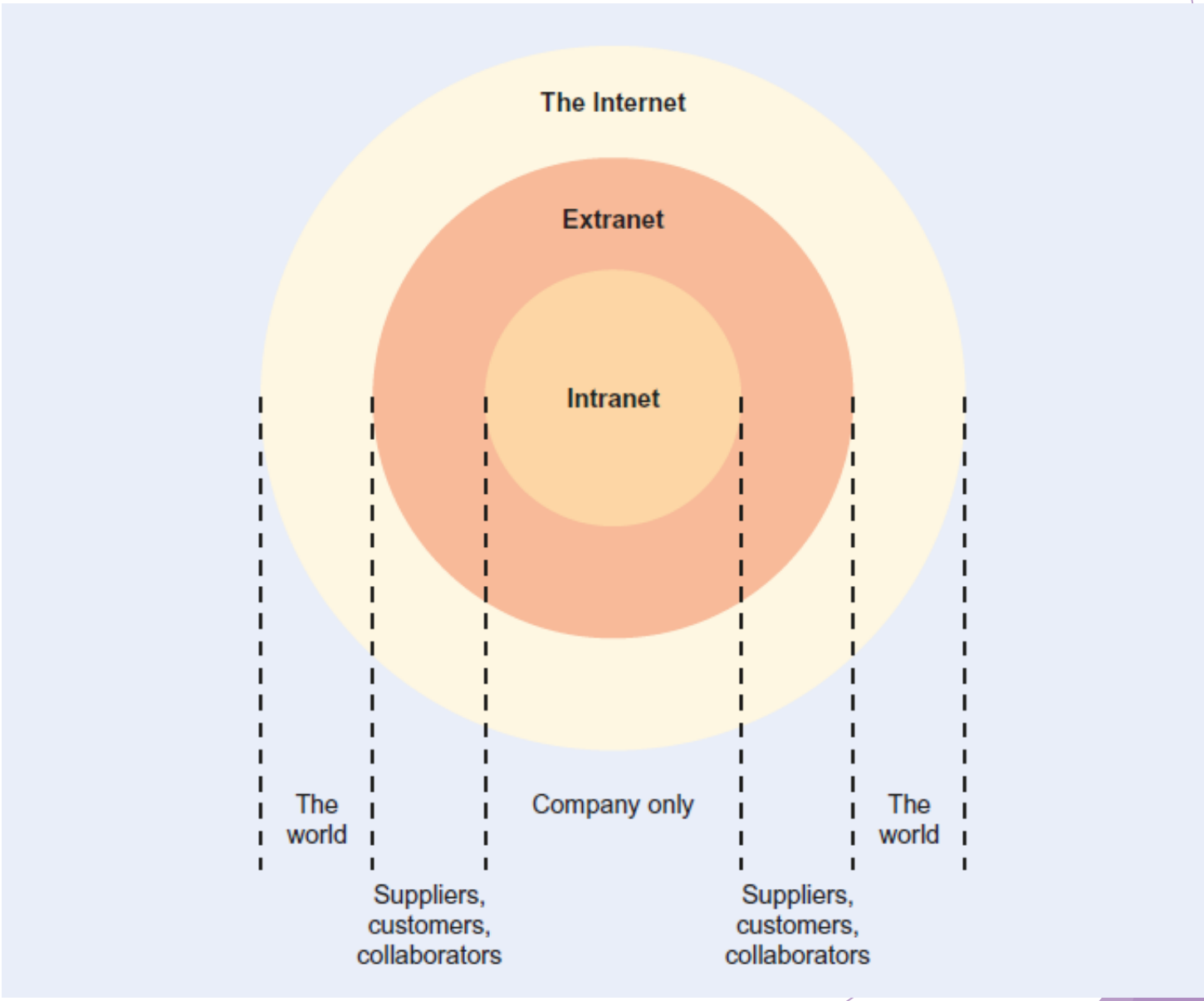
## Extranets

- Private internets that connect not only internal personnel but also selected suppliers and other strategic parties

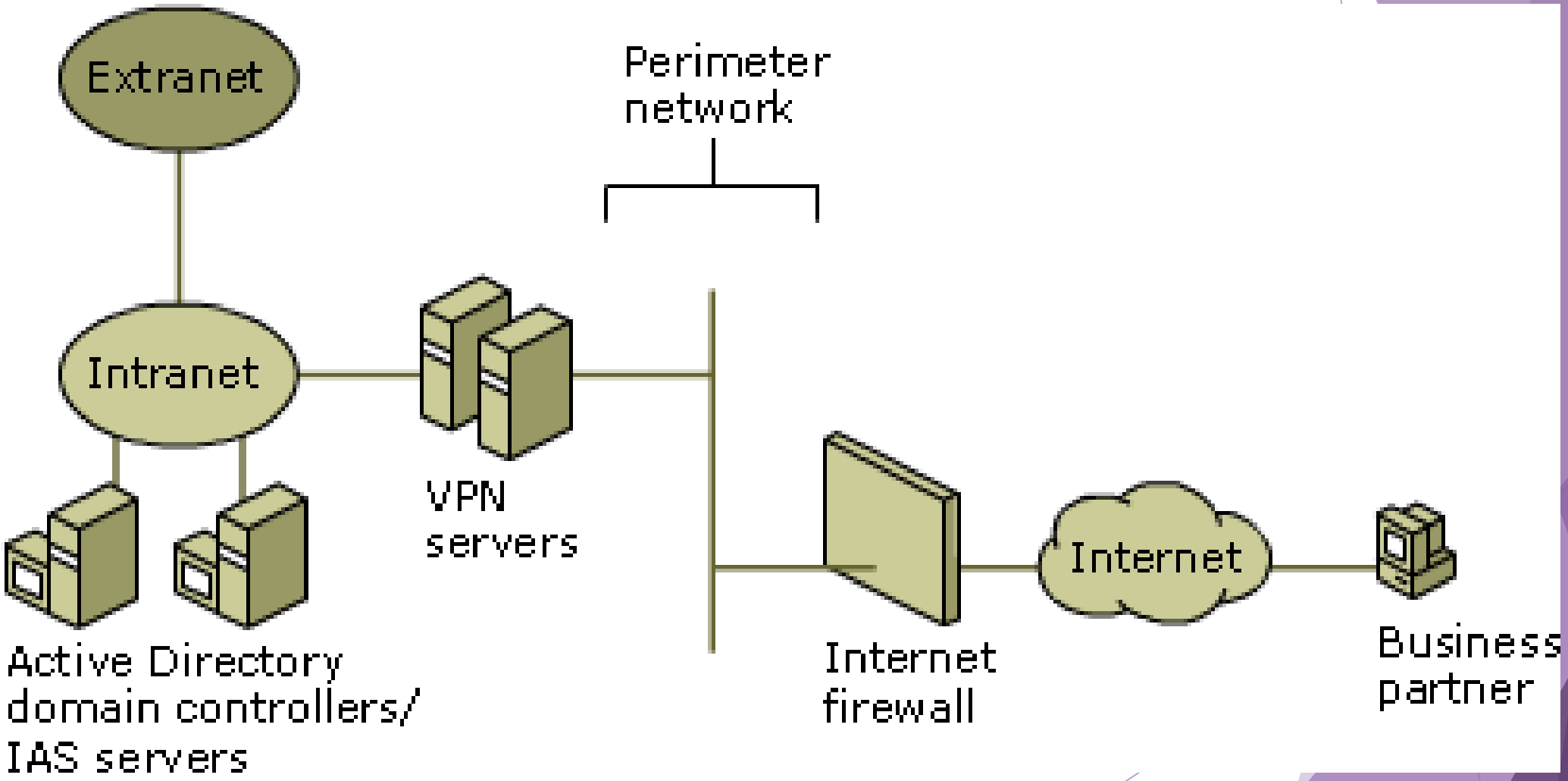
## Virtual Private Networks (VPN)

- Private networks that use a public network, usually the Internet, to connect remote sites

# Networks

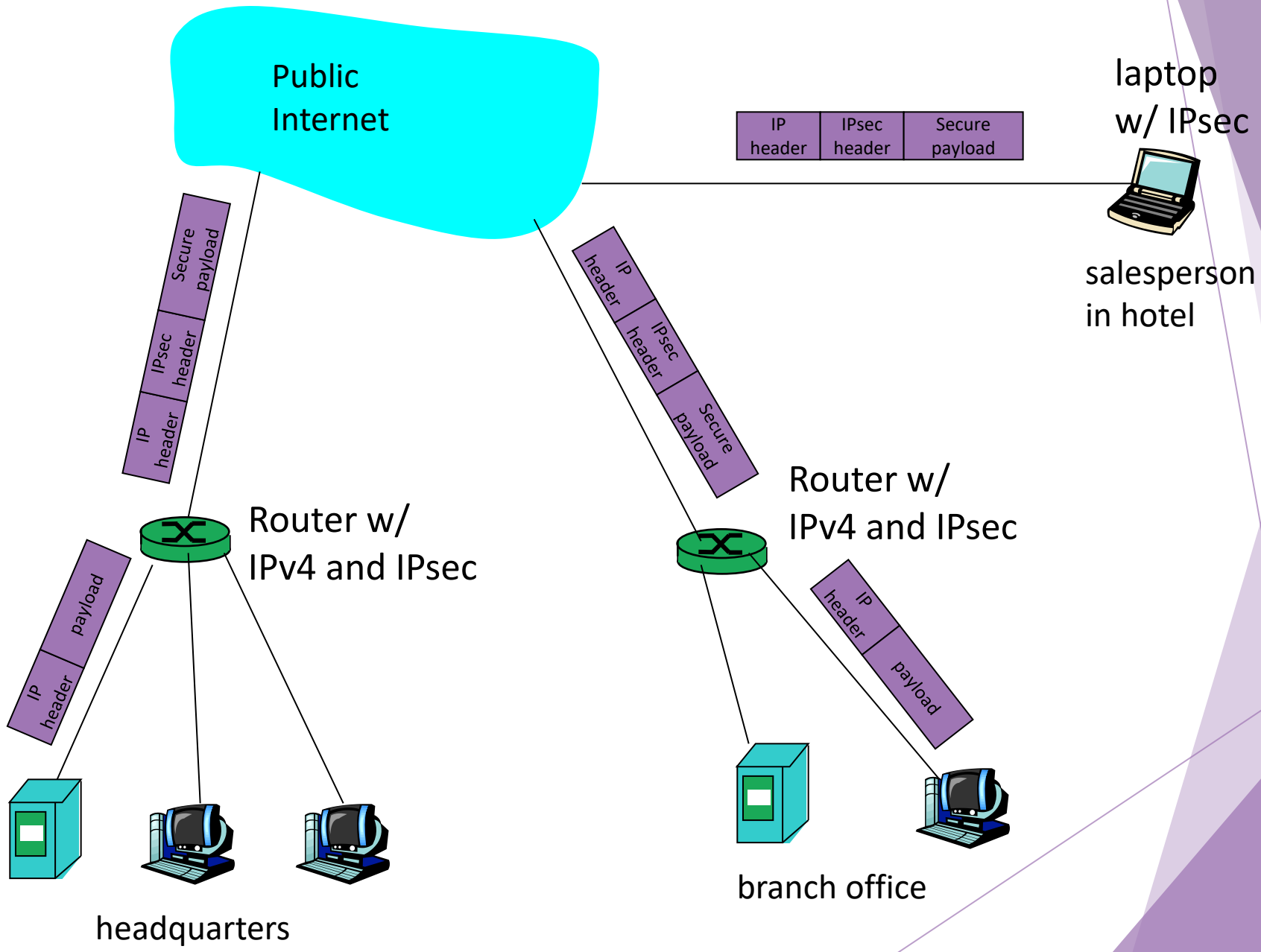

The Internet
Extranet
Intranet
The world
Suppliers, customers, collaborators
Company only
Suppliers, customers, collaborators
The world

# Networks




(source: Microsoft)

# Virtual Private Network (VPN)



# Advantages

# Advantages of a Network

- Facilitating communications
- Sharing hardware
- Sharing data and information
- Sharing software
- Transferring funds

# network advantages

*Reduce cost compared to traditional communications*.

- If information has to be sent to another location, the cost of sending is very low compared to other methods
- Meetings can be conducted by conferencing,
- Money & time is saved on transport and accommodation

# network advantages

*Reduce time for information transfer*.

- rapid transfer of information.
- operate 24 hours a day with people working in different time zones.
- product designs could be accelerated significantly.
- Customer service queries can also be turned around more quickly through the use of telecommunications.

# network advantages

*Enable sharing and dissemination of company information*.

- share information
- information accessible to all departments
- flow of information
- big benefits of intranets.
- information is always up to date

# network advantages

*Enable sharing of hardware resources such as printers, backup, processing power*

- cost of equipment such as printers or scanners to be shared between members
- a print server to schedule the jobs and store them while they are pending.
- security of the users' data increased
- server performs regular backups.
- administrative tasks made easier by centralising equipment

# network advantages

*Promote new ways of working*

- use group-working tools
- electronic data interchange

*Operate geographically separate businesses as one*.

Through using wide-area

- operated as one rather than as separate business units in different geographic locations,
- use common ways of working
- Sharing of information

*Restructure relationships with partners*.

different companies can also collaborate better.

# Advantages of a Network

| Advantages | Disadvantages |
| --- | --- |
| 1. Lower transaction costs due to less human input | 1. Overreliance on networks for mission-critical applications |
| 2. Improved sharing of information and hardware resources | 2. Cost of initial setup and administration |
| 3. Reduced costs through sharing hardware and software | 3. Disruption during initial setup and maintenance |
| 4. Reduced time for communication compared with traditional methods postal mail | 4. Reduced security due to more external access points to the network on wide-area networks and the Internet |
| 5. Increased security of data which are backed up on file servers. Increased security through restricting access via user names and passwords | |

# network disadvantages

- initial setup cost high,
- considerable period before the costs are paid off
- considerable practical difficulties.
- companies become reliant on networks, and
- breaks in service can be very disruptive.
- investment in network maintenance is vital
- reduced security more access points to sensitive data.

# servers

# servers

Servers are vital to an information system,

regulate the flow of information around the network

used to store large volumes of data

Network servers run the network operating system (NOS),

NOS = software that is used to manage the network,

*Maintain security*

restrict access to information with usernames

*Sharing of peripheral devices*

e.g. printers and tape drives

*Sharing of applications*

reduced costs with a ‘site license’

*Sharing of information*

stored within the server as files or in databases

maintained by the NOS

# servers

- applications and data managed better when stored on a server.
- ensure data security, Data quality, and easier to audit
- may be split between several servers to share the load (>20 users)
- all be linked by the network to ensure that the data are accessible by everyone
- can have separate file server, print server, password server and database server.

replication = same version of data exists on different servers.

distributed computing = sharing of functions across several computers

# servers

- blade servers are often dedicated to a single application
- storage and other facilities also provided in chassis
- substantial initial investment in hardware and implementation
- but have advantages with longer term benefits
  - space,
  - power consumption,
  - cable reduction,
  - reliability, and
  - economy of scale

# server – critical functions in an IS

*Performance*

- fast enough to handle all user requests
- built in margins for future growth in users and network traffic
  - suitable amount of memory,
  - a fast hard disk,
  - a fast processor

*Capacity*

- large hard disk capacity

*Resilience/fault tolerance*

- whole network does not ‘crash’
- use preventive measures
  - installing an uninterruptible power supply
  - running two disks in parallel
    - disk mirroring or
    - redundant array of inexpensive disks (RAID)

*Clustering*

- spread the load across different servers
- improving reliability and performance
- linking several servers
- enable parallel processing
  - share tasks between processors
- storage mirroring
  - store duplicate copies of data on different servers
  - improve performance and reduce the risk of failure

# types of servers

| Type of server | Purpose |
|---|---|
| Network | Contains functions to manage the network resources and control user access |
| File | This term is sometimes used to refer to network server functions. It can also indicate that users' files such as documents and spreadsheets are stored on the network server |
| Print | Dedicated print servers have a queue of all documents for which print requests have been made, often combined with file or network servers |
| Fax | Used to route incoming and outgoing faxes received and sent from the user's desktop |
| Mail | Stores and forwards e-mail messages |
| Database | Used to store data and provide the software to process data queries supplied by users, often accessed by Structured Query Language (SQL) |
| Application | Used to store programs such as spreadsheet or bespoke applications run by end-users on their PCs. This removes the need to store each application on every user's hard disk |
| Communications | Manages connections with other networks in a WAN configuration. Sometimes known as 'gateways' and attached to other gateway devices such as routers and firewall servers |
| Blade | A computer configuration where elements such as power, cooling, storage are largely provided in an outer housing or chassis. The chassis provides these services to a number of specialised, stripped down motherboard units – the blade servers – each one a complete computer or service device containing only vital processing and storage elements. |

# Network Operating system (NOS)

control the access to and flow of information around a network

provides the following functions:

- access control or security with user accounts
- file and data sharing
- communication between users
- sharing of devices.

most popular: Novell Netware and IBM LAN Manager

Also part of UNIX OS in UNIX-based servers

used by Sun Microsystems, Hewlett-Packard and IBM)

NOS features now in Microsoft Windows

# Thank you!

any questions?