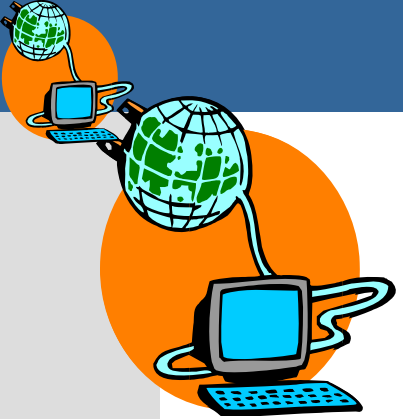


# Data Communications and Computer Networks

## A Business User's Approach

## Chapter 1

## Introduction to Computer Networks and Data Communications

Parviz Kermani
Polytechnic University

# Acknowledgement


- The original contents of this presentation were provided by the publisher, “Course Technology”. Additional materials from other sources were added
  - William Stallings, “Business Data Communications, 4th Edition”, Prentice Hall publisher

# Objectives

After reading this chapter, you should be able to:

- Define the basic terminology of computer networks
- Recognize the individual components of the big picture of computer networks
- Outline the basic network configurations
- Cite the reasons for using a network model and explain how they apply to current network systems

# Objectives (continued)

- List the layers of the OSI model and describe the duties of each layer
- List the layers of the TCP/IP protocol suite and describe the duties of each layer
- Compare the OSI model and TCP/IP protocol suite and list their differences and similarities

# Introduction

- Who today has *not* used a computer network?

- Mass transit, interstate highways, 24-hour bankers, grocery stores, cable television, pagers, mobile telephones, most businesses and schools, and other retail outlets can support some form of computer networks.

# The Language of Computer Networks

- Computer network - an interconnection of computers and computing equipment using either wires or radio waves over small or large geographic distances
- Divided in broad categories
  - Wide area network
  - Metropolitan area network
  - Local area network
  - Personal area network
  - Others….

# The Language of Computer Networks

- Wide area network - a large network that encompasses parts of states, multiple states, countries, and the world
- Metropolitan area network - networks that serve an area of 3 to 30 miles - approximately the area of a typical city
- Local area network - networks that are small in geographic size spanning a room, building, or campus
- Personal area network – a network of a few meters, between wireless devices such as PDAs, laptops, and similar devices

# The Language of Computer Networks

- Data communications - the transfer of digital or analog data using digital or analog signals
- Voice network - a network that transmits telephone signals
- Data network - a network that transmits mainly computer data

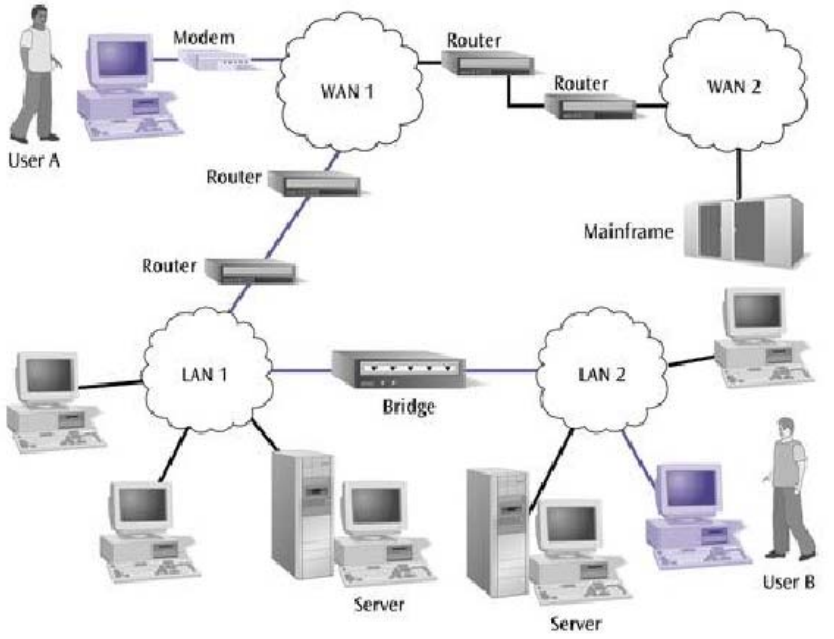
# The Language of Computer Networks

- Telecommunications - the study of telephones and the systems that transmit telephone signals
- Network management - the design, installation, and support of a network and its hardware and software

# The Big Picture of Networks

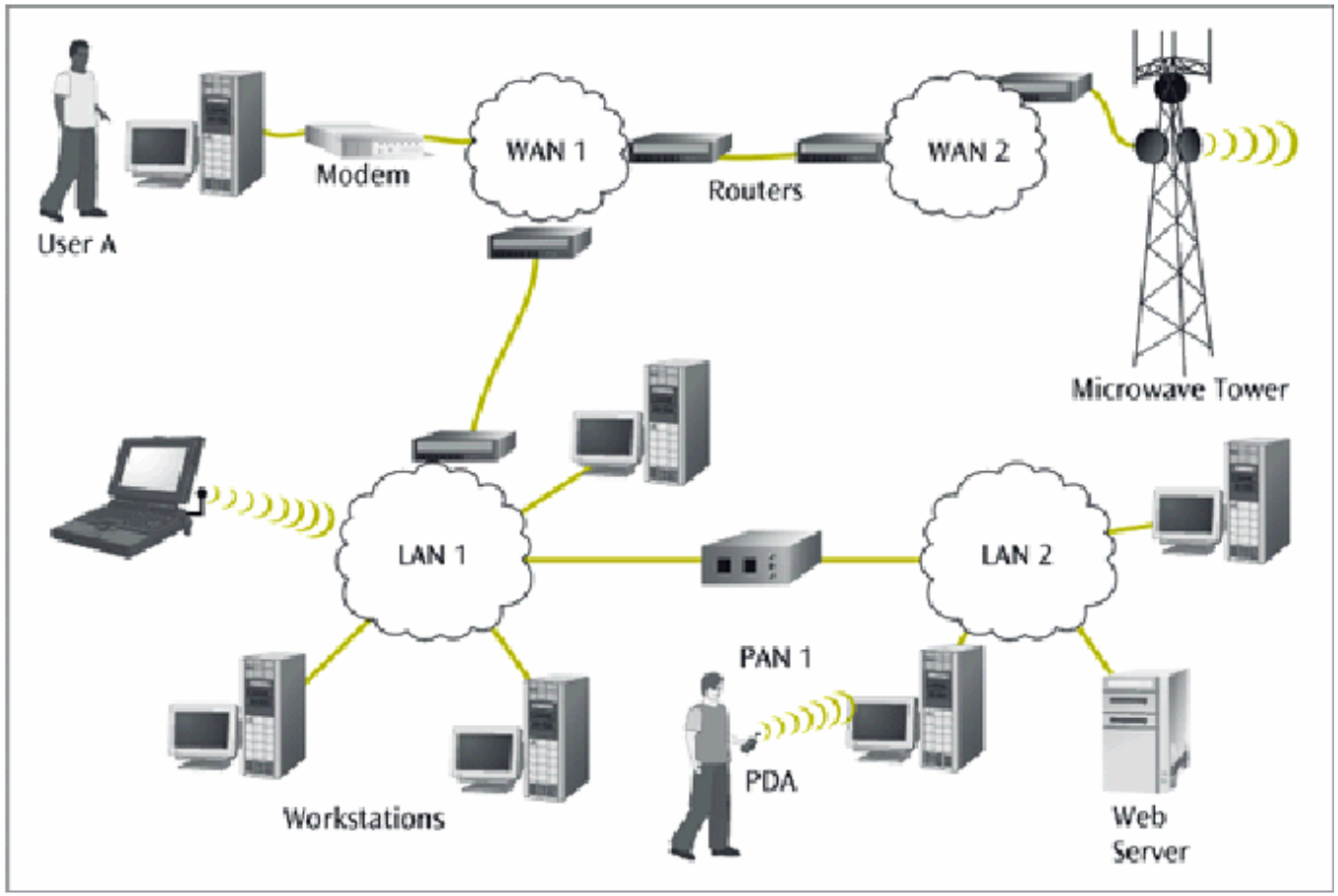
Networks are composed of many devices, categorized as:

- End-systems
  - Workstations
  - Servers
  - Nodes
- Communication Links
- Communication Nodes
  - Bridges
  - Routers
  - Hubs and switches



# A Computer Network

Figure 1-1
*An overall view of the interconnection between different types of networks*




- Workstations
- Servers
- Bridges
- Routers
- Hubs and witches
- Nodes

# Computer Networks- Basic Configuration

- Computer terminal to mainframe computer
- Microcomputer to mainframe computer
- Microcomputer to local area network
- Microcomputer to Internet
- Local area network to local area network

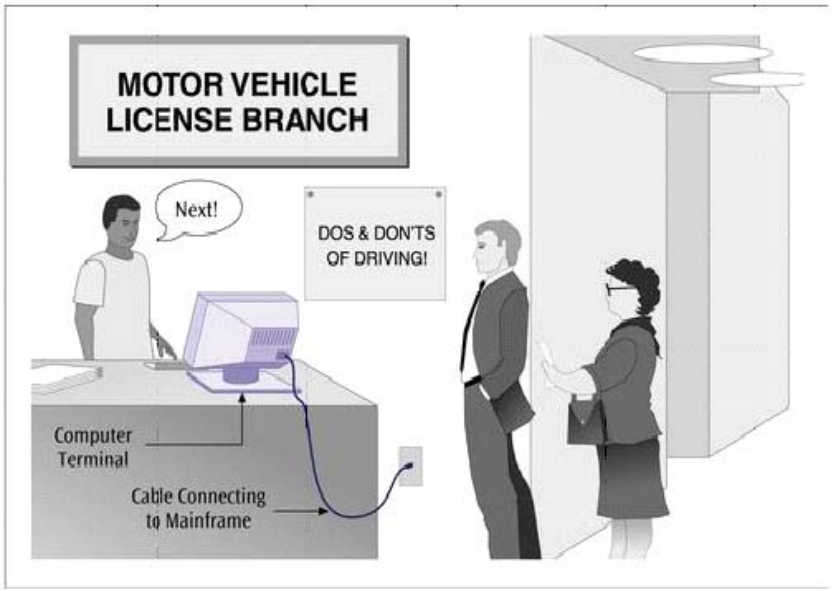
# Computer Networks- Basic Configuration

- Local area network-to-metropolitan area network
- Personal area network-to-workstation
- Local area network to wide area network
- Sensor to local area network
- Satellite and microwave
- Wireless and wired telephone to network

# Computer Networks- Basic Configuration

## Computer terminal to mainframe computer

- Predominant form in 60s and 70s
- Used in many types of businesses for data entry and data retrieval.
- Usually involves a low-speed connection.

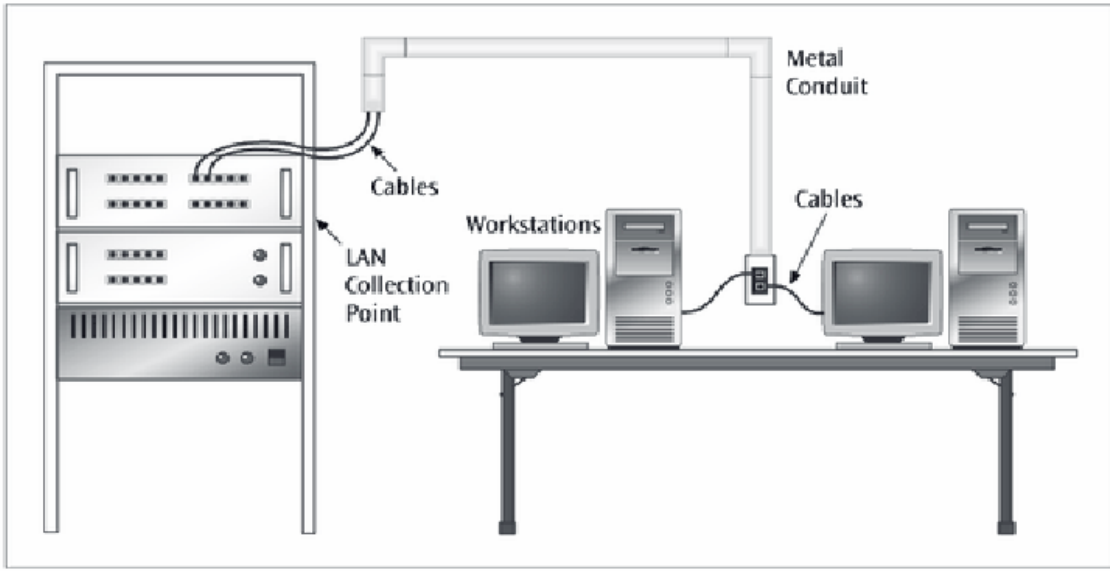


# Computer Networks- Basic Configuration

## Microcomputer to local area network

- Very common throughout business and academic environments.
- Typically a medium- to high-speed connection.

**Figure 1-3**
*A microcomputer lab, showing the cabling that exits from the back of a workstation and runs to a LAN collection point*

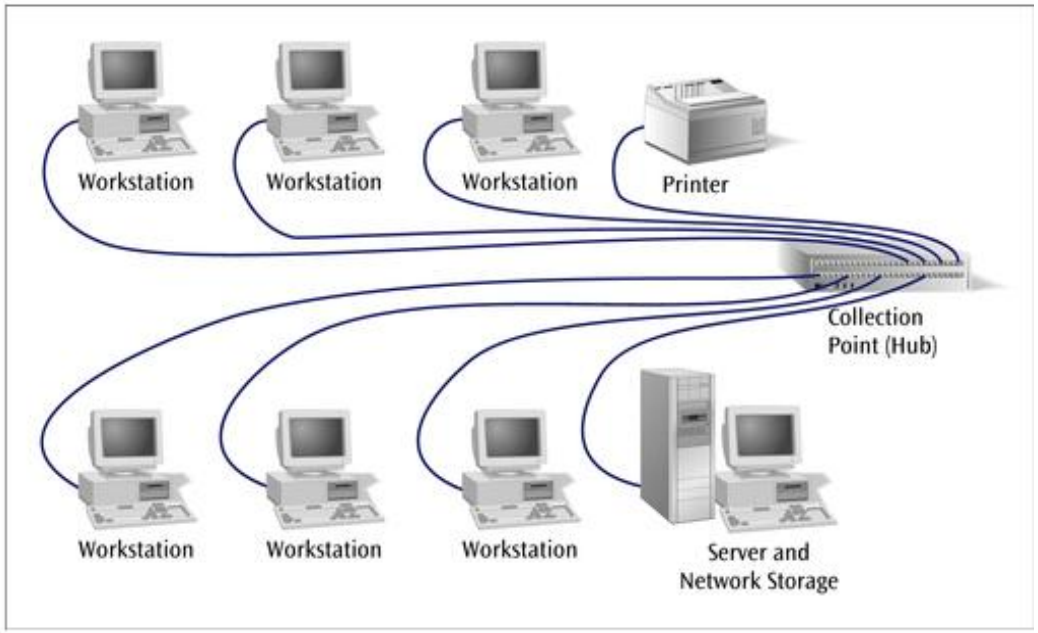


# Computer Networks- Basic Configuration

## Microcomputer to local area network

- Physical configuration
- The *network* resides in the hub

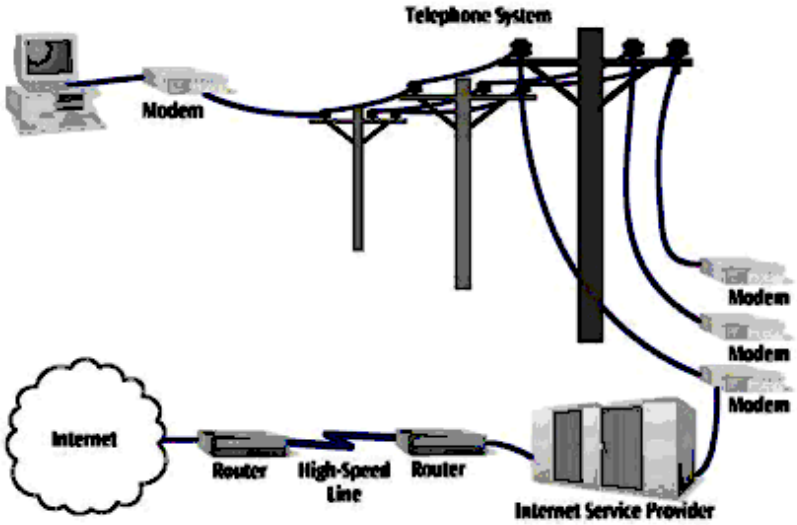
**Figure 1-3**
*A microcomputer lab, showing the cabling that exits from the back of a computer and runs to a collection point of the LAN in the back of the room*



# Computer Networks- Basic Configuration

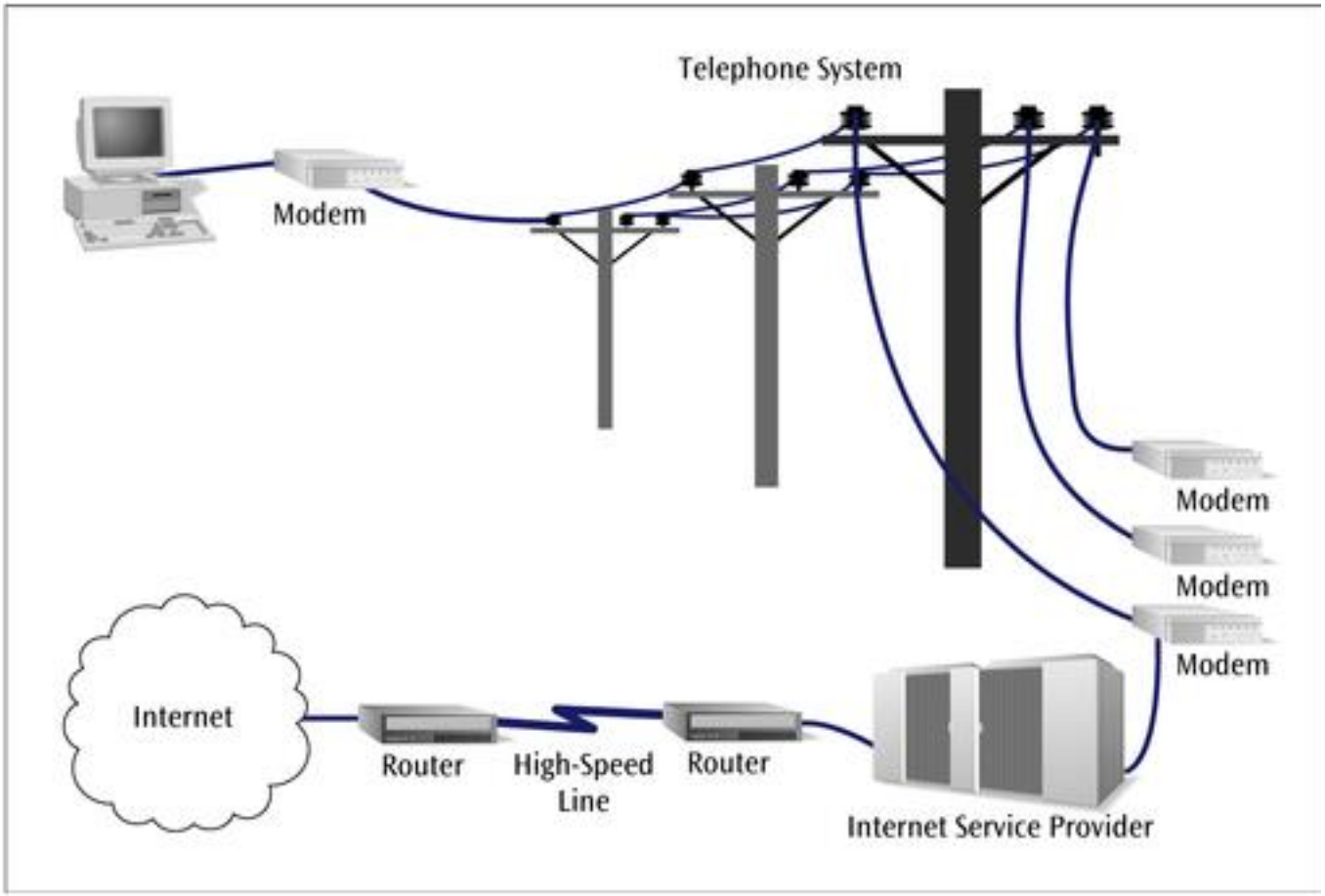
## Microcomputer-to-Internet

- Very popular with home users.
- Typically a modem is used to connect user's microcomputer to an Internet Service Provider
- Newer technologies such as DSL and cable modems are replacing modems.



# Computer Networks- Basic Configuration

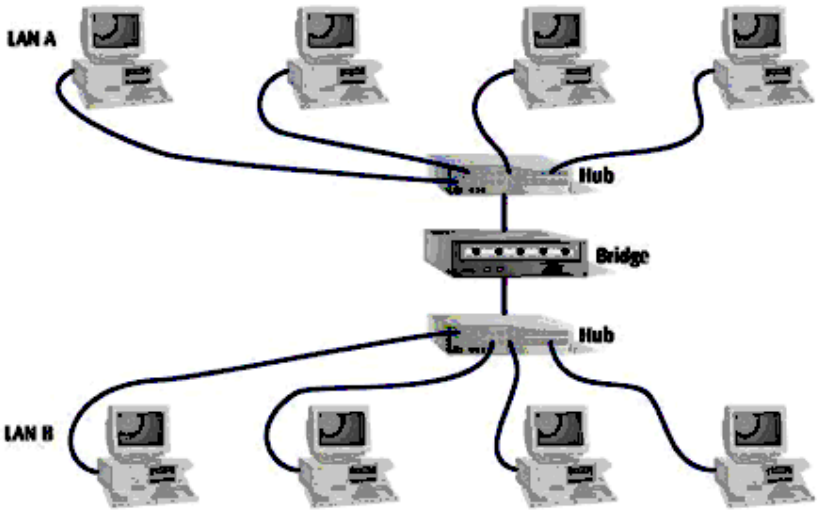
**Figure 1-4**
*A microcomputer sending data over a telephone line to an Internet service provider and into the Internet*



# Computer Networks- Basic Configuration

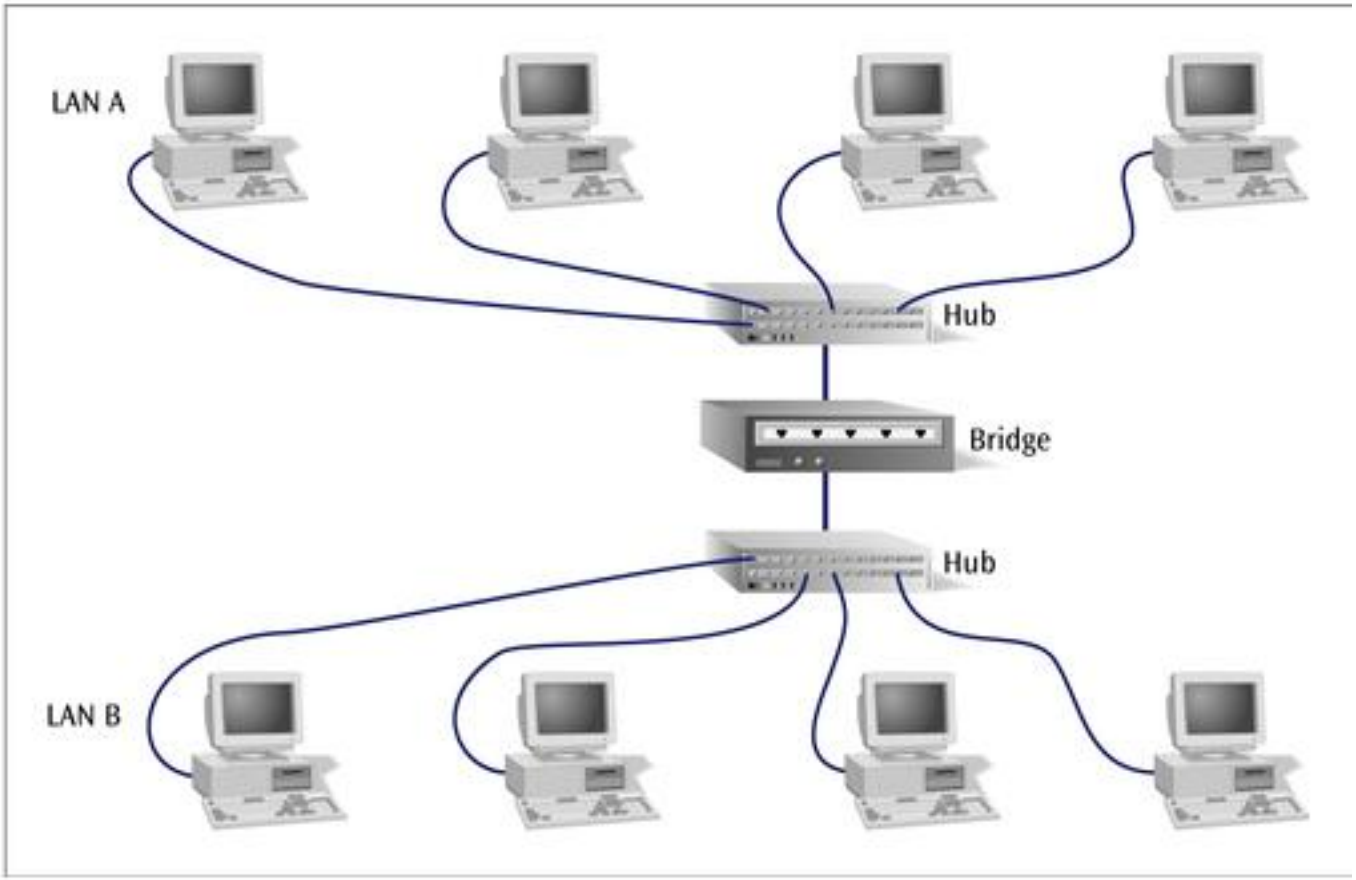
## Local area network-to-local area network

- Found in businesses and schools that have two or more LANs and a need for them to intercommunicate
- The bridge is a typical device used to interconnect LANs.
- Bridge-like device can filter frames



# Computer Networks- Basic Configuration

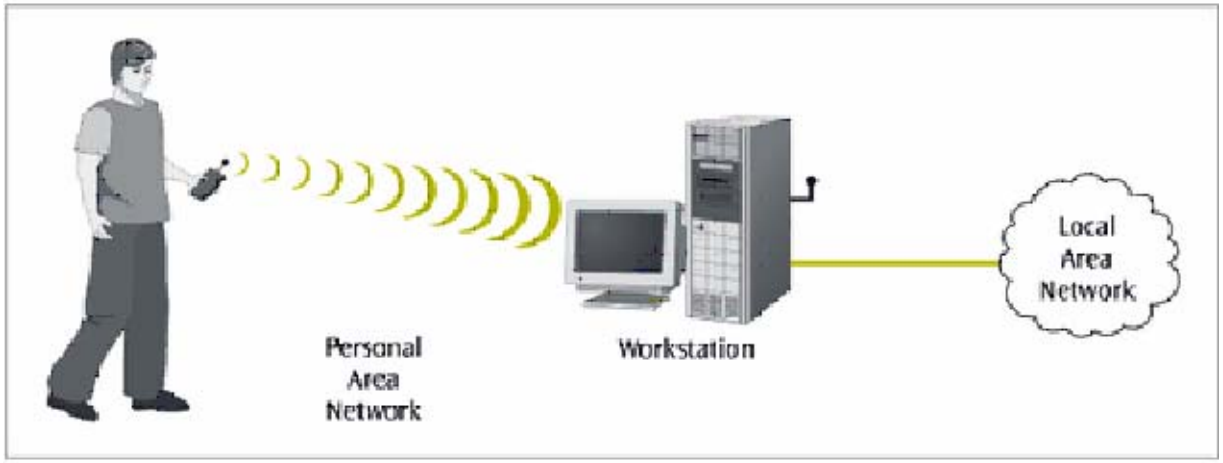
**Figure 1-5**
*Two local area networks connected by a bridge*



# Computer Networks- Basic Configuration

## Personal Area Network-to-Workstation

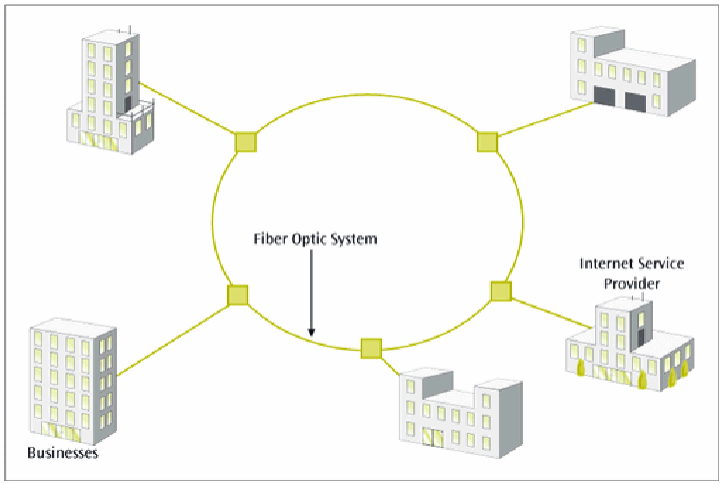
- Interconnects wireless devices such as PDAs, laptops, and music playback devices
- Used over a short distance such as a few meters



# Computer Networks- Basic Configuration

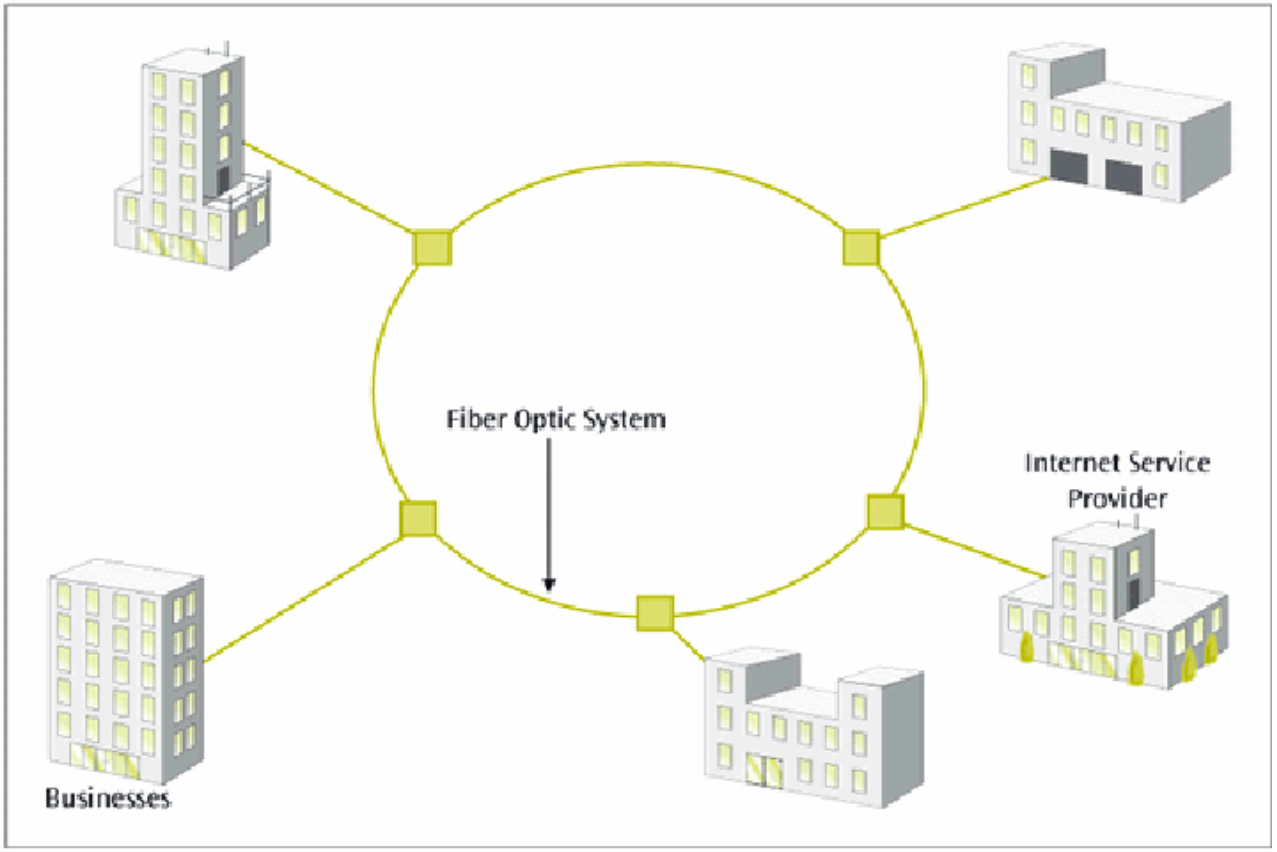
## Local Area Network-to-Metropolitan Area Network

- Used to interconnect companies (usually local area networks) to networks that encompass a metropolitan city
- High speed networks with redundant circuits



# Computer Networks- Basic Configuration

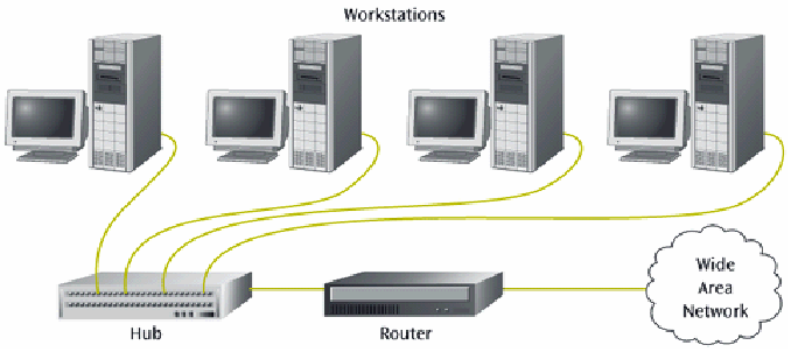
**Figure 1-7**
*Businesses interconnected within a large metropolitan area via a metropolitan area network*



# Computer Networks- Basic Configuration

## Local area network-to-wide area network

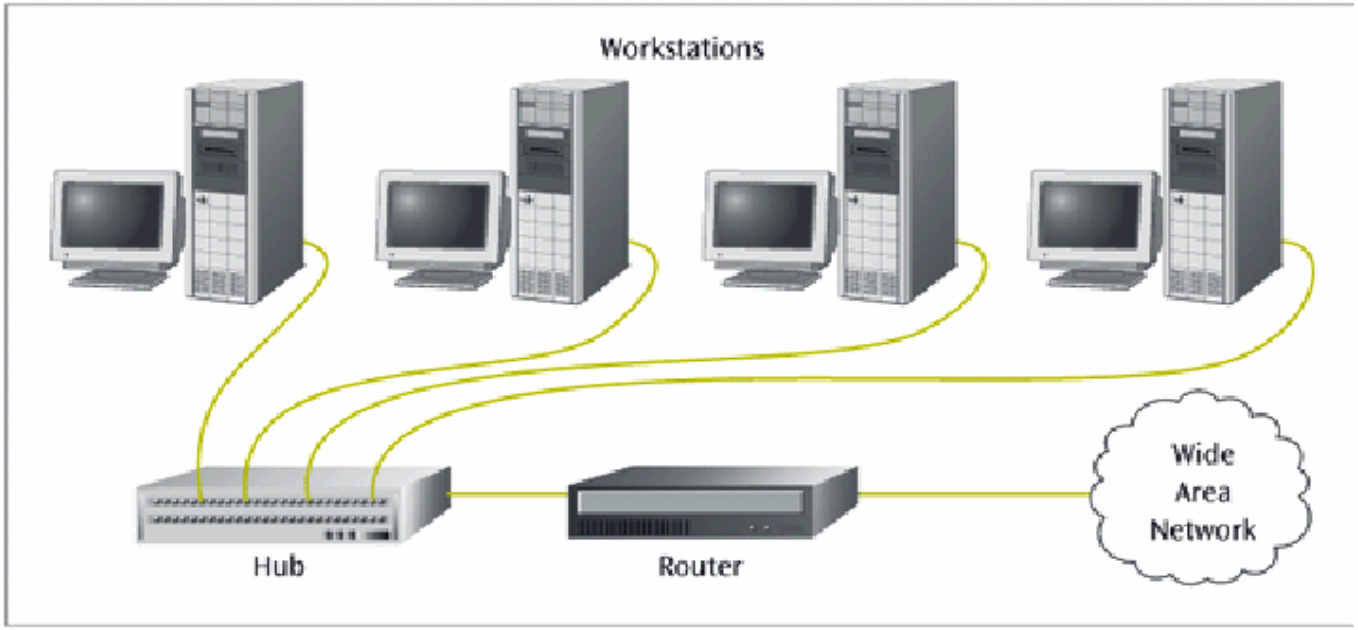
- One of the best ways to interconnect a user on a LAN workstation to the Internet (a wide area network).
- A router is the typical device that performs LAN to WAN connections.
- Routers are more complex devices than bridges/switches



# Computer Networks- Basic Configuration

## Local area network-to-wide area network

**Figure 1-8**
*Local area network-to-wide area network configuration*



# Computer Networks- Basic Configuration

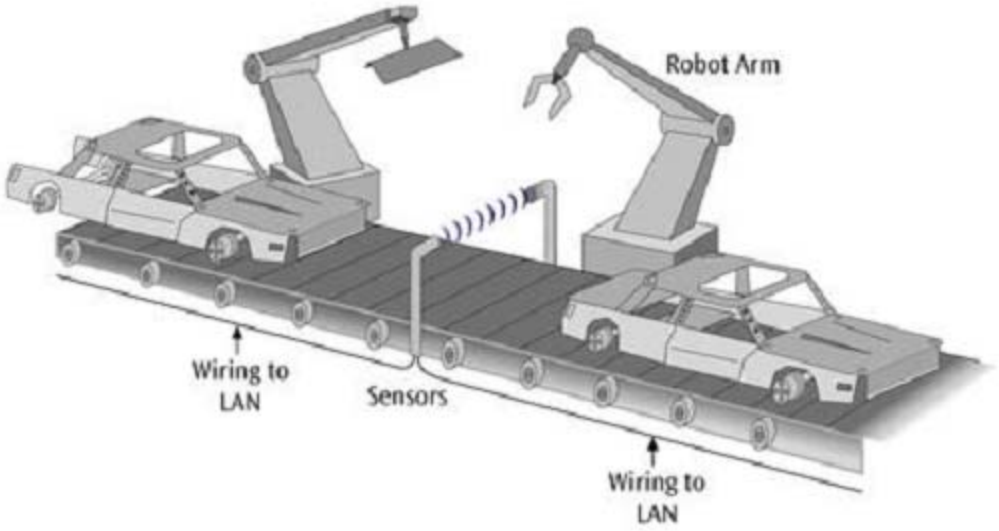
## Wide Area Network-to-Wide Area Network

- High-speed routers and switches are used to connect one wide area network to another
- Thousands of wide area networks across North America
  - Many interconnected via these routers and switches

# Computer Networks- Basic Configuration

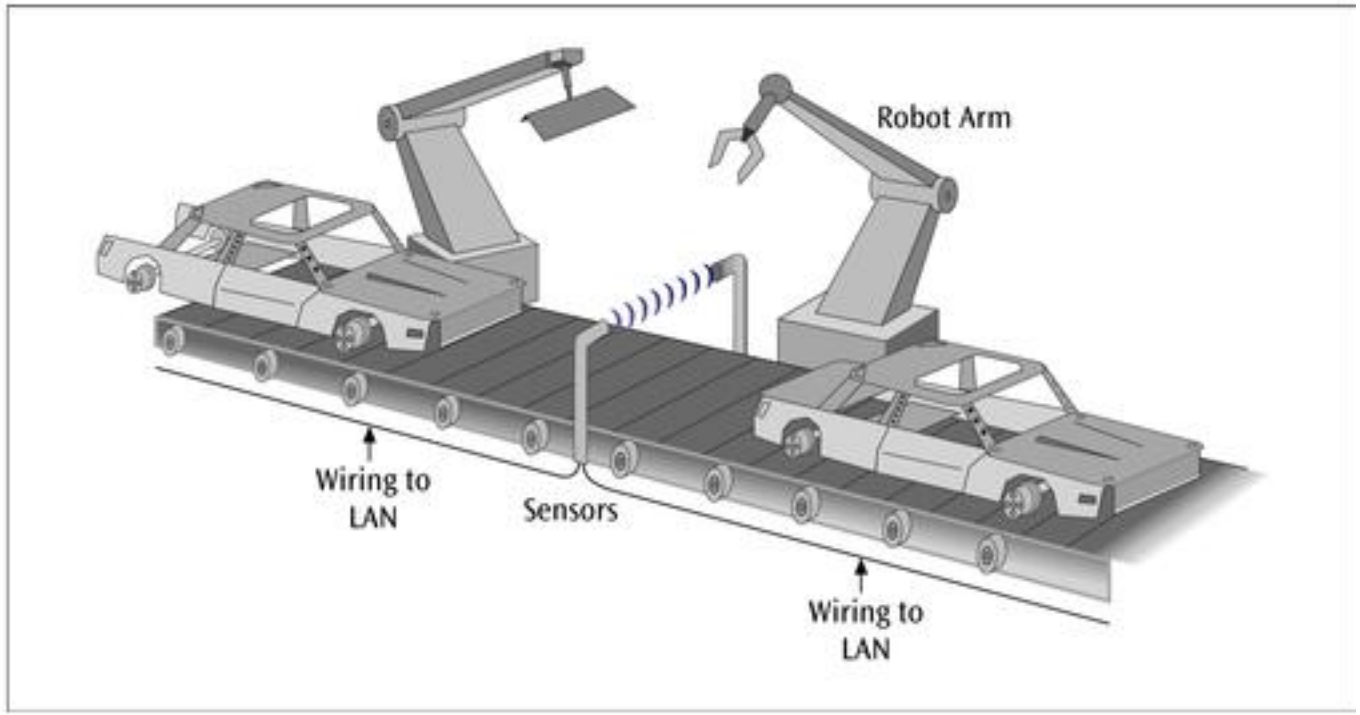
## Sensor-to-Local Area Network

- Not all local area networks deal with microcomputer workstations
- Often found in industrial environments.
- Assembly lines and robotic controls depend heavily on sensor-based local area networks.



# Computer Networks- Basic Configuration

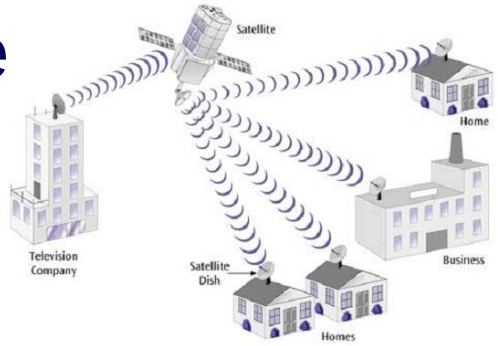
**Figure 1-7**
*An automobile moves down an assembly line and triggers a sensor*



# Computer Networks- Basic Configuration

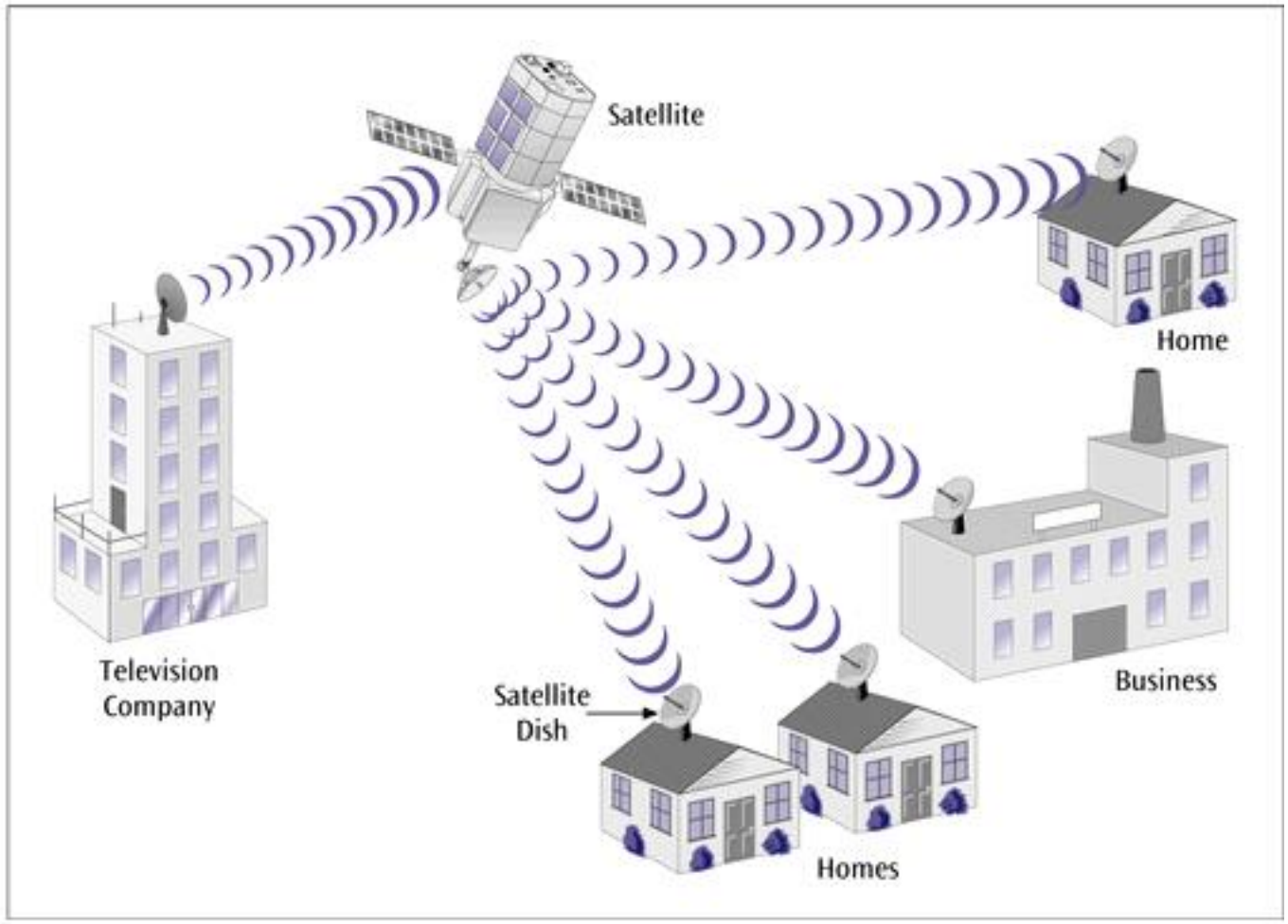
## Satellite and microwave

- Long distance wireless connections
- Many types of applications including long distance telephone, television, radio, long-haul data transfers, and wireless data services.
- Typically expensive services but many companies offer competitive services and rates.



# Computer Networks- Basic Configuration

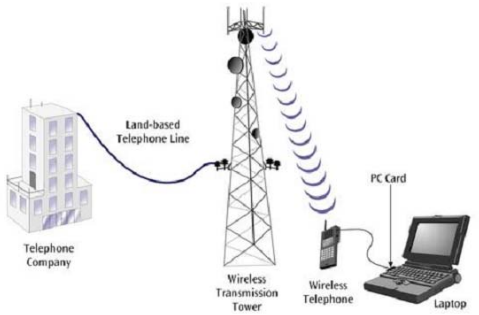
**Figure 1-8**
*Example of a television company using a satellite system to broadcast television services into homes and businesses*



# Computer Networks- Basic Configuration

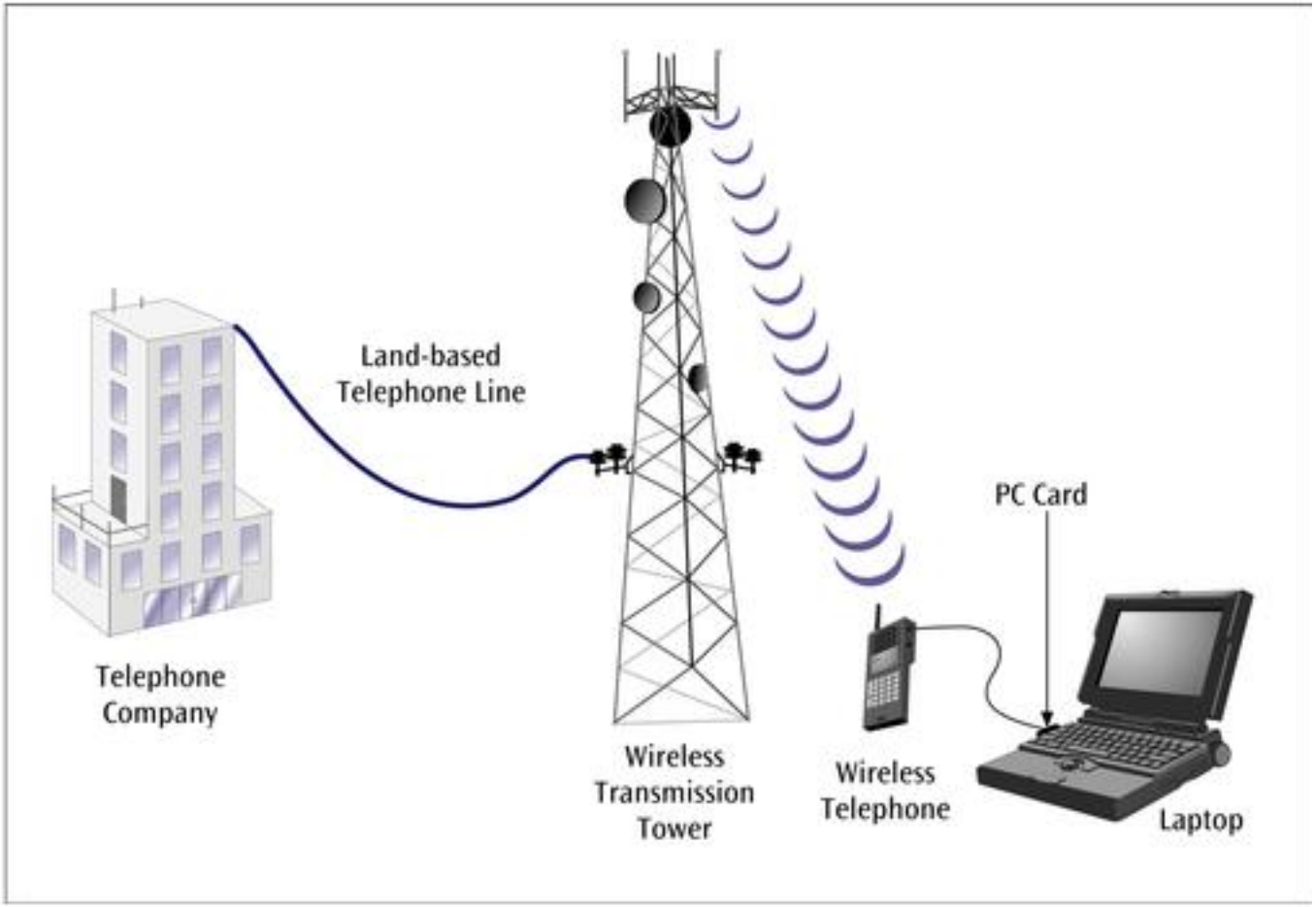
## Wireless/Mobile Telephone

- Quickly expanding market across the U.S. and world.
- First generation analog services and second generation PCS services available in most areas and under many types of plans.
- Third generation services beginning to appear in Europe and Asia.



# Computer Networks- Basic Configuration

**Figure 1-9**
*An example of a laptop computer connected to a wireless telephone system to transmit and receive data*



# Network Architecture Models

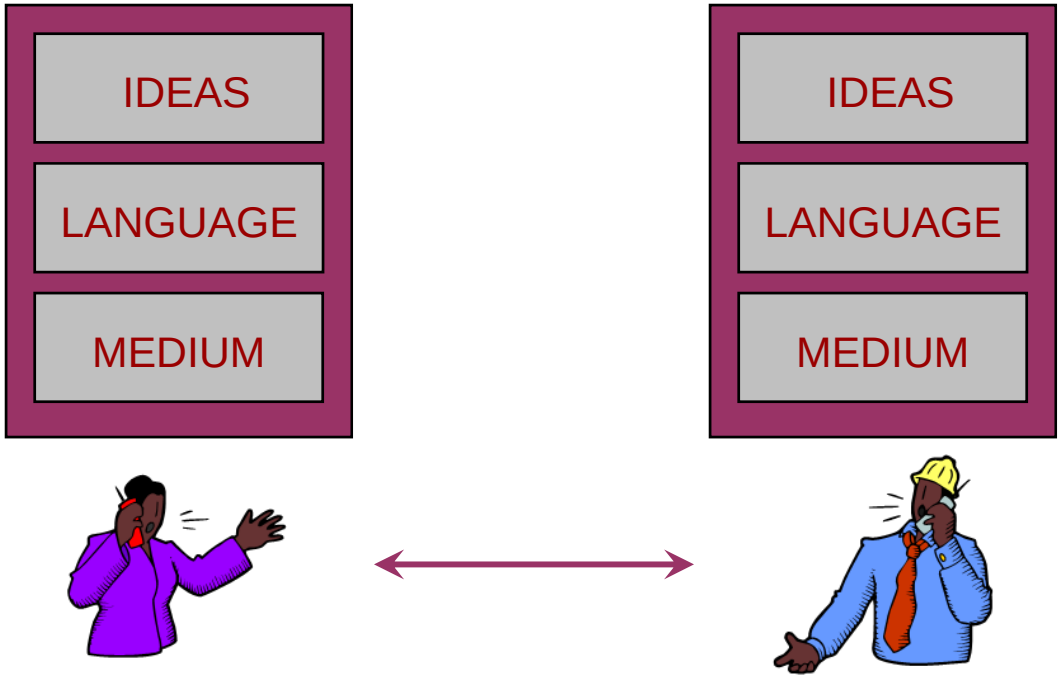
- A reference model that describes the layers of hardware and software necessary to transmit data between two points
- Reference models are necessary to increase the likelihood that different components from different manufacturers will converse
- There are two models that are required learning (other models also exist):
  - The classical OSI Model, and
  - The Internet Model

# Layered Architecture

- Networks are complex system
- It is difficult (if not impossible) to define the entire system without breaking it into building elements
- For the sake of definition, a network is defined in terms of inter-related layers

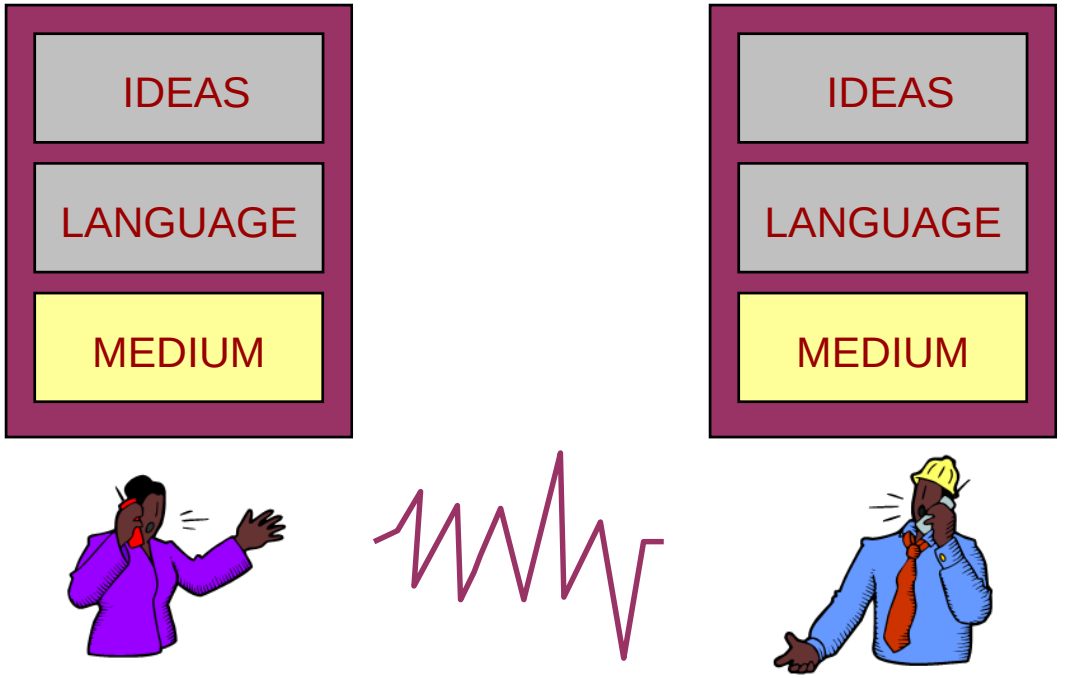
# Human Communication Analogy

- A division of functions performed during human communication



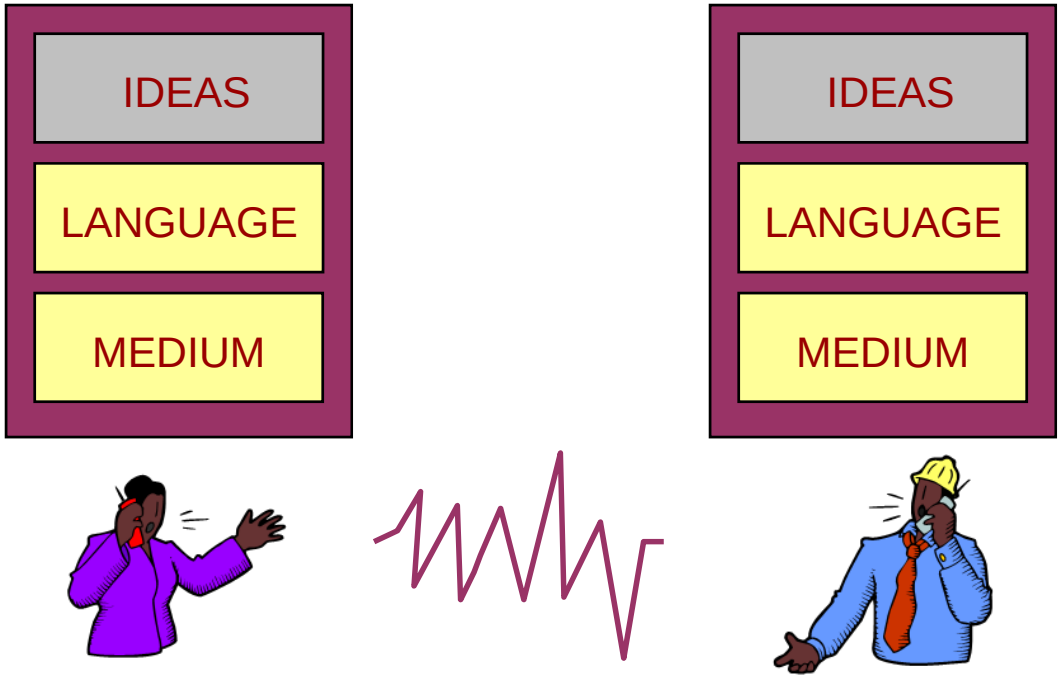
# Medium Layer: Human Speech

- In the *medium* layer, the two parties should agree on a common communication medium
  - If one is speaking and the other is deaf, no spoken communication can take place



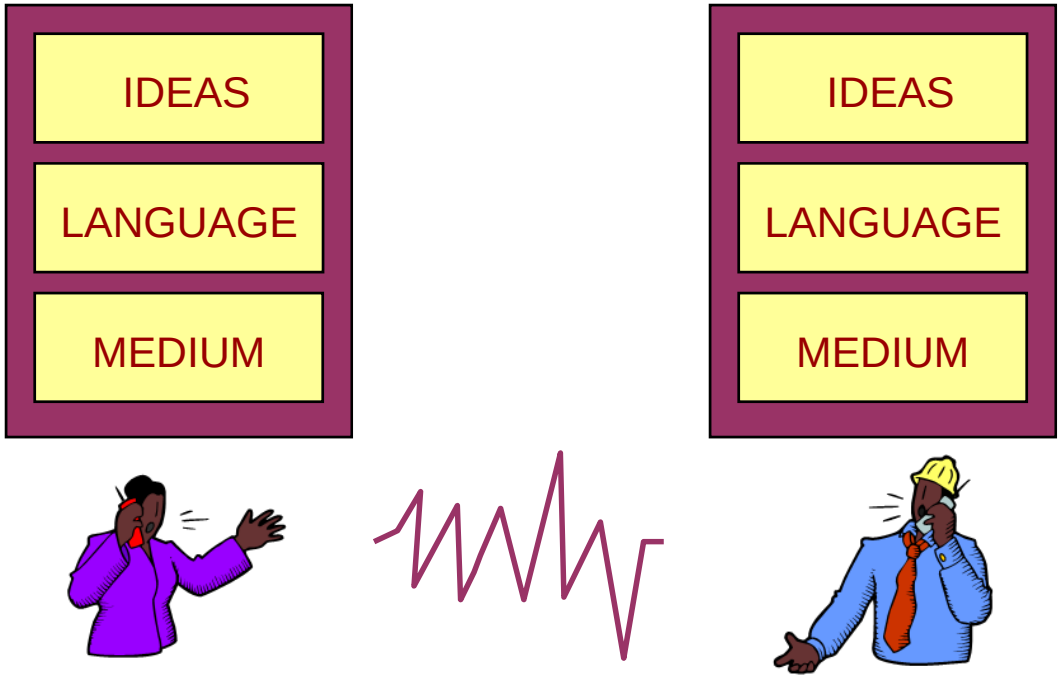
# Language Layer: English

The parties must agree on a language understood by both.



# The Idea Layer: LAN

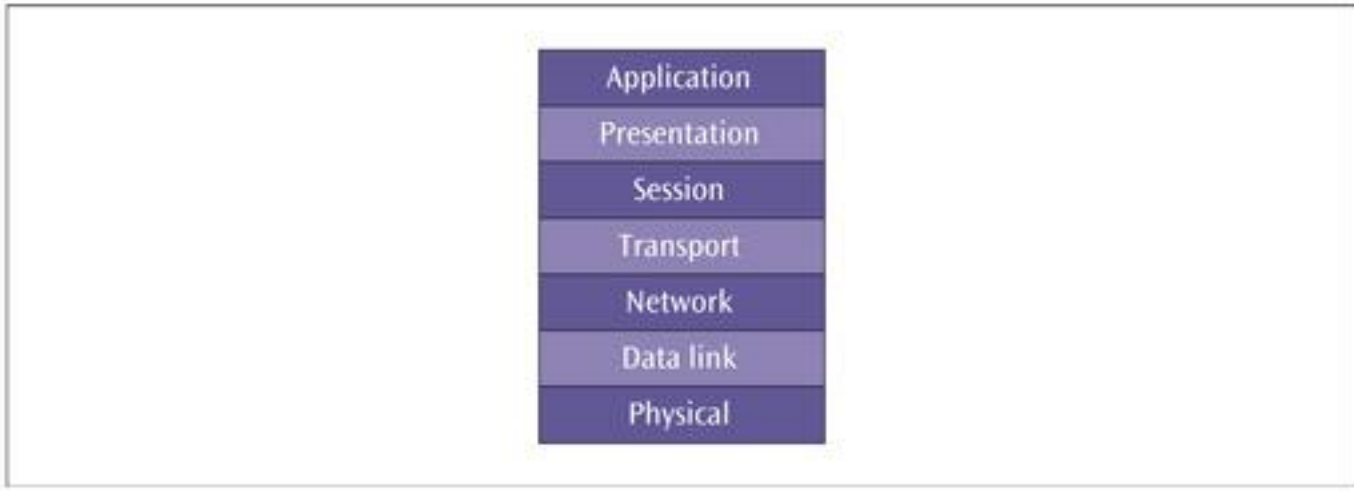
The parties should have a common idea on what the conversation is about.



# Network Architecture Models

- The OSI model's seven layer

**Figure 1-11**
*The seven layers of the OSI model*



# Network Architecture Models


- 1-Physical layer - handles the transmission of bits over a communications channel. Includes voltage levels, connectors, media choice, modulation techniques.

- 2-Data link layer - responsible for taking the data and transforming it into a *frame* with header, control and address information, and error detection code.

# Network Architecture Models


- 3-Network layer - responsible for creating, maintaining and ending network connections.
  - Transfers a data packet from node to node within the network.
- 4-Transport layer - provides an end-to-end, error-free network connection.
  - Makes sure the data arrives at the destination exactly as it left the source.

# Network Architecture Models


- 5-Session layer - responsible for establishing sessions between applications.

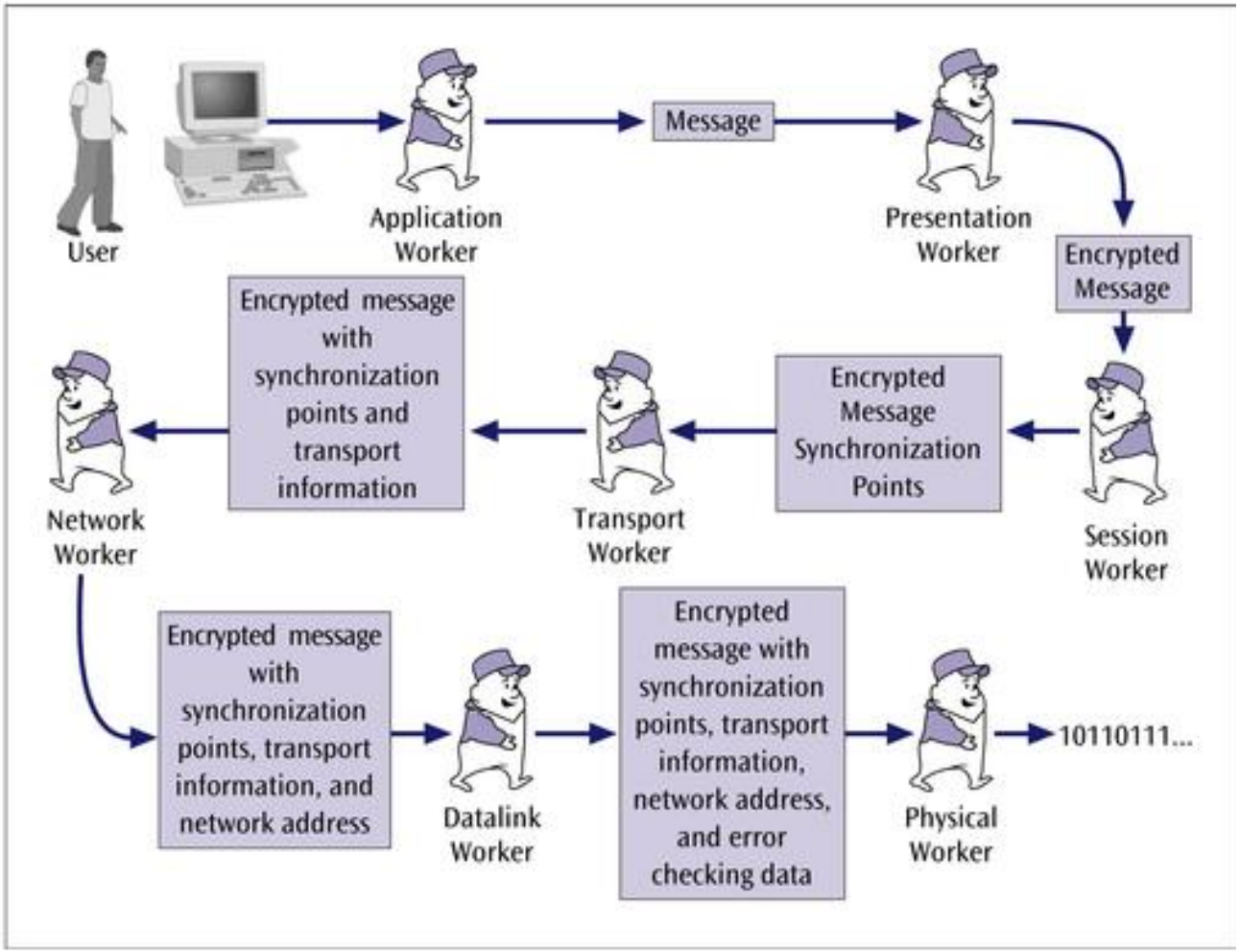
- 6-Presentation layer - performs a series of miscellaneous functions necessary for presenting the data package properly to the sender or receiver.

# Network Architecture Models


- 7-Application layer - where the application using the network resides.
- Common network applications include remote
  - login (Telnet),
  - file transfer (FTP),
  - e-mail (SMTP), and
  - Web page browsing (HTML).

# Network Architecture Models

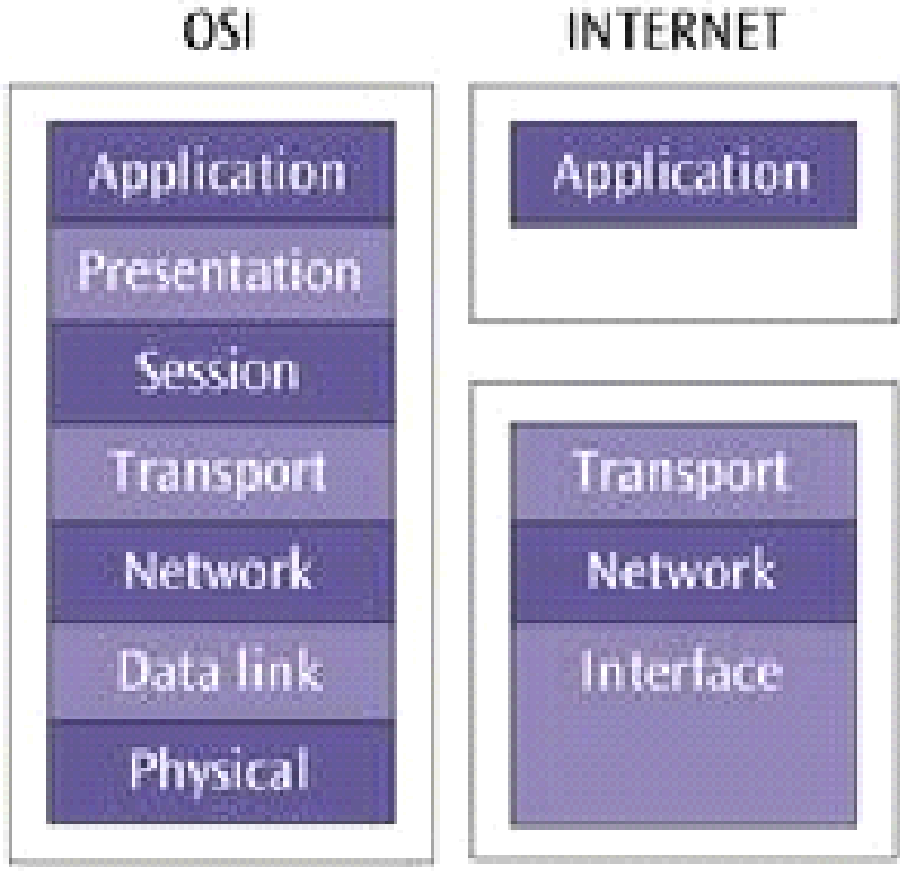
**Figure 1-10**
*The network workers performing their job duties at each layer in the model*



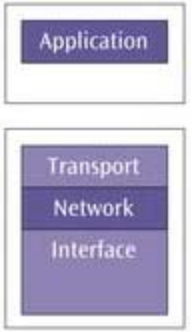
# Network Architecture Models

- The Internet model (DoD Model or TCP/IP Model)

The layers of the Internet model compared to the layers of the OSI model



# Network Architecture Models: The Internet




- Interface layer - equivalent to the OSI's physical and data link layers
- Network layer - roughly equivalent to the OSI's network layer
- Transport layer - performs same function as OSI transport layer
- Application layer - equivalent to the OSI's presentation and application layers

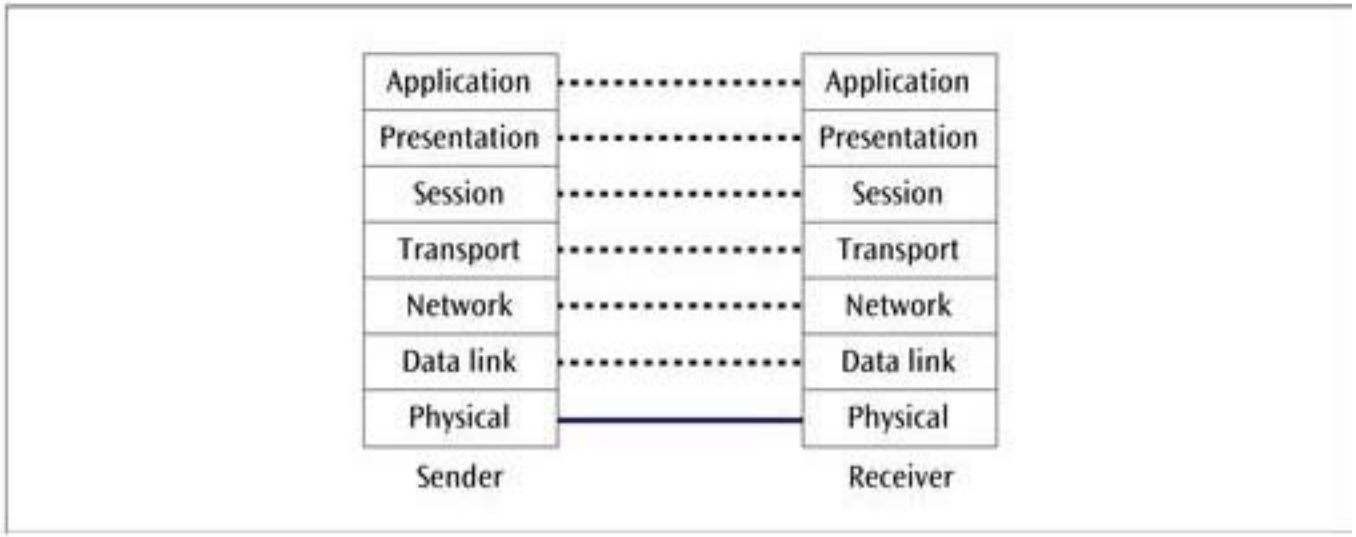
# Network Architecture Models

- Logical and physical connections - A logical connection is one that exists only in the software, while a physical connection is one that exists in the hardware.
- Note: In a network architecture model, only the lowest layer contains a physical connection, while all higher layers contain logical connections.

# Network Architecture Models

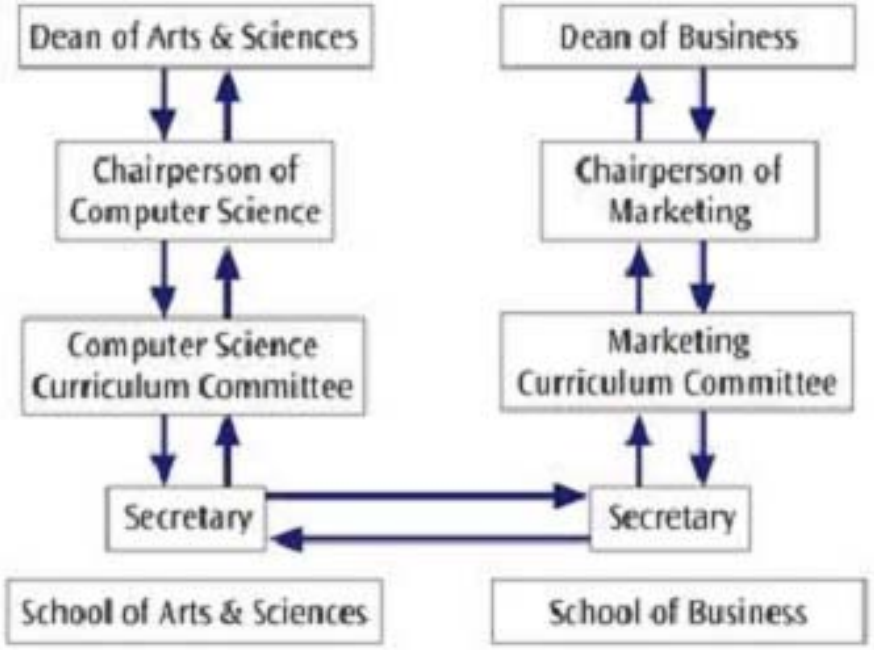
- Logical and physical connections

**Figure 1-14**
*Sender and receiver communicating using the OSI model*



# The Internet Model in Action

- Flow of data through layers of bureaucracy
  - Create a new joint degree

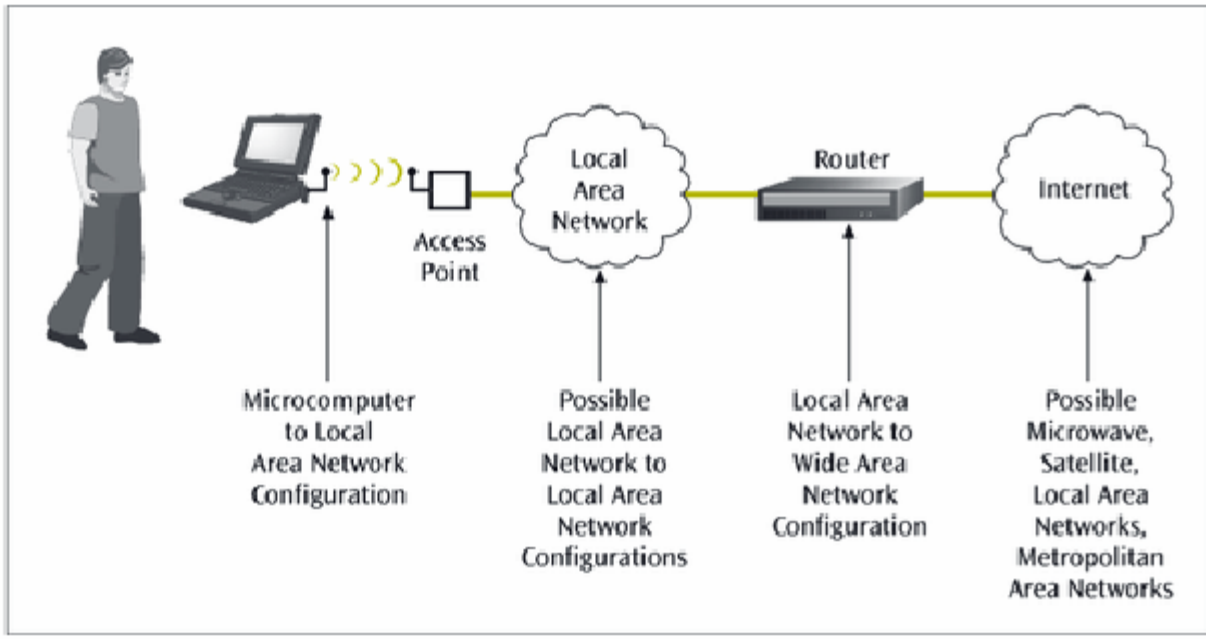


# The Internet Model in Action

- Note the flow of data from user to web browser and back
- At each layer, information is either added or removed, depending on whether the data is leaving or arriving at a workstation
- The adding of information over pre-existing information is termed *encapsulation*

# The Internet Model in Action

**Figure 1-18**
*The numerous network configurations involved with a user downloading a web page at work*

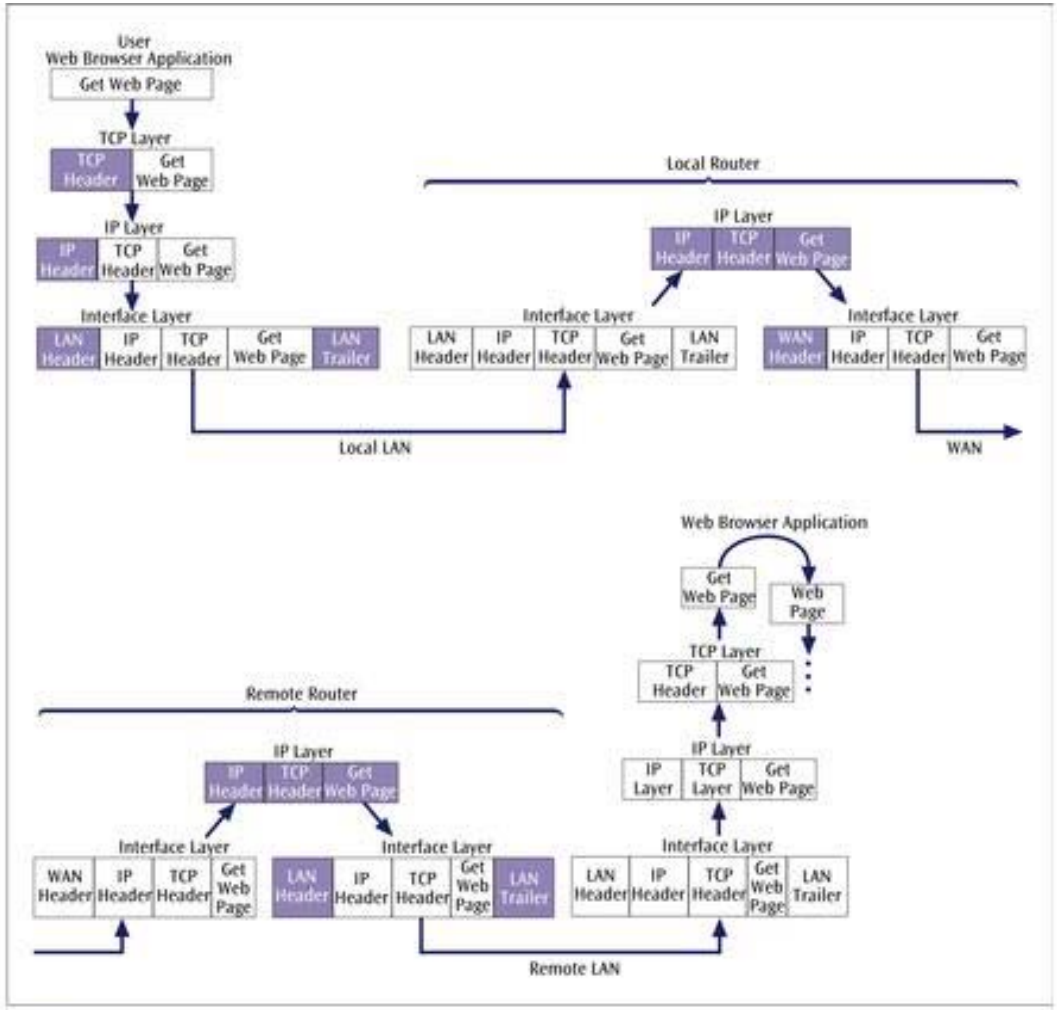


# The TCP/IP Protocol Suite in Action

- Note the flow of data from user to web browser and back
- At each layer, information is either added or removed
  - Depends on whether data is leaving or arriving at a workstation
- Encapsulation - adding information over pre-existing information

# The Internet Model in Action

**Figure 1-16**
*Path of a web page request as it flows from browser to Internet server and back*



# What we learned in this chapter

- Define the basic terminology of computer networks
- Recognize the individual components of the big picture of computer networks
- Outline the basic network configurations
- Cite the reasons for using a network model and how those reasons apply to current network systems
- List the layers of the OSI model and describe the duties of each layer
- List the layers of the Internet model and describe the duties of each layer
- Compare the OSI and Internet models and list their differences and similarities