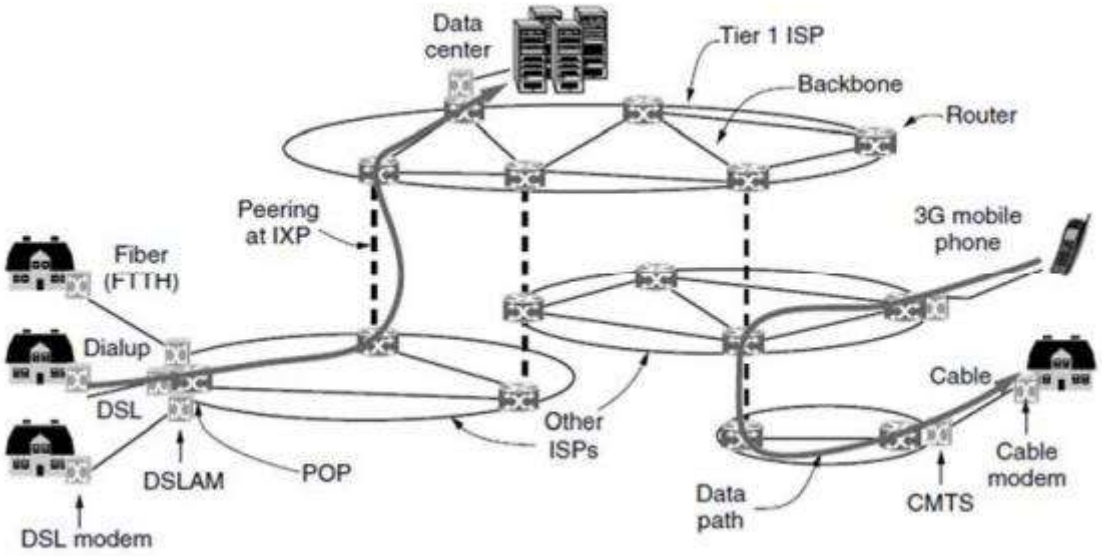
Unit Three

Computer Networks



Unit Focus

Reading 1: Computer Networks

Reading Strategy: Scanning

Building Vocabulary: Grouping Words

Language Focus: Relative Clauses with a Participle

Reading 2: Network Software

Before You Read

1. What was the key technology in the 20th century?

2. What did technological progress lead to in the 21st century?

3. Do you think the merging (combine) of computers and communications resulted in the advent (appearance) of networks?

4. Networks can be classified by transmission technology and scale. How much do you know about each?

5. What does a point-to-point link refer to?

6. Take a quick look at Figure 3-1 in the following text to find out different technologies used at different scales.

7. Now, you should be able to summarize the content of the reading. Share your ideas with a partner.

Computer Networks

main idea

Each of the past three centuries was dominated (influenced) by a single new technology. The 18th century was the era (period; age) of the great mechanical systems

accompanying the Industrial Revolution. The 19th century was the age of the steam engine. During the 20th century, the key technology was information gathering, processing, and distribution. Among other developments, we saw the installation of worldwide telephone networks, the invention of radio and television. the birth and unprecedented growth
never done or known before; unexampled
of the computer industry, the launching of communication satellites, and,
beginning
of course, the Internet.


main idea

As a result of rapid technological progress, these areas are rapidly converging in the 21st century and the differences between collecting,
connect
transporting, storing, and processing information are quickly disappearing. Organizations with hundreds of offices spread over a wide geographical area routinely expect to be able to examine the current
regularly
status of even their most remote outpost at the push of a button. As our
a remote part of a country
ability to gather, process and distribute information grows, the demand for even more sophisticated information processing grows even faster.


main idea

The merging of computers and communications has had a profound
very great
influence on the way computer systems are organized. The once dominant concept of the "computer center" as a room with a large

computer to which users bring their work for processing is now totally obsolete (although data centers holding thousands of Internet servers are becoming common). The old model of a single computer serving all of the organization's computational needs has been replaced by one in which a large number of separate but interconnected computers do the job. These systems are called computer networks.

out of date

main idea

The technical issues involved in network design are the subject of this reading. There is generally no accepted taxonomy into which all computer networks fit, but two dimensions stand out as important: transmission technology and scale. We will examine each of these in turn.

classification

Broadly speaking, there are two types of transmission technology that are in widespread use: broadcast links and point-to-point links.

main idea

Point-to-point links connect individual pairs of machines. To go from the source to the destination on a network made up of point-to-point links, short messages called packets in certain contexts, may have to first visit one or more intermediate machines. Often multiple routes, of different length are possible, so finding good ones is important in point-to-point

networks. Point-to-point transmission with exactly one sender and exactly one receiver is sometimes called unicasting.

main idea

In contrast on a broadcast network, the communication channel is shared by all the machines on the network: packets sent by any machine are received by all the others. An address field within each packet specifies the intended recipient. Upon receiving a packet, a machine checks the

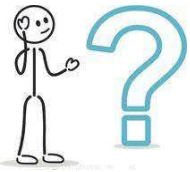
considered

address field. If the packet is intended for the receiving machine, that machine processes the packet; if the packet is intended for some other machine. it is just ignored. A wireless network is a common example of a broadcast link with communication shared over a coverage region that depends on the wireless channel and the transmitting machine.

main idea

Broadcast systems usually also allow the possibility of addressing a packet to *all* destinations by using a special code in the address field. When a packet with this code is transmitted, it is received and processed by every machine on the network. This mode of operation is called broadcasting. Some broadcast systems also support transmission to a subset of the machines, which is known as multicasting.

An alternative criterion for classifying networks is by scale. Distance is
different
important as a classification metric because different technologies are
standard; system
used at different scales.



main idea

In Figure 3-1 we classify multiple processor systems by their rough
approximate
physical size. At the top are the personal area networks, networks that are meant for one person. Beyond these come longer-range networks. These can be divided into local, metropolitan, and wide area networks, each with increasing scale. Finally, the connection of two or more networks is called an internetwork. The worldwide Internet is certainly the best-known (but not the only) example of an internetwork.

Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

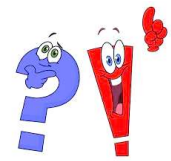
Figure 3-1. Classification of interconnected processors by scale.

Personal Area Networks

main idea

PANs (Personal Area Networks) let devices communicate over the range of a person. A common example is a wireless network that connects a computer with its peripherals. Almost every computer has an attached monitor, keyboard, mouse, and printer. Without using wireless, this connection must be done with cables.

Local Area Networks



main idea

The next step up is the LAN (Local Area Network). A LAN is a privately owned network that operates within and nearby a single building like a home, office or factory. LANs are widely used to connect personal computers and consumer electronics to let them share resources (e.g., printers) and exchange information. When LANs are used by companies, they are called enterprise networks.

next to

main idea

Wireless LANs are very popular these days, especially in homes, older office buildings, cafeterias, and other places where it is too much trouble to install cables. In these systems, every computer has a radio modem and an antenna that it uses to communicate with other computers. In most cases, each computer talks to a device in the ceiling as shown in

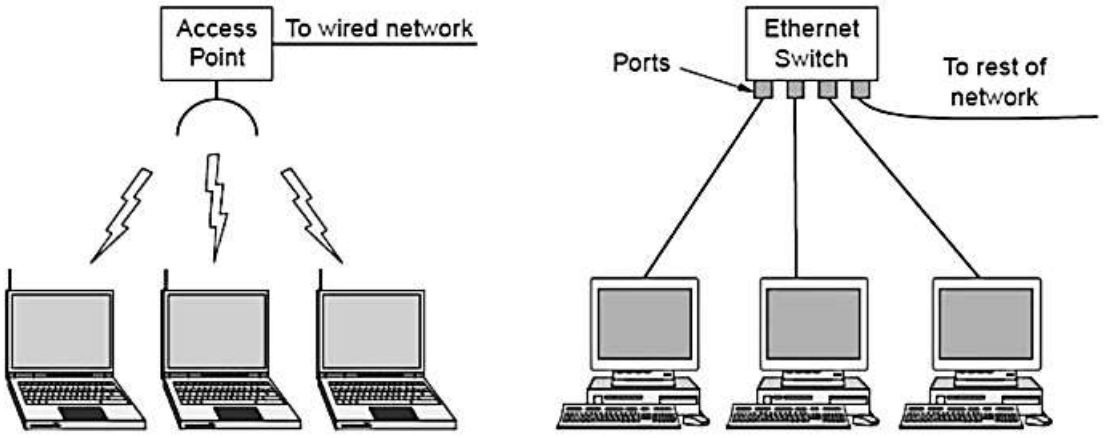
Figure 3-2(a). This device, called an AP (Access Point), wireless router, or base station, relays packets between the wireless computers and also between them and the Internet.


main idea

There is a standard for wireless LANs called IEEE 802.11, popularly known as WiFi, which has become very widespread. The topology of many wired LANs is built from point-to-point links. IEEE 802.3, popularly called Ethernet, is, by far, the most common type of wired LAN. Figure 3-2(b) shows a sample topology of switched Ethernet. Each computer speaks the Ethernet protocol and connects to a box called a switch with a point-to-point link. Hence the name. A switch has multiple ports, each of which can connect to one computer. The job of the switch- is to relay packets between computers that are launched to it, using the address in each packet to determine which computer to send it to.

?

resend



(a) (b)

Figure 3-2. Wireless and wired LANs. (a) 802.11. (b) Switched Ethernet.

Metropolitan Area Networks

A MAN (Metropolitan Area Network) covers a city. The best-known examples of MANs are the cable television networks available in many cities. These systems grew from earlier community antenna systems used in areas with poor over-the-air television reception. In those early systems, large antenna was placed on top of a nearby hill and a signal was then piped to the subscribers' houses.

Wide Area Networks

main idea

A WAN (Wide Area Network) spans a large geographical area, often a country or continent. We will begin our discussion with wired WANs, using the example of a company with branch offices in different cities. The WAN in Figure 3-3 is a network that connects offices in three cities. Each of these offices contains computers intended for running user (i.e., application) programs. We will follow traditional usage and call these machine hosts. The rest of the network that connects these hosts is then called the communication subnet, or just subnet for short. The job of the subnet is to carry messages from host to host, just as the telephone system carries words (really just sounds) from speaker to listener.

main idea

In most WANs, the subnet consists of two distinct components: transmission lines and switching elements. Transmission lines move bits between machines. They can be made of copper wire, optical fiber, or even radio links. Most companies do not have transmission lines lying about, so instead, they lease the lines from a telecommunications company. Switching elements, or just switches, are specialized computers connecting two or more transmission lines. When data arrive on an incoming line, the Switching element must choose an outgoing line on

which to forward them. These switching computers have been called by various names in the past; the name **router** is now most commonly used.

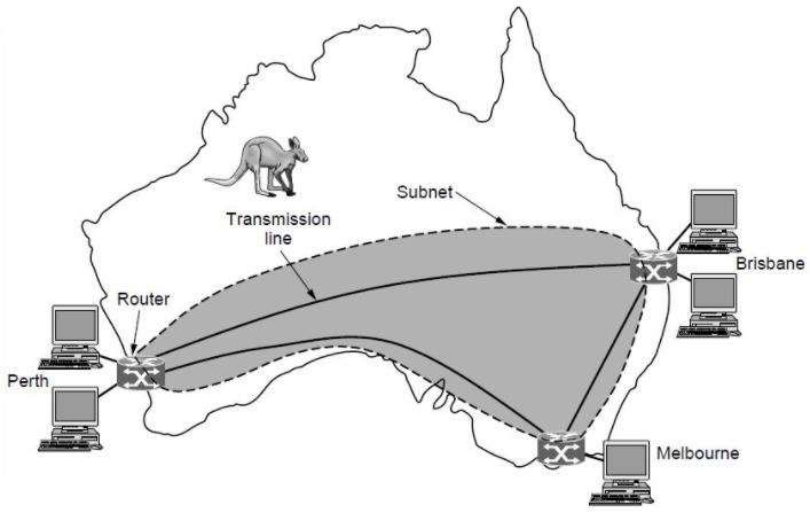


Figure 3-3. WAN that connects three branch offices in Australia

Internetworks

Many networks exist in the world, often with different hardware and software. People connected to one network often want to communicate with people attached to a different one. The fulfillment (realization) of this desire requires that different, and frequently incompatible, networks be connected. A collection of interconnected networks is called an internetwork or internet. These terms will be used in a generic (general) sense, in contrast to the worldwide Internet (which is one specific internet), which

we will always capitalize. The Internet uses ISP (Internet Service Provider) networks to connect enterprise networks, home networks, and many other networks.

(Tanenbaum & Wetherall: pp. 1-29)