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- *Nicolae Tapus*
  - *ntapus@cs.pub.ro*
  - *Sala EF304*

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References

- *Behrouz A Forouzan*
  - *Data Communications and Networking*
    - *McGraw Hill*
    - *http://highered.mcgraw-hill.com/sites/0072515848/student_view0/*
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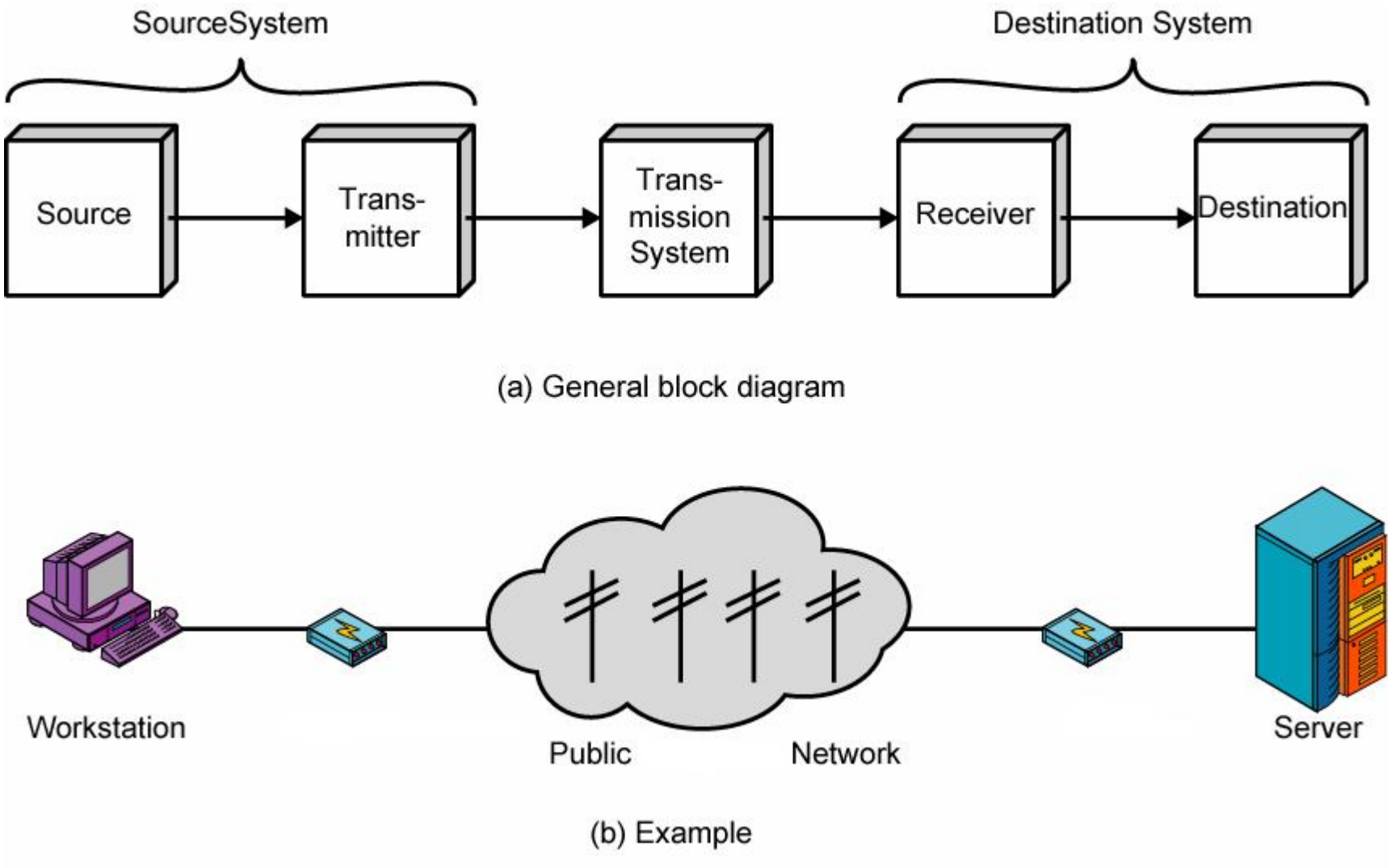
    - *Pearson Prentice Hall*
- *Andrew Tanenbaum*
  - *Retele de Calculatoare*
    - *Byblos*

Overview of Data Communications and Networking

Simplified Communications Model-Diagram

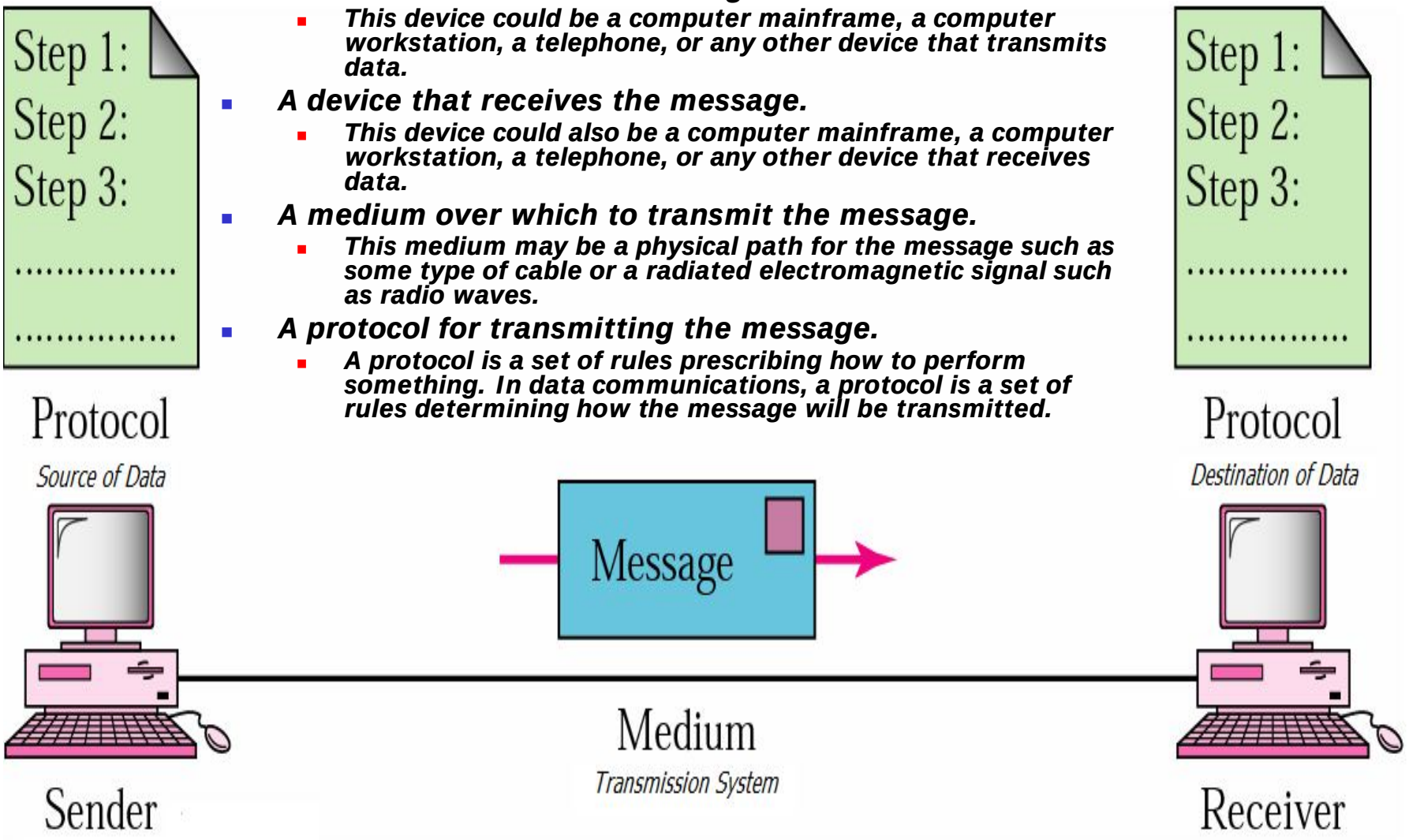


A Communications Model

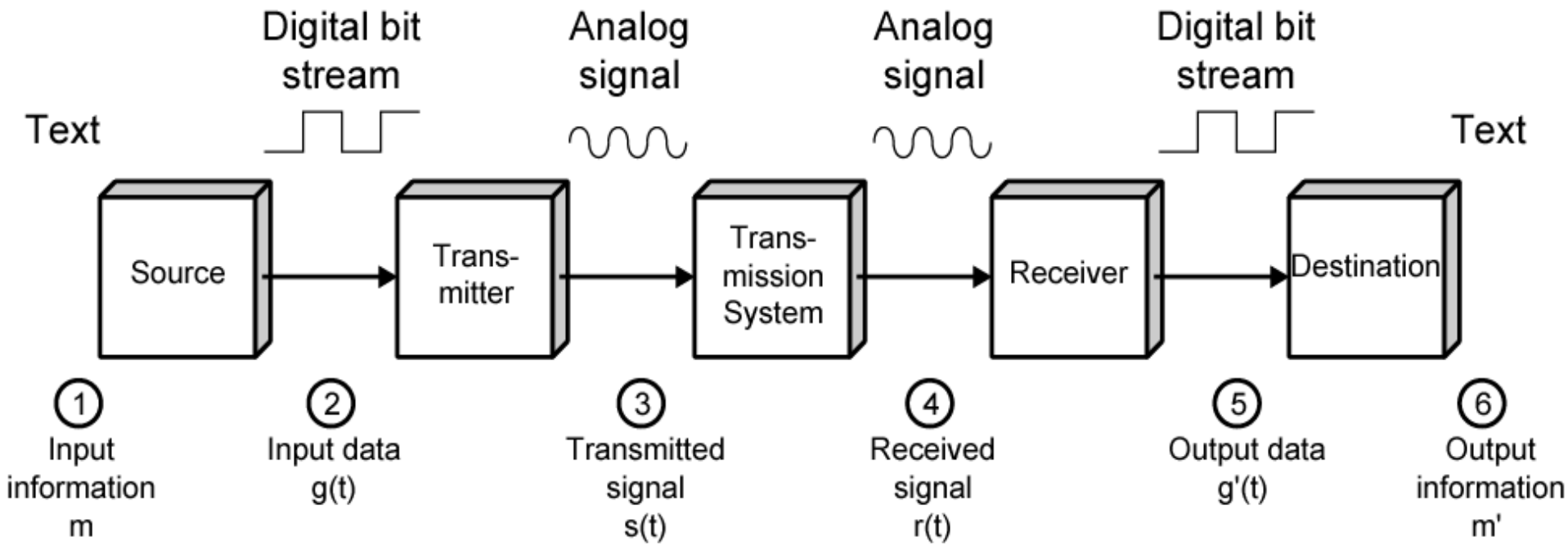
- Source
  - generates data to be transmitted
- Transmitter
  - Converts data into transmittable signals
- Transmission System
  - Carries data
- Receiver
  - Converts received signal into data
- Destination
  - Takes incoming data

Five components of data communication

- ***A message to be communicated.***
  - ***This message may be data, text, audio, graphics, or video.***
- ***A device that sends the message.***
  - ***This device could be a computer mainframe, a computer workstation, a telephone, or any other device that transmits data.***
- ***A device that receives the message.***
  - ***This device could also be a computer mainframe, a computer workstation, a telephone, or any other device that receives data.***
- ***A medium over which to transmit the message.***
  - ***This medium may be a physical path for the message such as some type of cable or a radiated electromagnetic signal such as radio waves.***
- ***A protocol for transmitting the message.***
  - ***A protocol is a set of rules prescribing how to perform something. In data communications, a protocol is a set of rules determining how the message will be transmitted.***



Simplified Data Communications Model



Several terms that are often used

- A **line** is a physical connection between two points in a network.
- A **circuit** can be a single or multiple connection or a nonphysical connection such as a satellite or microwave transmission.
- A **link** is an unbroken circuit between two network nodes.
- A **channel** is either a whole circuit or part of a circuit.

Basic Concepts

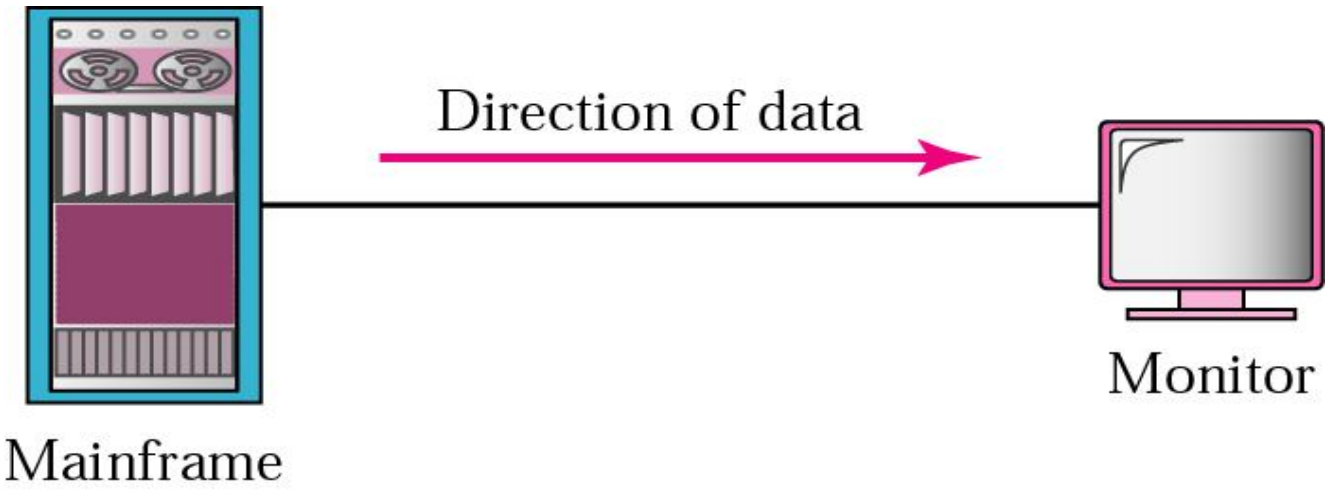
- The five basic concepts that describe the relationships between communicating devices are:
  - transmission mode
  - line configuration
  - topology
  - types of networks
  - internetworks

Transmission Mode

- The three types of data transmission
  - simplex,
  - half-duplex, and
  - full-duplex

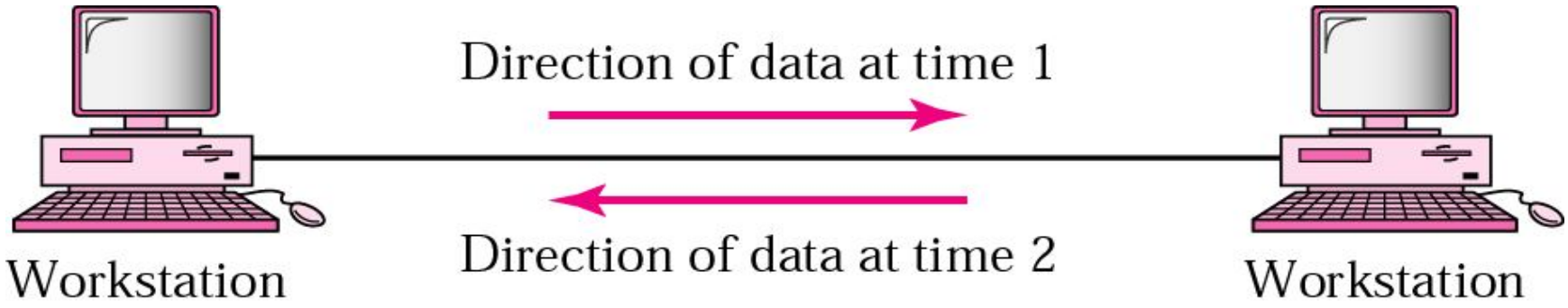
Simplex

Simplex data transmission: data can flow only in one direction



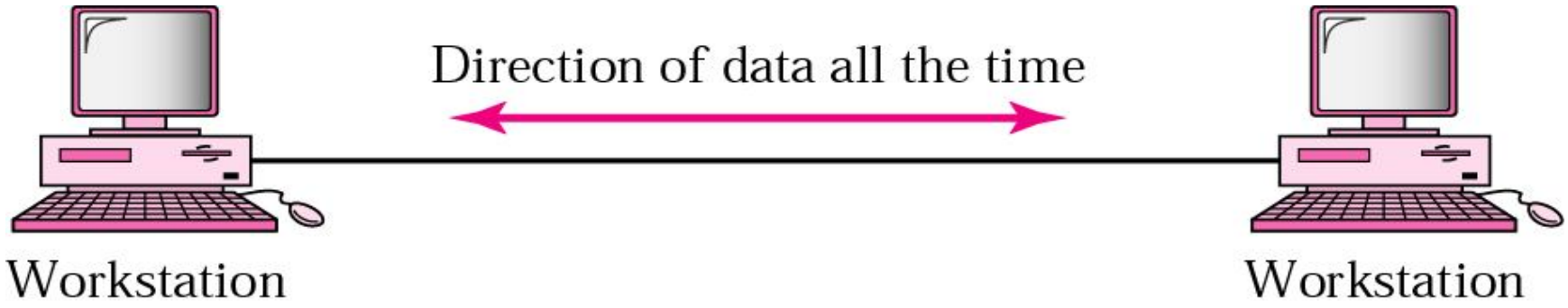
Half-duplex

Half-duplex data transmission: data can flow in both directions, but only in one direction at a time.



Full-duplex

Full-duplex data transmission: data can flow in both directions at the same time.

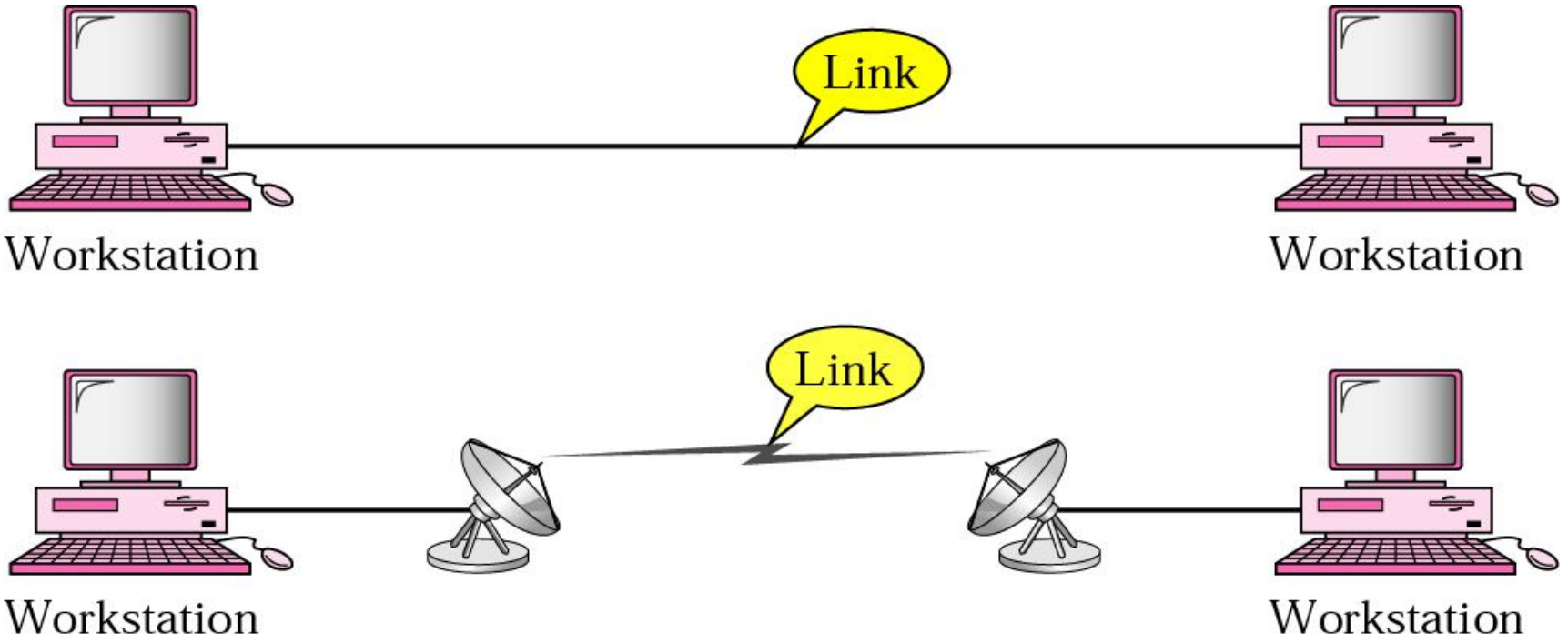


Line configurations

- Line configurations describe the way devices are connected.
- There are two configurations:
  - (1) point-to-point configuration and
  - (2) multipoint, or multidrop, configuration.

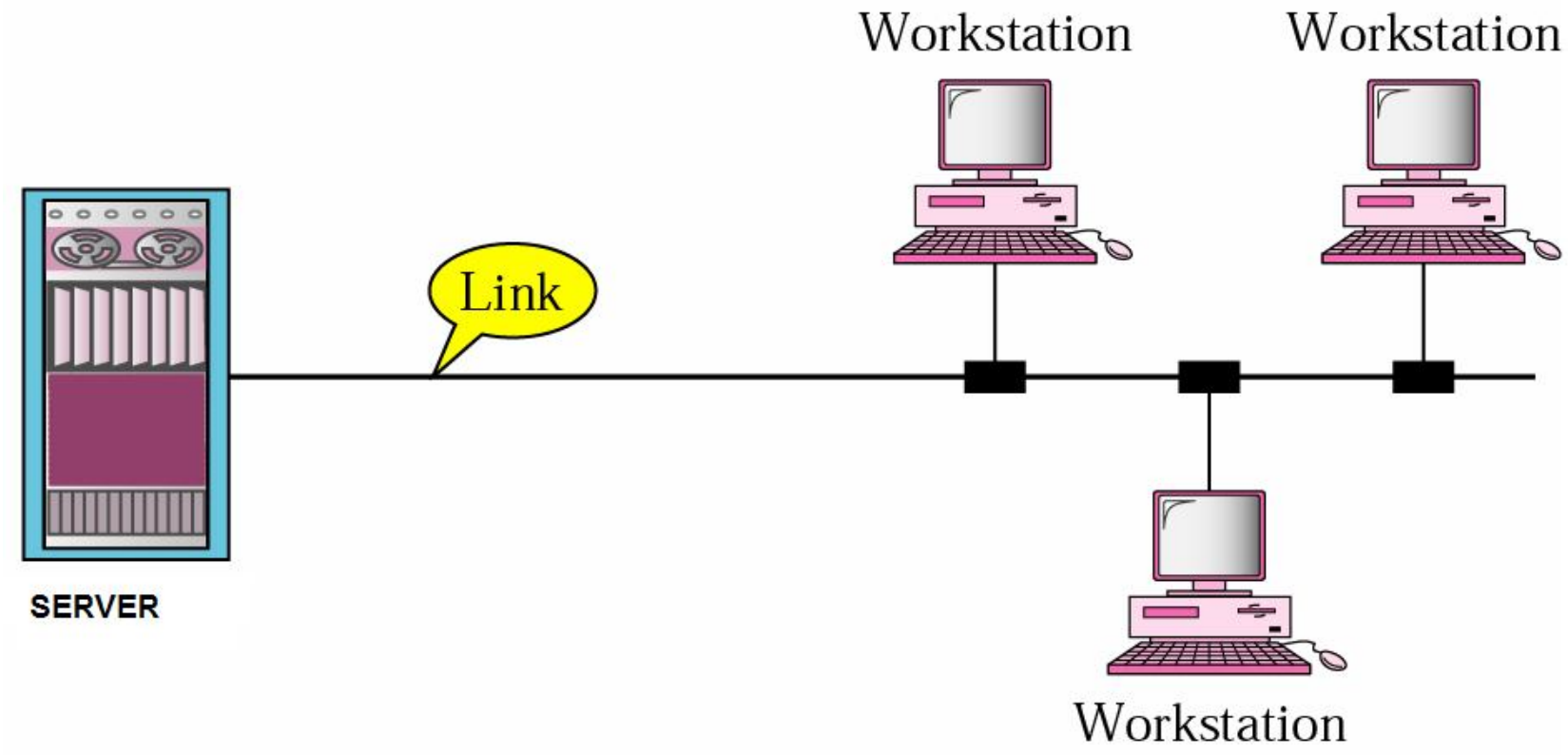
Line Configuration (1): Point-to-point connection

In the point-to-point configuration, the link is dedicated to communications between two devices.

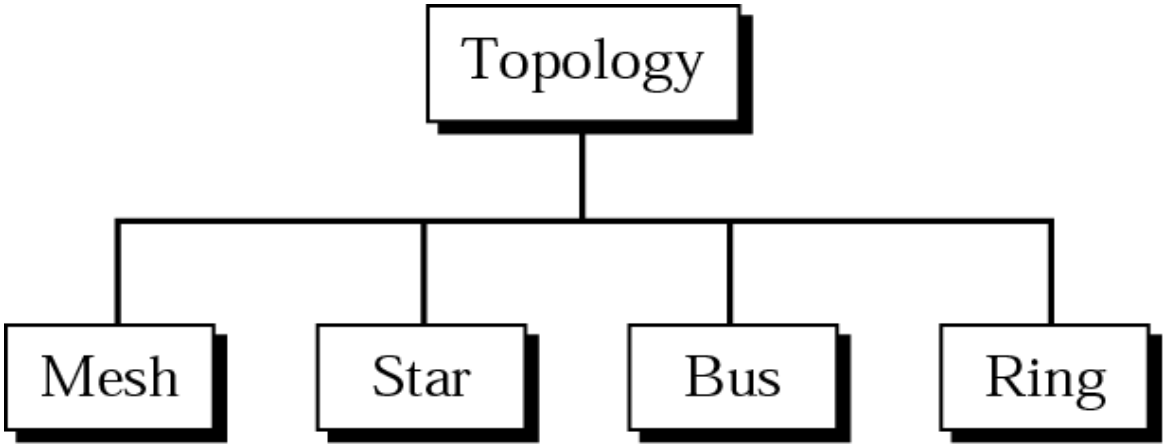


Line Configuration (2): Multipoint connection

In the multipoint configuration, the link is shared by multiple terminals.



Categories of topology

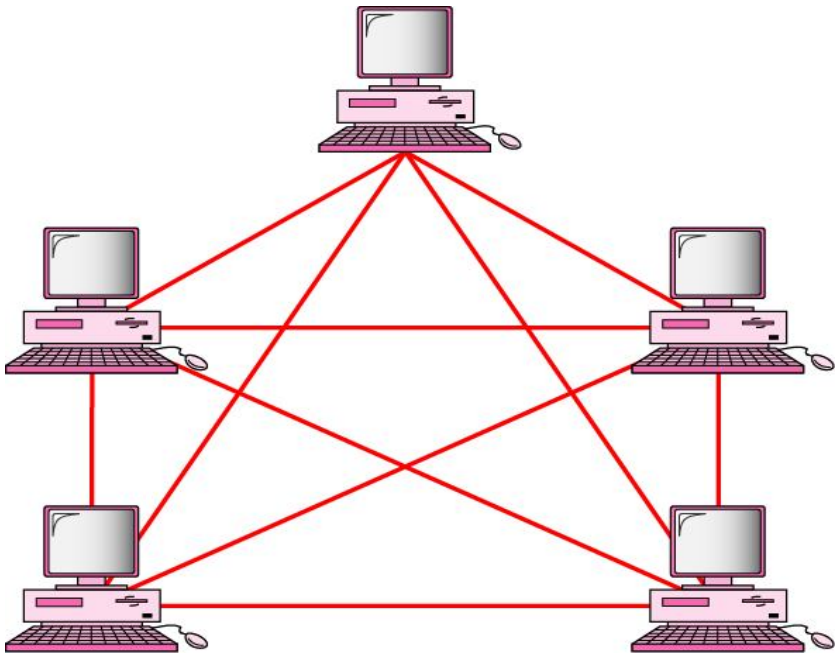


Fully connected mesh topology (for five devices)

In mesh topology, every node is connected by a dedicated point-to-point connection to all other nodes. A message will require only one hop no matter where the sending and receiving nodes are located in the network.

Number of connections = T × (T – 1)/2

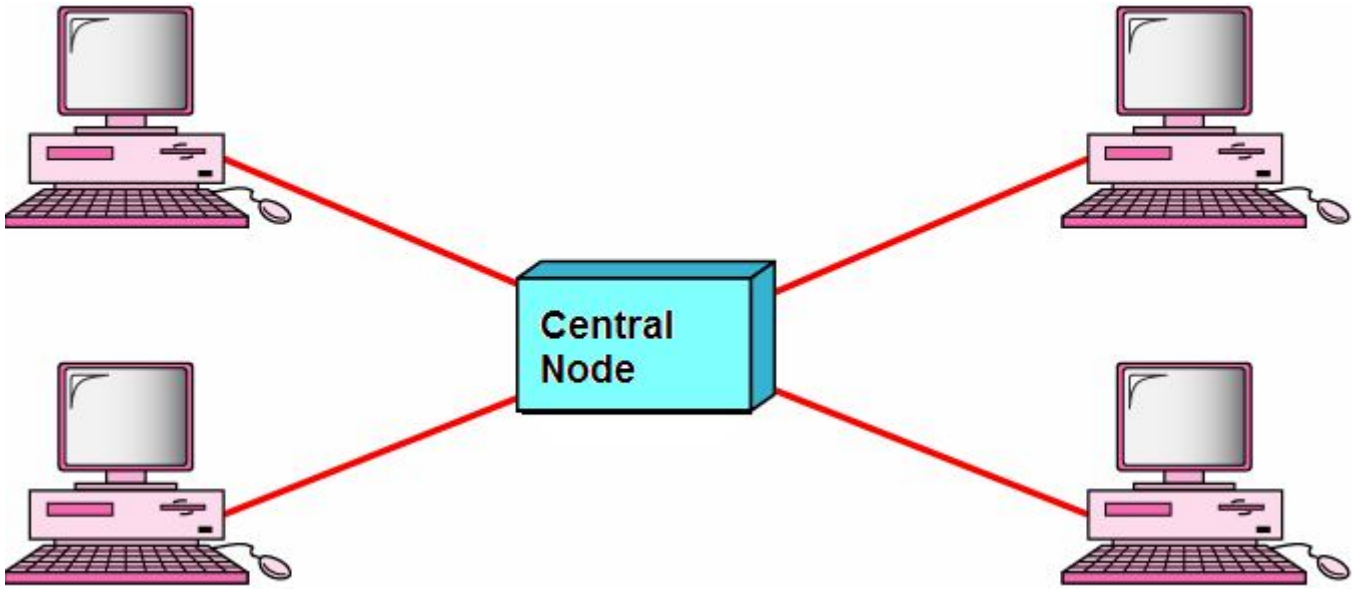
where T = the number of nodes or terminals.



Star topology

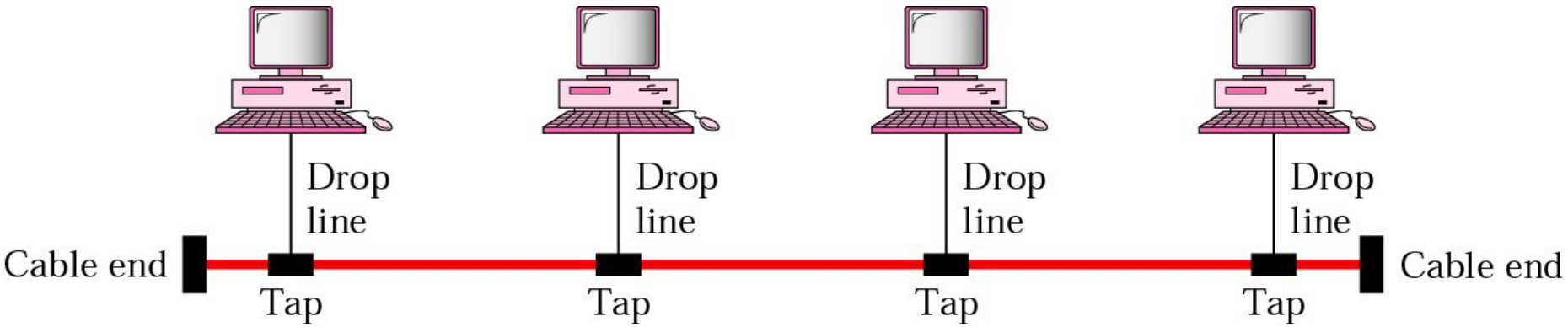
In the star topology, the central node is connected to every other node.

Messages between two nodes, where neither is the central node, always require two hops.



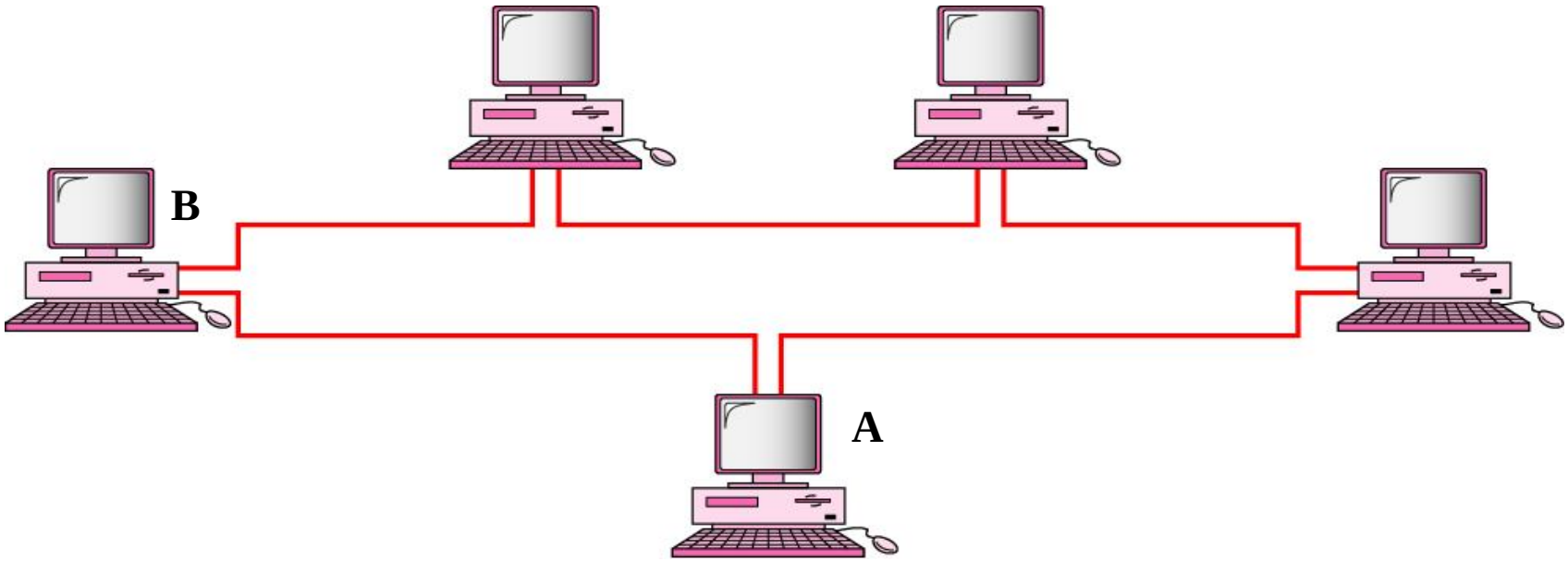
Bus topology

In the bus topology, a cable running the length of the network connects all nodes or workstations with a multipoint connection. The small solid rectangles at each end represent the cable ends. A message from node A to node B is put onto the bus and is received by all nodes on the bus, including node B.

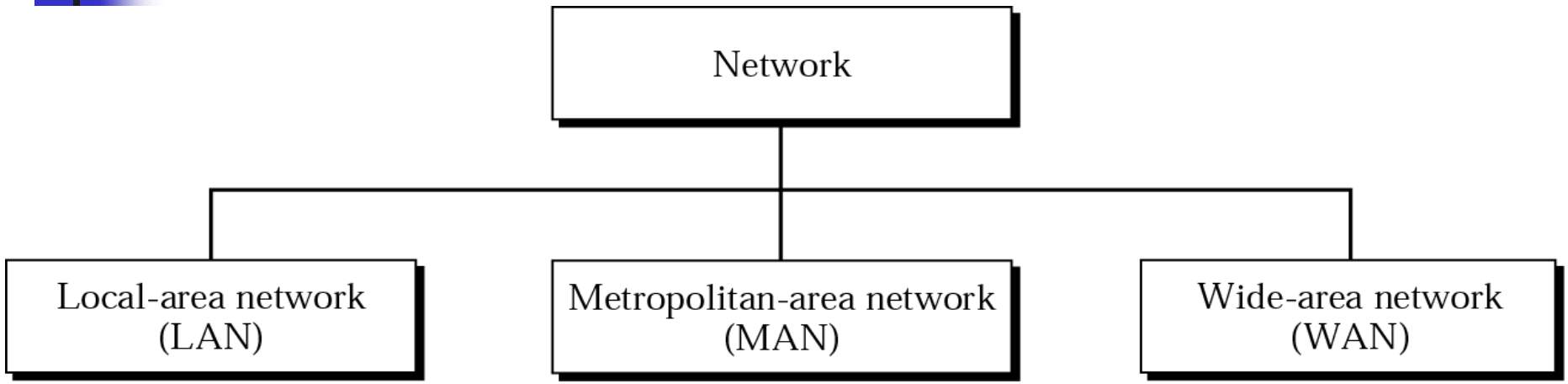


Ring topology

In the ring topology, a closed loop connects all of the workstations. Messages from A to B flow through the intervening nodes, in sequence, until they reach B. In our diagram, four hops are required if the traffic flows only in the counterclockwise direction.



Categories of networks



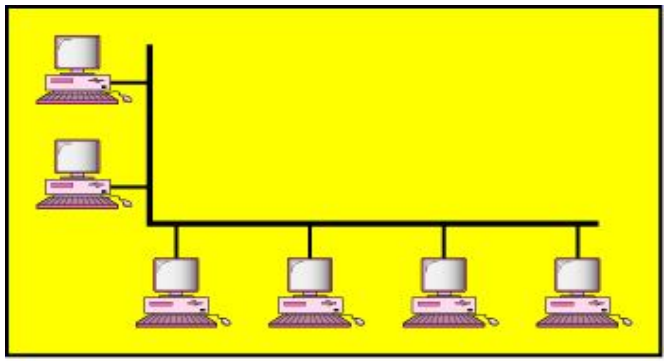
Local area networks (LANs), wide area networks (WANs), and metropolitan area networks (MANs) are the primary categories of networks.

In addition to these three categories, hybrid networks are created using internetworking devices. Hybrid networks often combine the best characteristics of pure LAN, WAN, or MAN networks. LANs, WANs, and MANs differ in the way they are used and in the technologies

LAN- Local Area Network

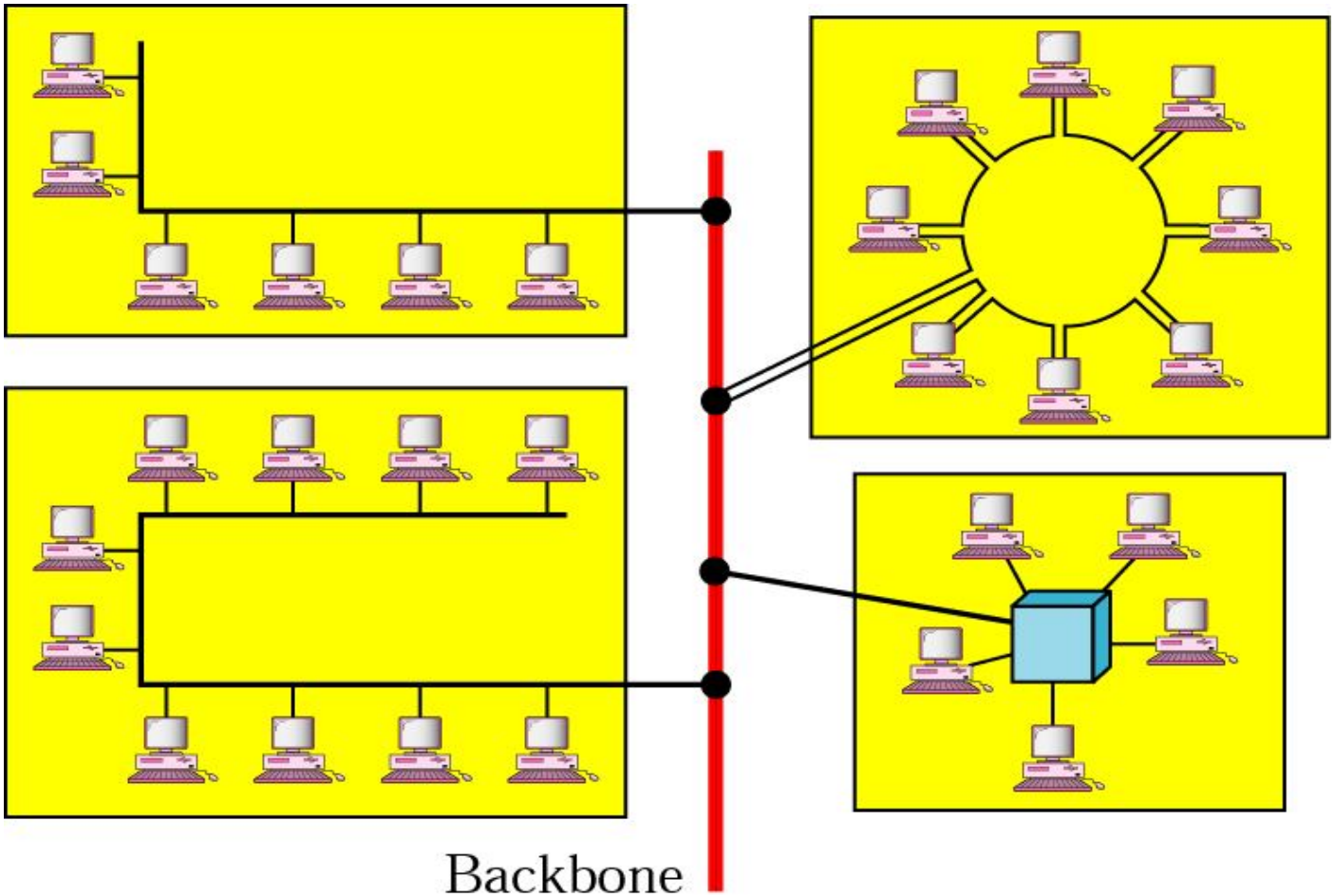
LANs connects microcomputers and other workstation devices located in a single office, a single building, or on a campus.
The use of LANs allowed the sharing of resources, including hardware, software, and data.
LAN characteristics include:

- *a common transmission medium throughout the network*
- *bus, ring, or star topologies*
- *lengths of less than 10 km*
- *usually owned by their users*
- *typical data rates of 10 Mbps (Megabits per second) , 100 Mbps, 1Gbps and 10 Gbps systems in development*



a. Single-building LAN

LAN (Continued)

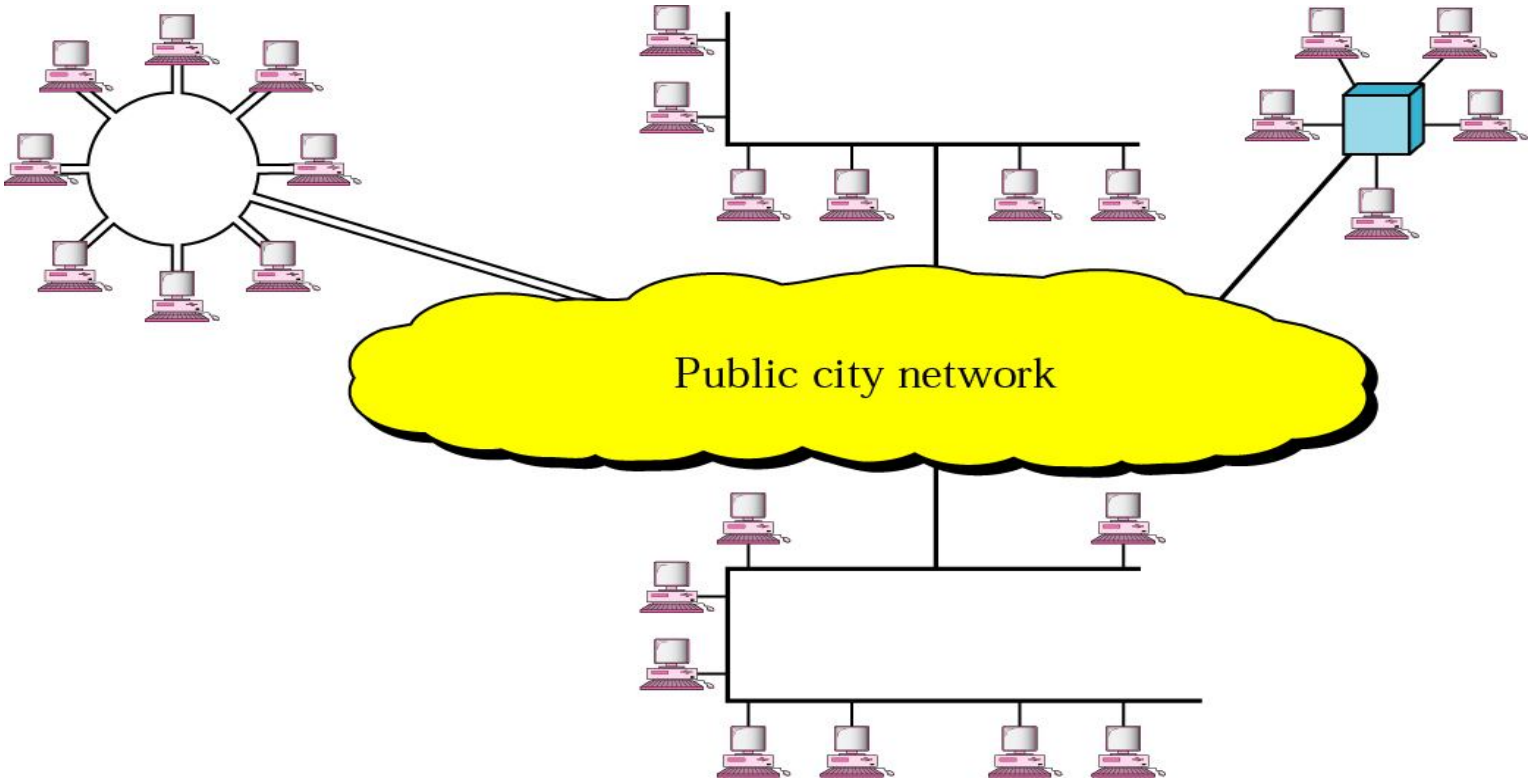


b. Multiple-building LAN

MAN – Metropolitan Area Network

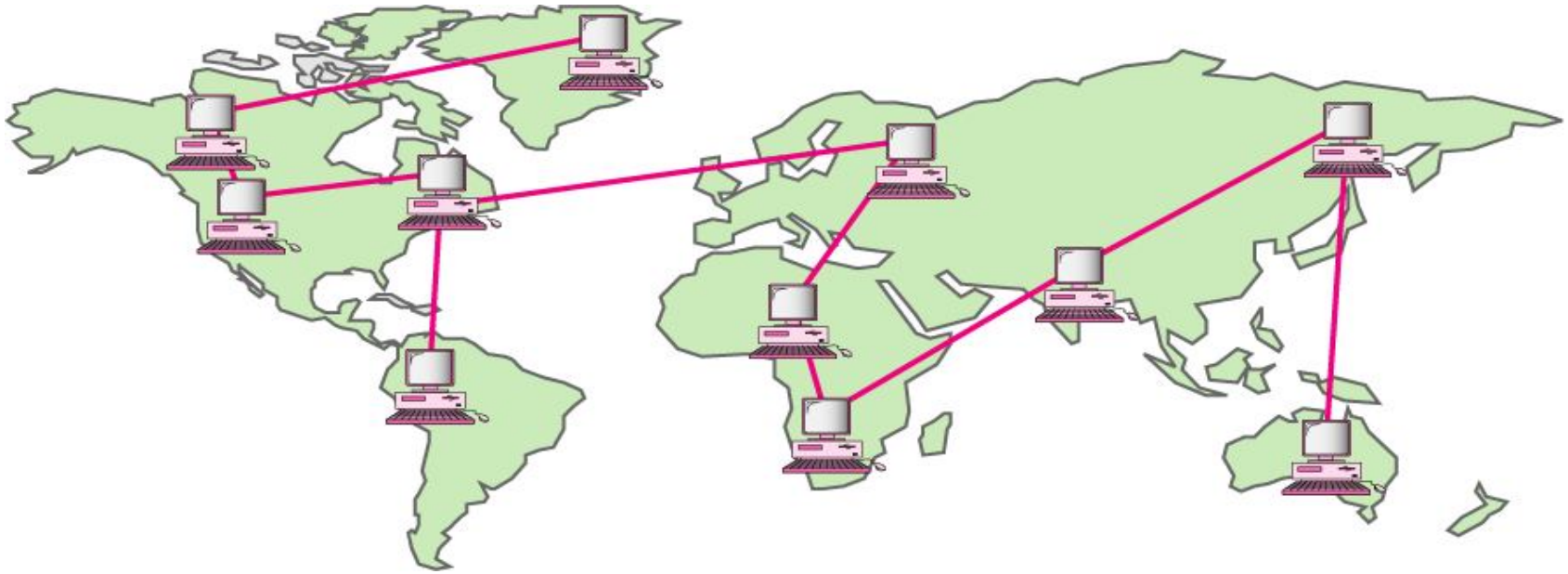
MANs, the newest of the three network types, span geographical areas that usually encompass a city or county and use digital technology similar to that used in LANs. MANs are often used to connect a series of LANs. Because of the larger area covered, MANs are usually owned by a public carrier or local government agency.

MANs may also be used as a backbone network to interconnect distributed LANs.



WAN- Wide Area Networks

WANs are centrally monitored and managed networks used to interconnect users over large geographical areas that may span cities, states, or countries.
A public carrier owns the communication circuits for most WANs. This makes sense for all but the largest corporations, because of the cost involved in establishing and maintaining the circuits over long distances.
When a single company owns a WAN, it is often called an enterprise network.



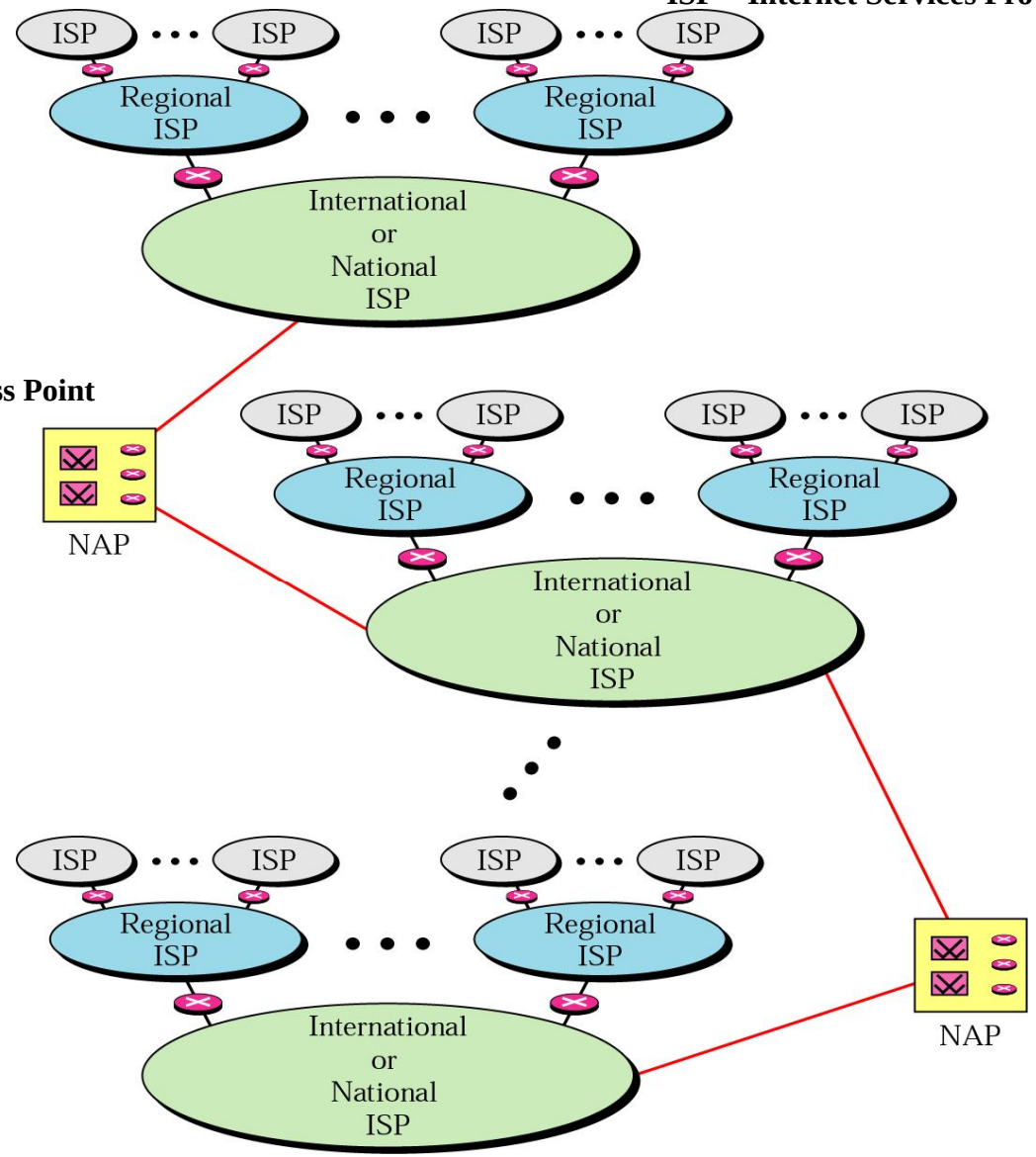
Internetworks

- It is often desirable to connect networks. The following terms are used to describe these types of connections:
- An **internet** or **internetwork** is the connection of two or more networks.
- The **Internet** is the worldwide network we all use.
- An **intranet** is a private network that uses Internet technologies.
- The devices used for network interconnections include bridges, routers, and gateways.

Internet today

ISP – Internet Services Provider

NAP- Network Access Point



Significant Events in Data Communications History

1837

- **Invention of the telegraph.**
- Samuel Morse invented the telegraph. By using a series of dots and dashes, people were able to send messages over long distances using telegraph wires.

- 1876
  - **Invention of the telephone.**
  - Antonio Meuci (Alexander Graham Bell) invented the telephone. It allowed people to talk to each other over telephone lines.
- 1885
  - **AT&T incorporated.**
  - By 1983, American Telephone and Telegraph (AT&T) controlled 90 percent of our nation's telephones and owned companies that provided most of the end-to-end telephone service (Fitzgerald 1993, 272). Because of its size and importance, AT&T was regulated by the FCC.

Significant Events in Data Communications History

- 1937
  - **ARINC case.**
  - The FCC granted Aeronautical Radio Inc. (ARINC) permission, over the objections of AT&T, to provide a communications network for the airline industry.
- 1940
  - **Bell Labs succeeded in data communication experiment.**
  - One of the first attempts to attach computer-related devices to communication devices occurred when Bell Labs (an AT&T company) at Dartmouth College communicated with an electronic calculator in New York City.
- 1956
  - **Hush-a-Phone case.**
  - Hush-a-Phone developed a rubber shield that could be placed over the telephone mouthpiece to provide privacy in a crowded room. AT&T sued to halt the sale of these devices and won, but then lost on an appeal. AT&T was concerned that any foreign attachment to its network could affect performance and strongly discouraged such attachments.

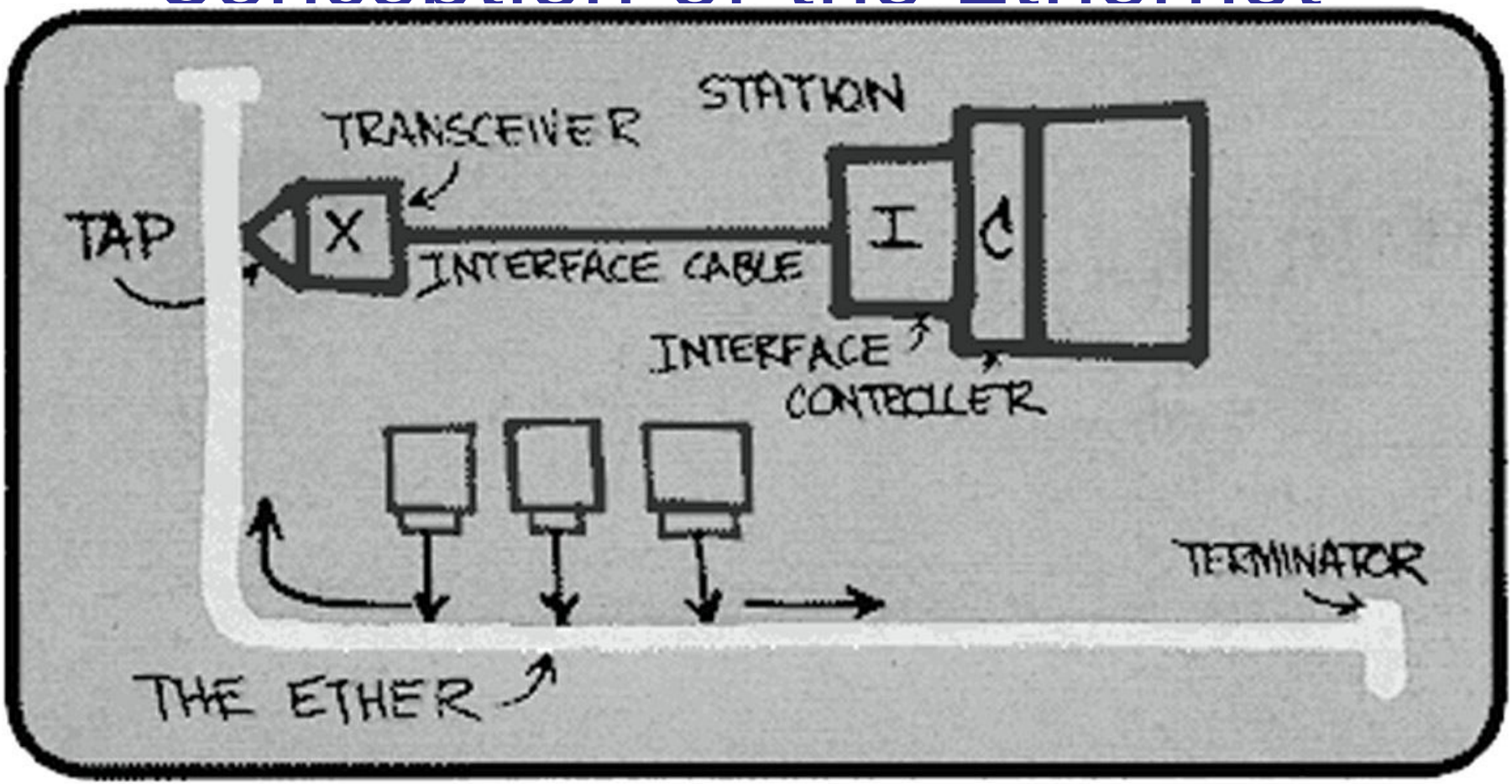
Significant Events in Data Communications History

- 1964
  - Rand Corporation introduced the concept of packet-switching networks.
  - The Arpanet was based on the concept of packet-switching networks, as was later the Internet.
- 1969
  - MCI case.
  - MCI (then known as Microwave Communications, Inc.) asked the FCC for approval to build a microwave service between St. Louis and Chicago, which implied that the local phone companies would provide local connectivity for users. AT&T contended that doing so would:
    - fragment the nation's communications because of differing standards and interface problems
    - construct duplicate systems the country didn't need
    - cause "cream skimming" of the best customers
    - MCI won a landmark decision that broke AT&T's monopoly of leased lines and required AT&T to provide local connections.

Significant Events in Data Communications History

- 1969
  - Arpanet implemented.
  - The Arpanet, a network funded by the U.S. Department of Defense's Advanced Research Projects Agency (ARPA), was implemented with four nodes. Arpanet was the forerunner of the Internet.
- 1971
  - University of Hawaii developed Alohanet.
  - The University of Hawaii developed the Alohanet, a radio network used to transmit data packets in the Hawaiian Islands. This network was the inspiration for Ethernet, which we will discuss in module 3.
- 1973
  - Xerox developed Ethernet.

Conception of the Ethernet



Metcalfe's original conception of the Ethernet

Significant Events in Data Communications History

- 1989
  - World Wide Web introduced.
  - The World Wide Web (WWW) was created, leading to a commercialization of the Internet.
- 1998
  - Ericsson introduces Bluetooth wireless communications.
  - Bluetooth provides short-range data communications for local area networks (LANs) and other computer-related equipment.