CNT3004 - Computer Network Concepts

Dr. C. Tidwell, Fall 2020

Chapter 1

Introduction

The term telecommunication means communication at a distance. The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data. Data communications are the exchange of data between multiple devices via some form of transmission medium such as a wired cable or wirelessly.

Topics discussed in this section:

Components
Data Representation
Data Flow

Criteria of Effectiveness of Data Communication

Delivery:

Data must arrive at the correct destination.
Data only arrive at the right destination.

Accuracy:

Data must be correct without any error.

Timeliness:

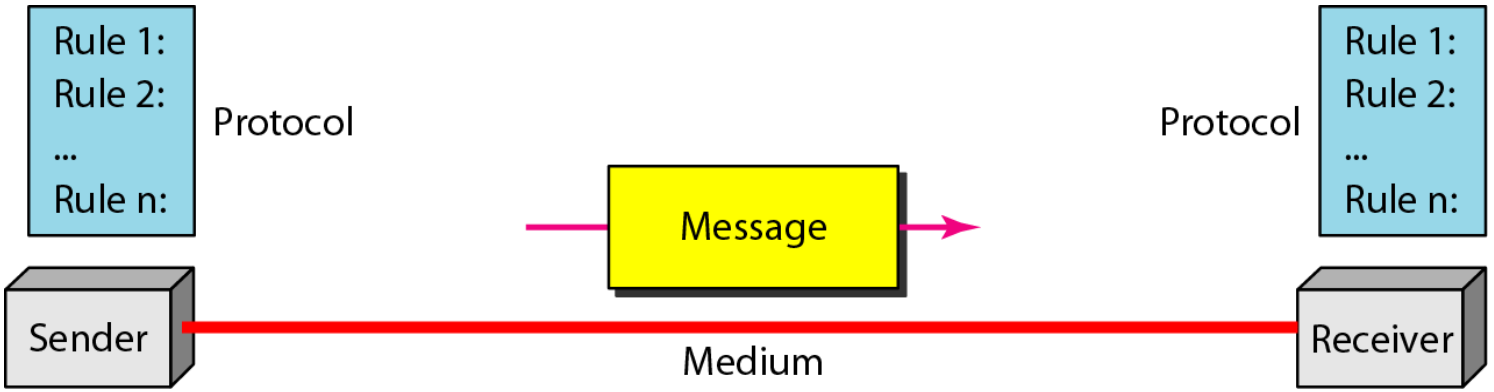
Data must be delivered in *timely* manner

Jitter:

Variation in the data arrival time at the detonation

Different applications have different requirements on these criteria

Figure 1.1 *Five components of data communication*



- Message – what are you sending (text, email, etc.)
- Sender – who is sending the information
- Receiver – who is the information going to
- Transmission medium – how is it being sent (wired, wirelessly (Bluetooth, etc.)
- Protocol – for the Internet (like HTTP, FTP, SMTP, etc.)

Data Representation

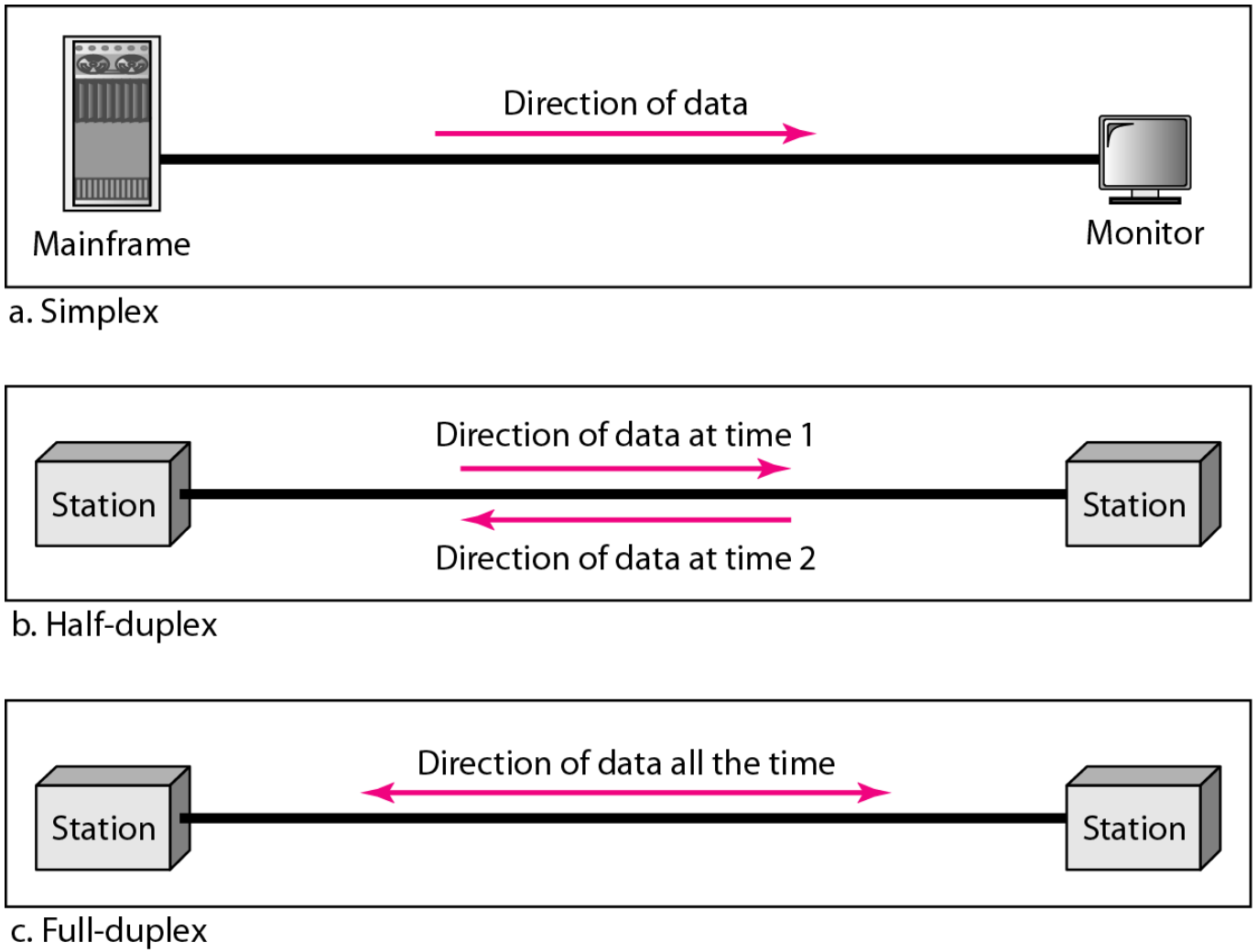
- **Text**
- **Numbers**
- **Images**
- **Audio**
- **Video**

Data Representation: Text

- ASCII code: includes definitions for 128 characters
  - 33 are non-printing control characters (now mostly obsolete) that affect how text and space is processed
  - 95 printable characters, including the space

- Unicode: current prevalent coding system for text
  - 32 bits to represent a symbol or char in *any language in the world*
  - First 127 characters are ASCII code
  - Details can be found at Appendix A in the textbook

Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*



Data Flow Examples

- Simplex mode
  - Keyboard, mouse, traditional monitor
  - GPS device
- Half duplex
  - Walkie-talkie
  - Citizen band radio
  - Advantage: entire bandwidth can be used for transmission
  - Cons: not suitable for high interactive application
- Full duplex

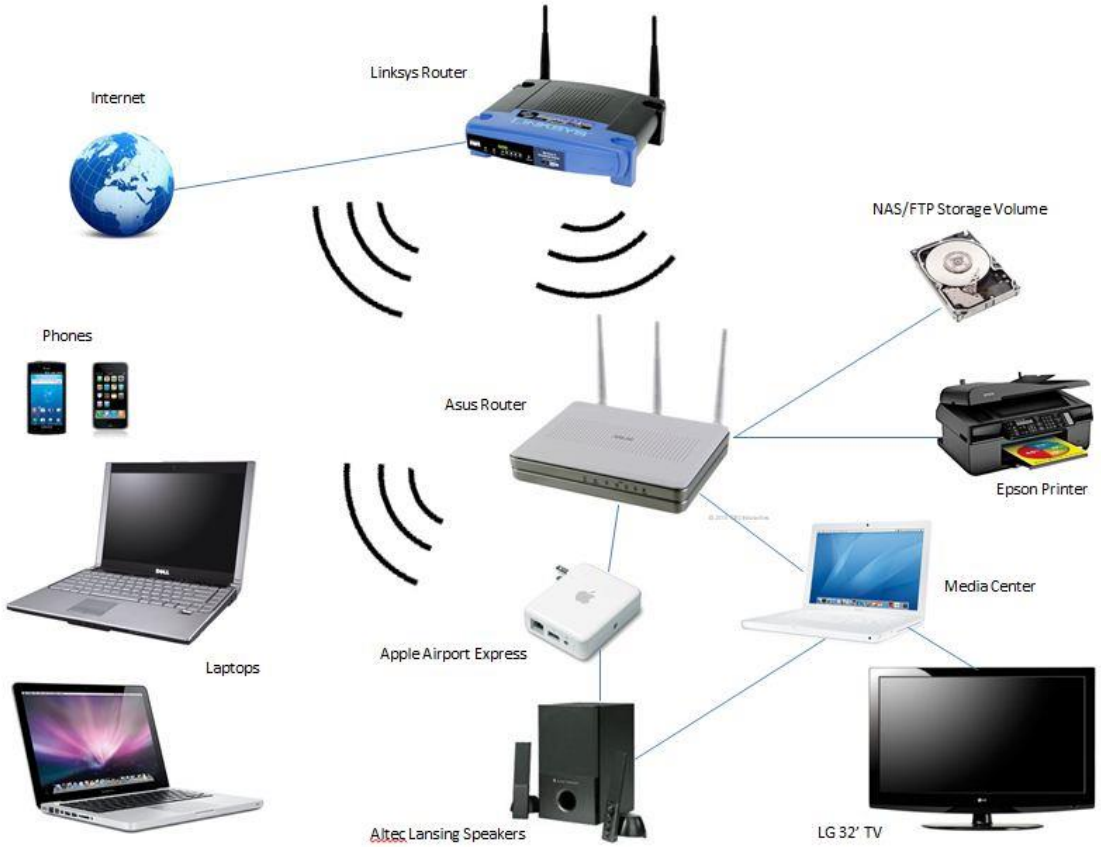
A network is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

Topics discussed in this section:

Distributed Processing
Network Criteria
Physical Structures
Network Models
Categories of Networks
Interconnection of Networks: Internetwork

Communication Devices: Examples

Common communication devices



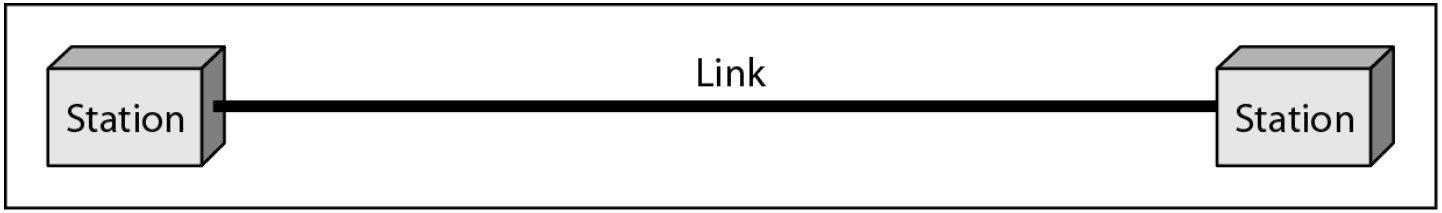
Devices that are part of the Internet of Things (IoT)

Network Criteria

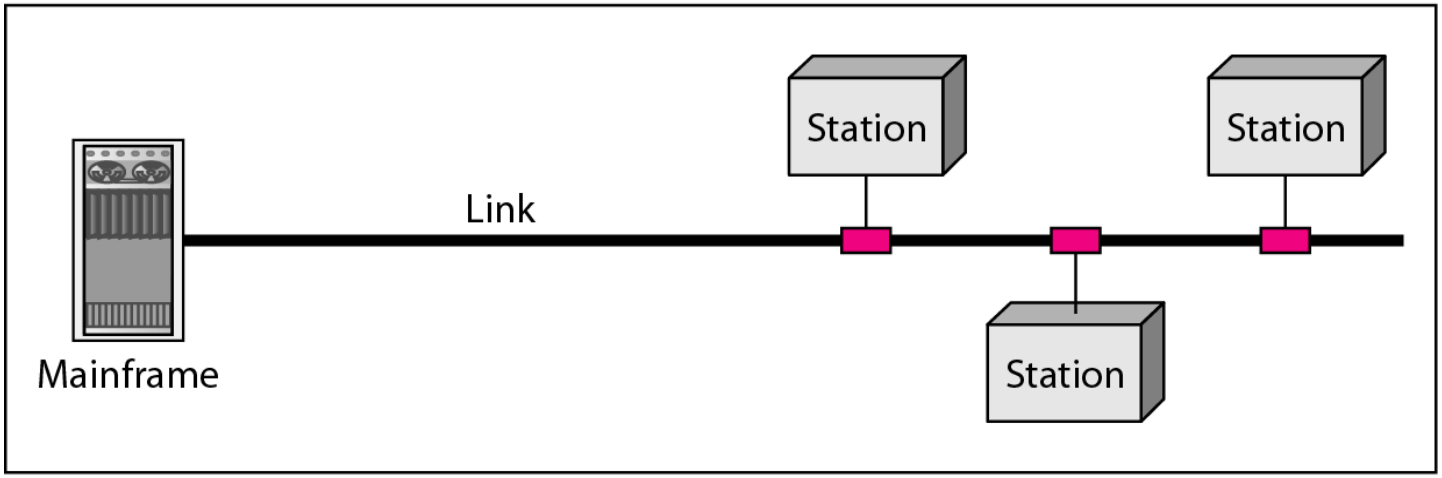
- **Performance:**
  - **Throughput: average rate of *successful* message delivery**
  - **Delay**
  - **Other criteria**
- **Reliability: frequency of failure, recover time, robustness**
- **Security**
  - becoming more important now

Figure 1.3 *Types of connections: point-to-point and multipoint*

Whether the link capacity is shared or not



a. Point-to-point



b. Multipoint

Categories of topology

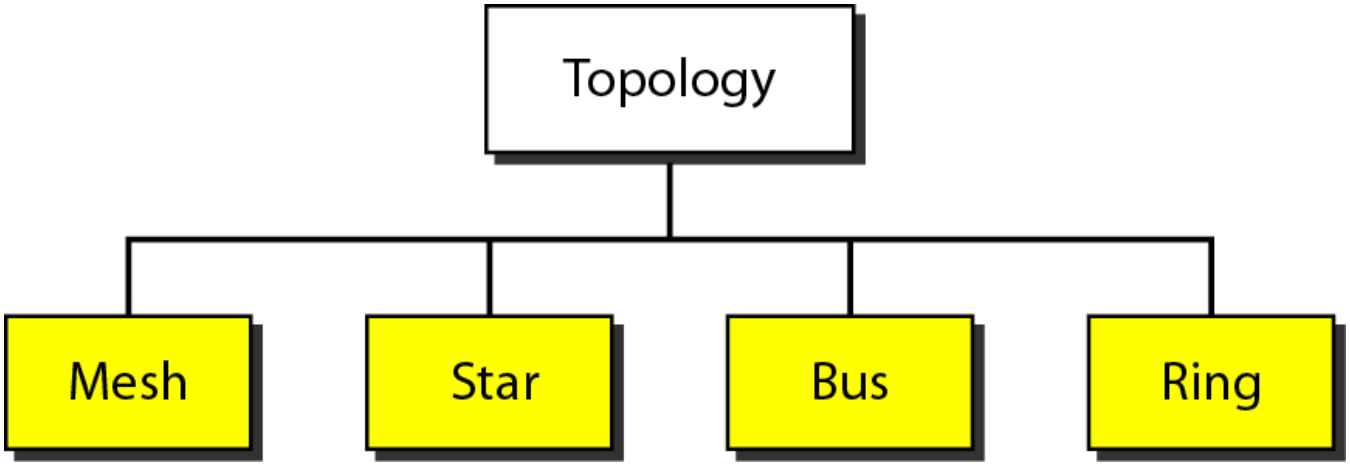
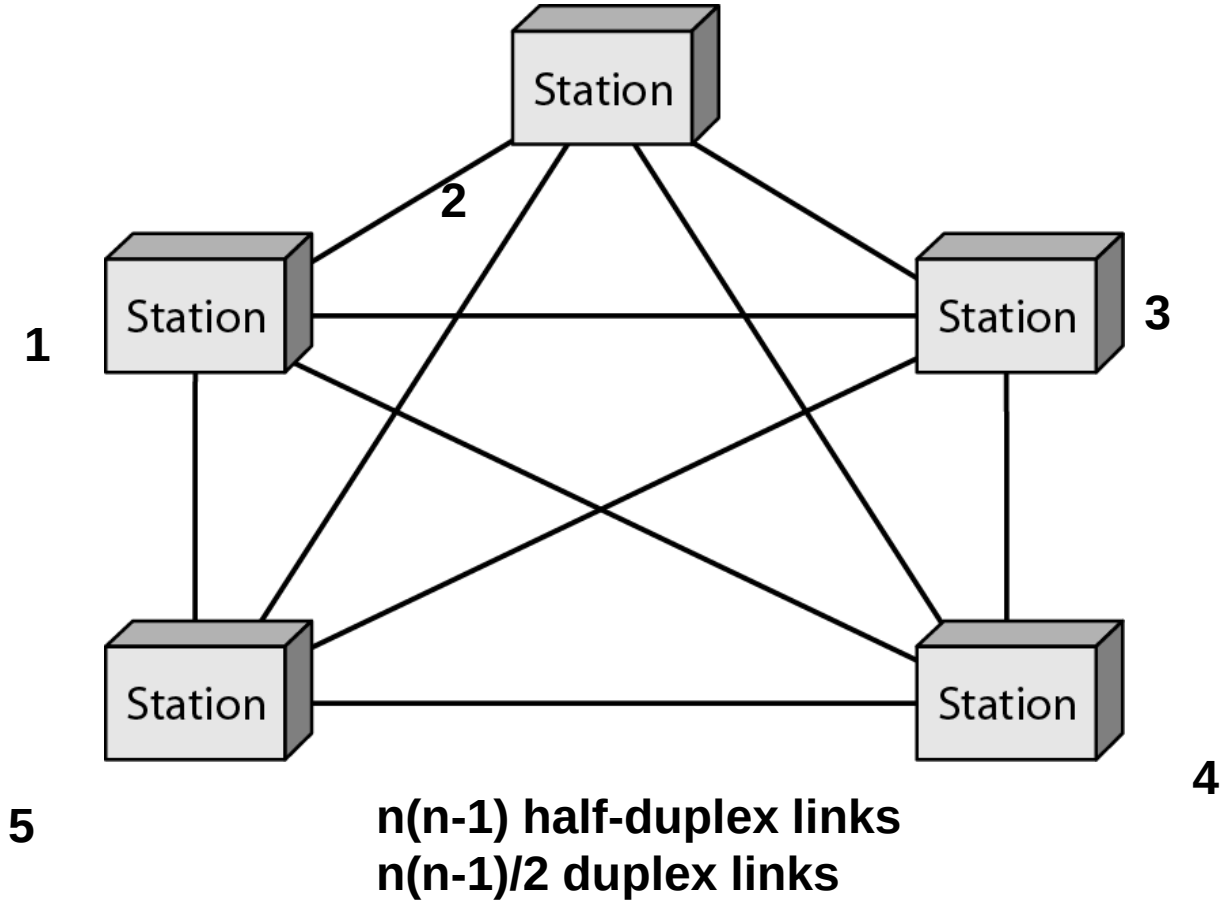


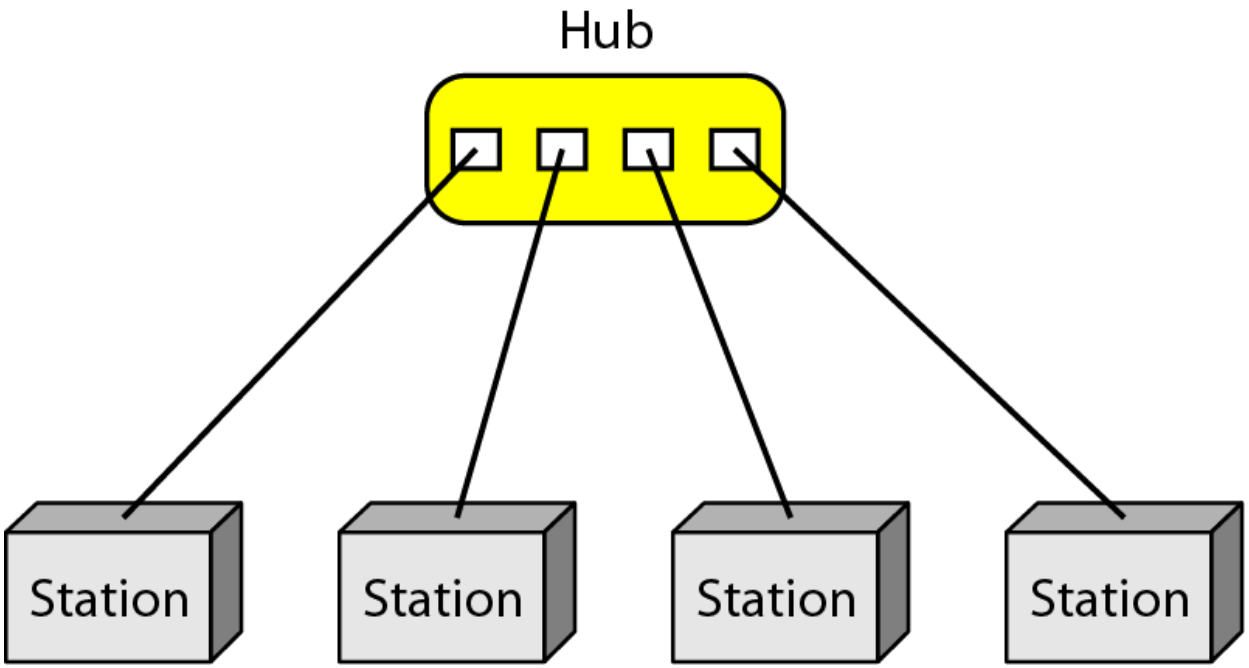
Figure 1.4 *A fully connected mesh topology (five devices)*



Pro: robustness

Con: many cabling/installation and need many I/O ports on nodes

Figure 1.6 *A star topology connecting four stations*

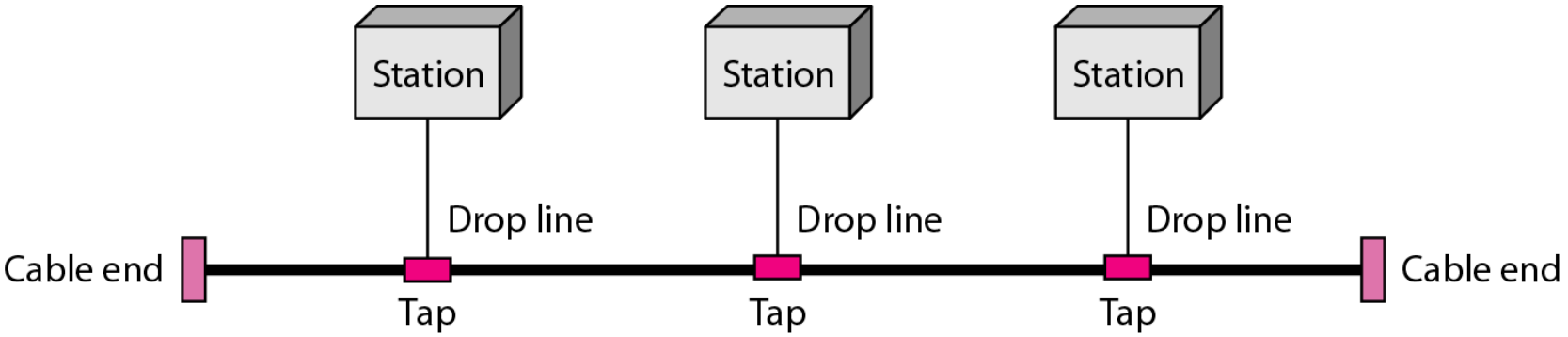


Example: Ethernet switch/hub, Wifi access point

Pro: robust against a node's failure or a link failure

Con: single point of failure at the hub

Figure 1.5 *A bus topology connecting three stations*

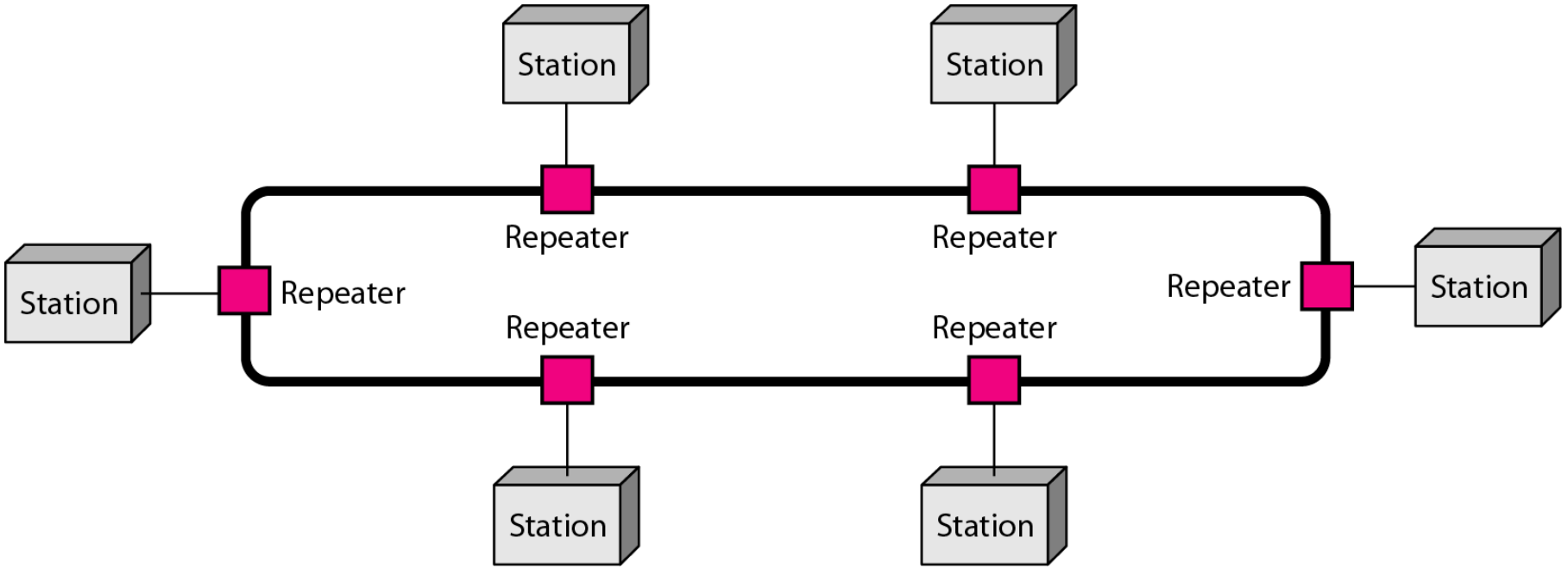


Example: first generation Ethernet that using cable for wiring

Con: any tap device failure will cause the whole system fail

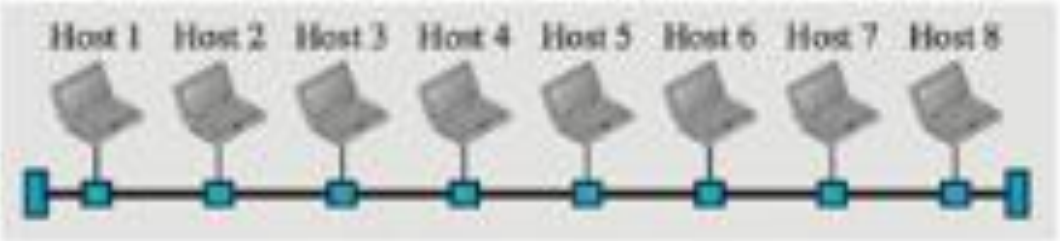
Figure 1.6 *A bus topology connecting three stations*

Figure 1.7 *A ring topology connecting six stations*

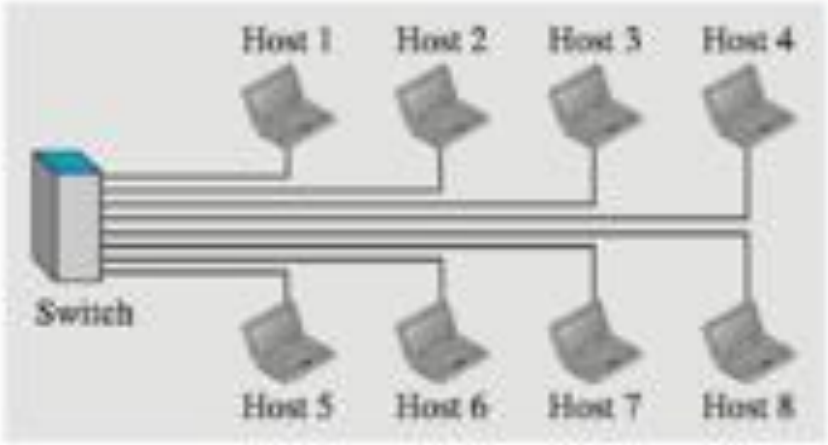


Example: IBM token ring LAN (less popular now).

Figure 1.8 *An isolated LAN in the past and today*

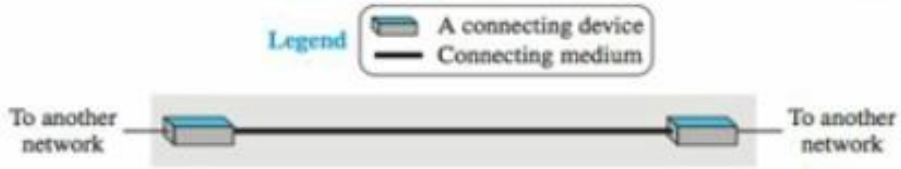


a. LAN with a common cable (past)



b. LAN with a switch (today)

Figure 1.9 *A point-to-point WAN*



Switched WAN

A switched WAN is a network with more than two ends. A switched WAN, as we will see shortly, is used in the backbone of global communication today. We can say that a switched WAN is a combination of several point-to-point WANs that are connected by switches. Figure 1.10 shows an example of a switched WAN.

Figure 1.10 *A switched WAN*

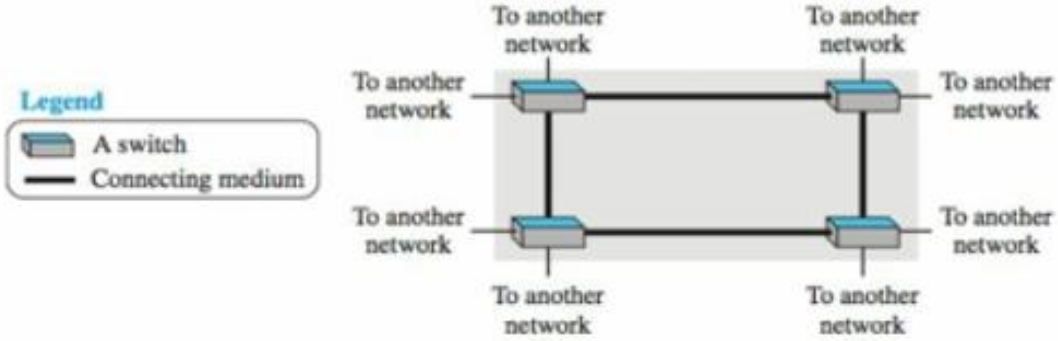
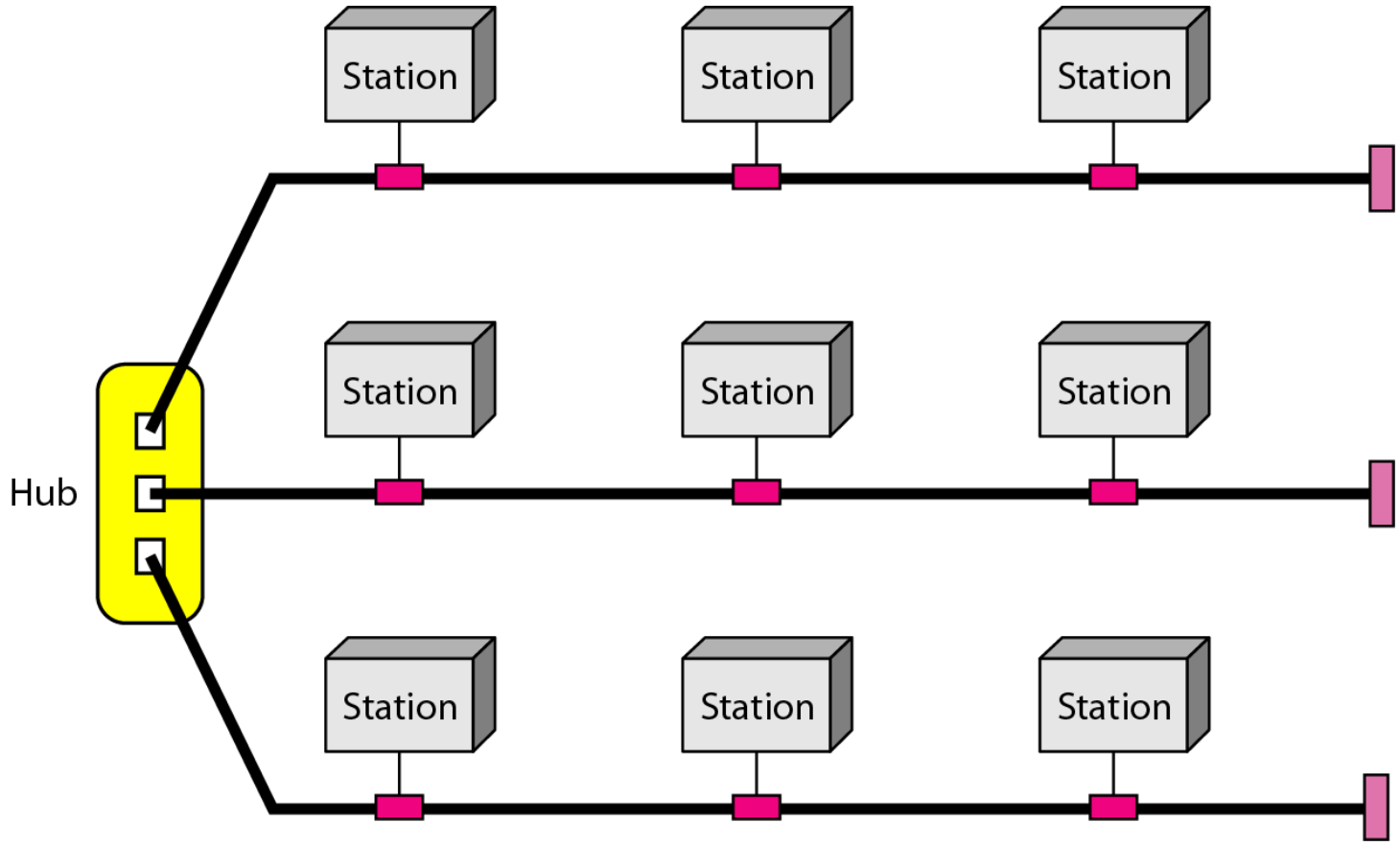


Figure *A hybrid topology: a star backbone with three bus networks*



Categories of Networks

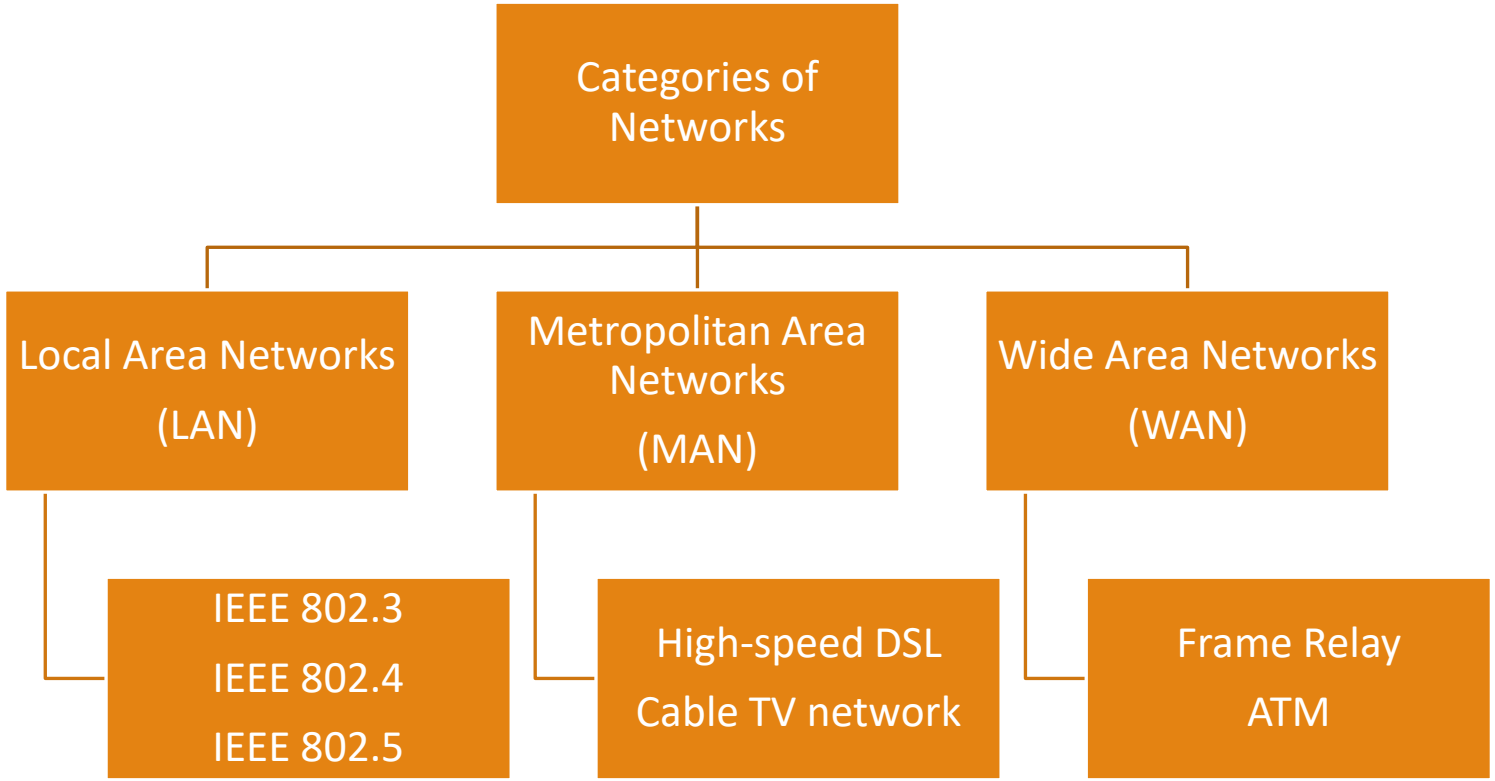


Figure 1.10 *An isolated LAN connecting 12 computers to a hub in a closet*

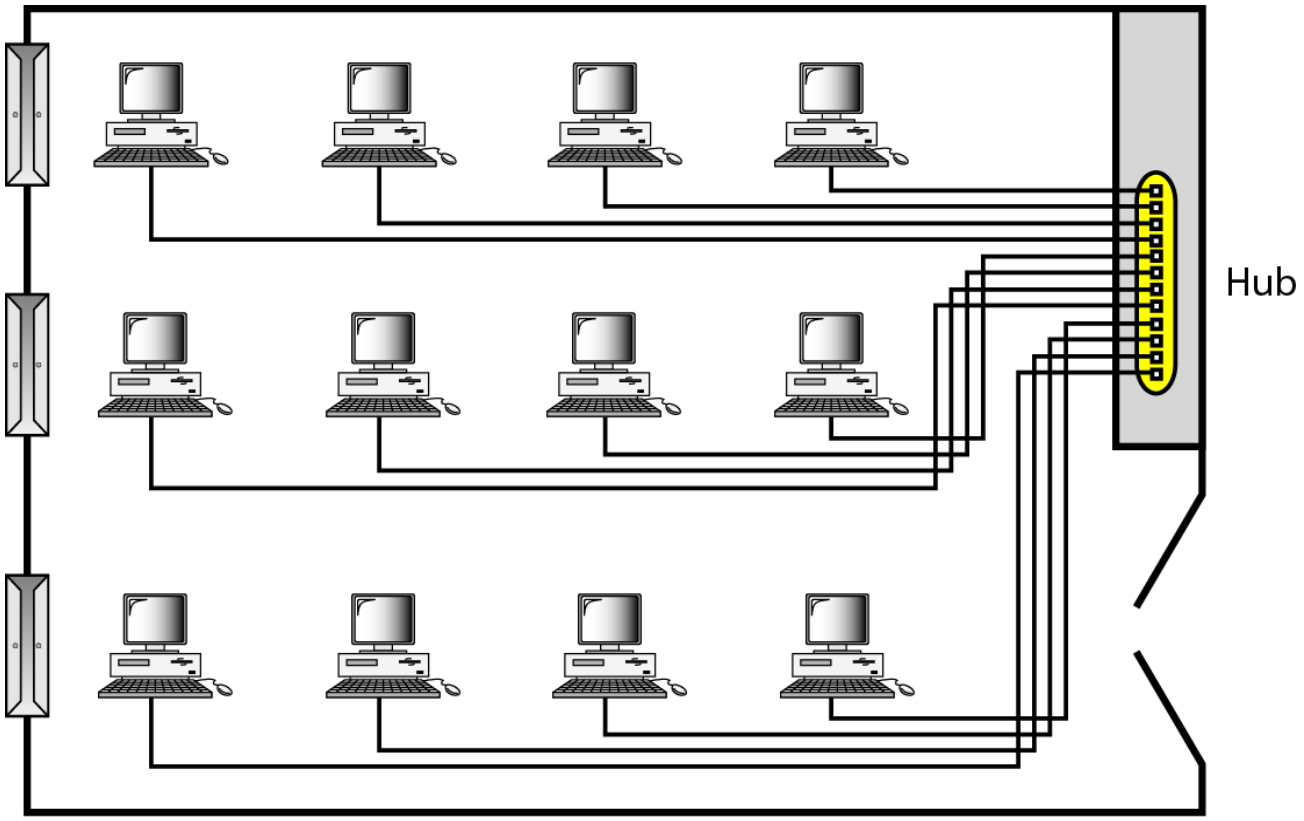
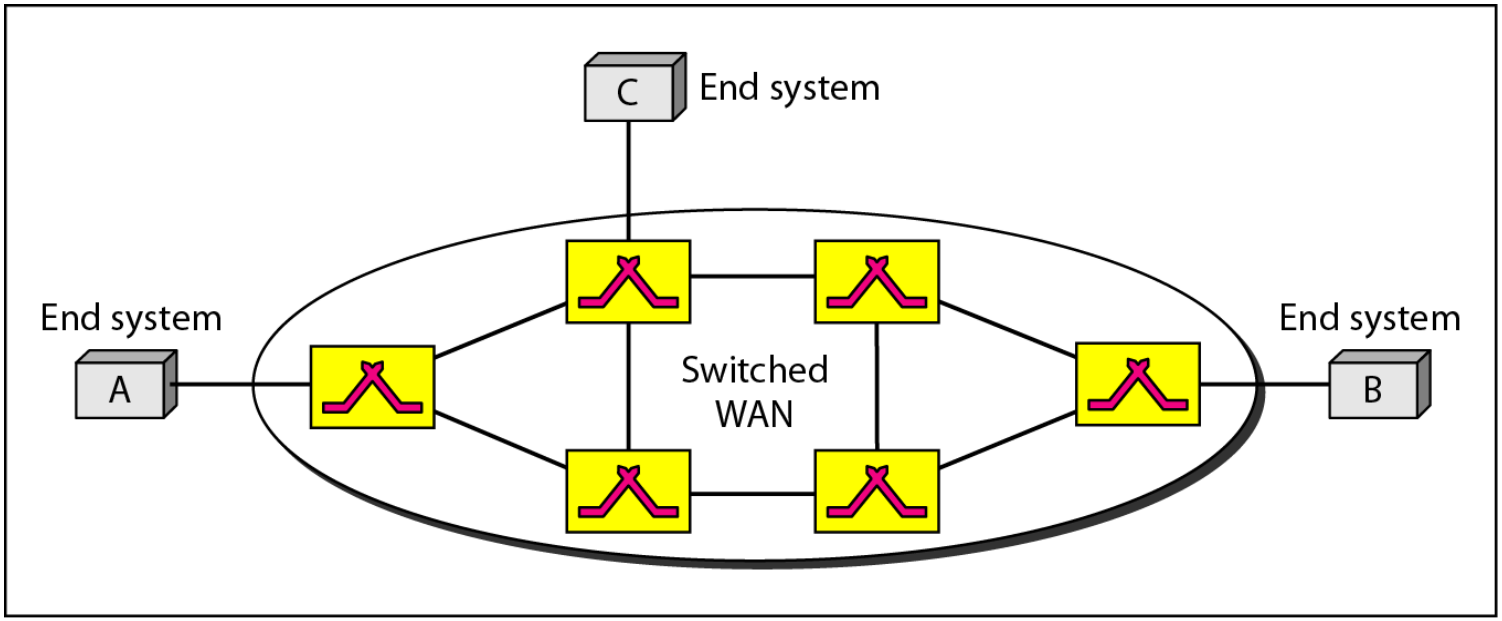
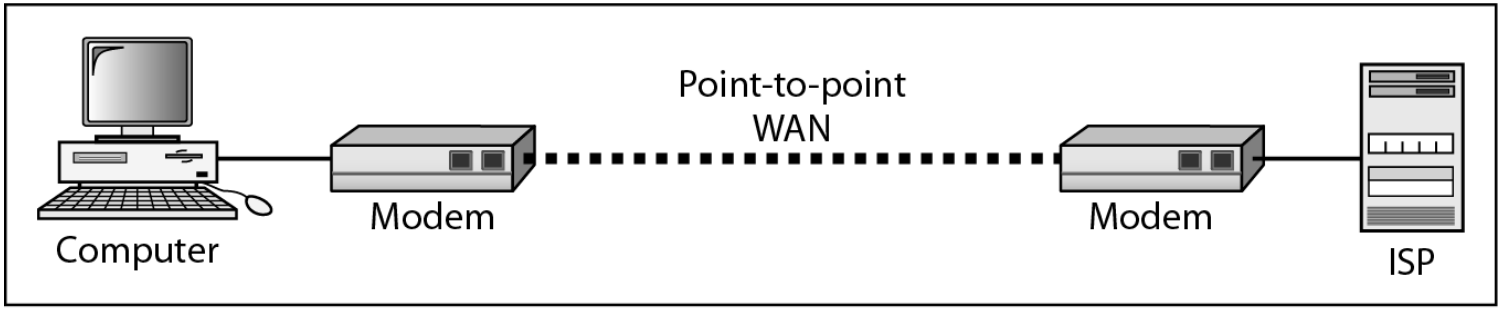


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

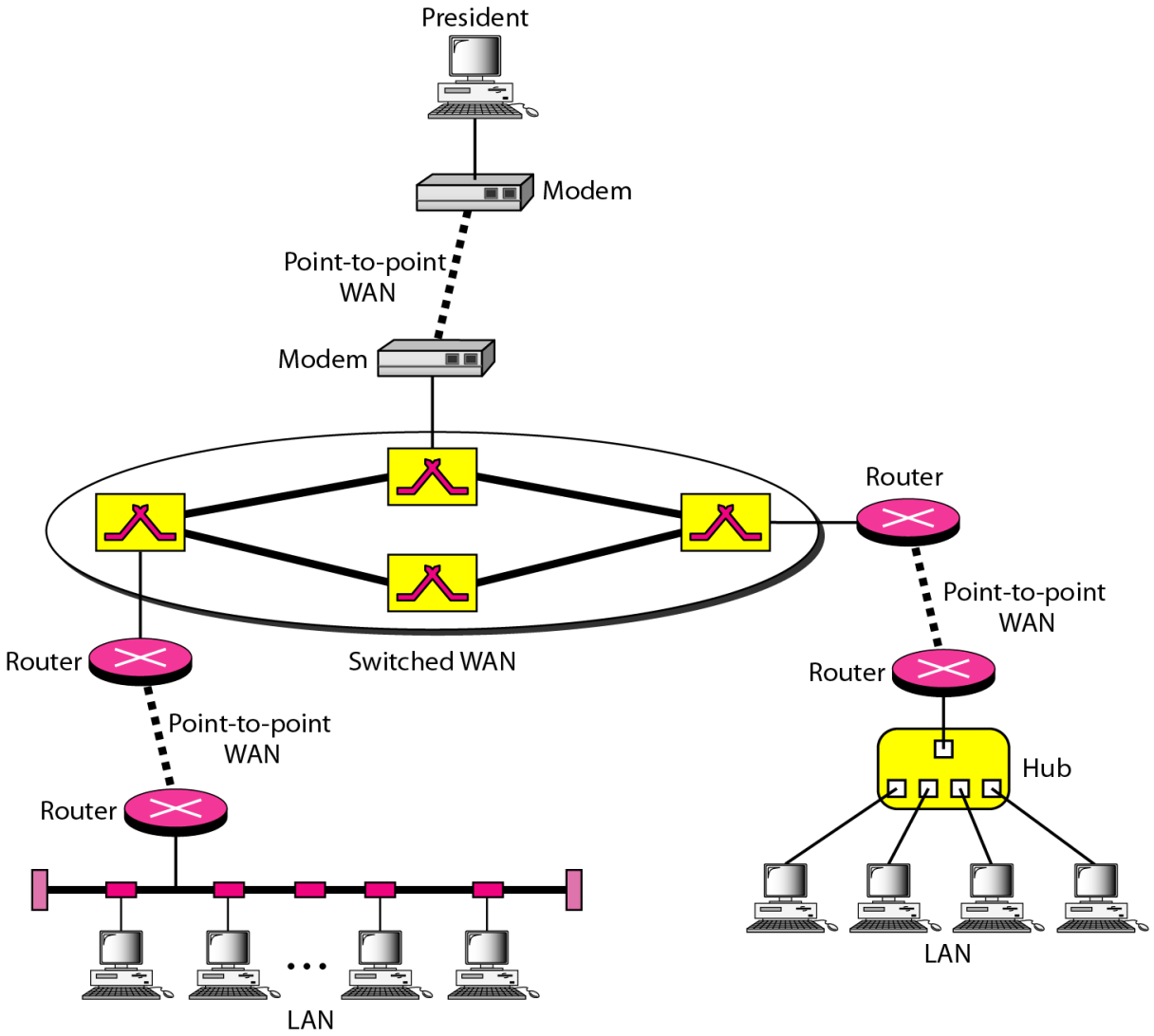


a. Switched WAN



b. Point-to-point WAN

Figure 1.12 *A heterogeneous network made of four WANs and two LANs*



Internet: Interconnection of Networks

Before Internet:

- *Many isolated Local Area Networks (LANs) existed*
- *Those LANs had very different hardware and network protocols*
  - *Protocol example: TCP/IP, IPX (from Novell)*

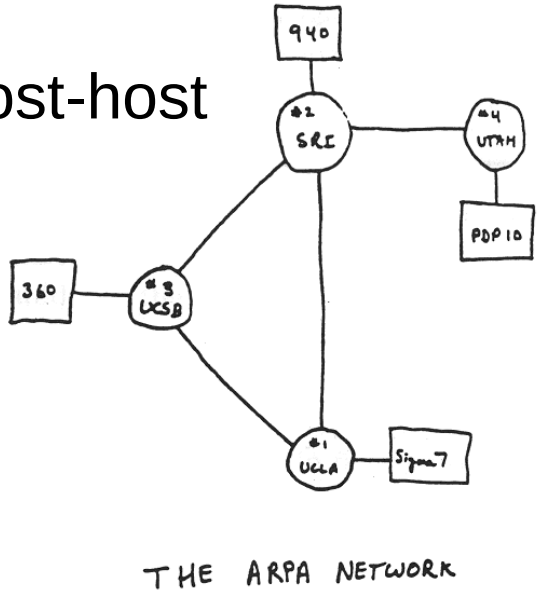
Topics discussed in this section:

A Brief History

The Internet Today (ISPs-Internet Service Providers)

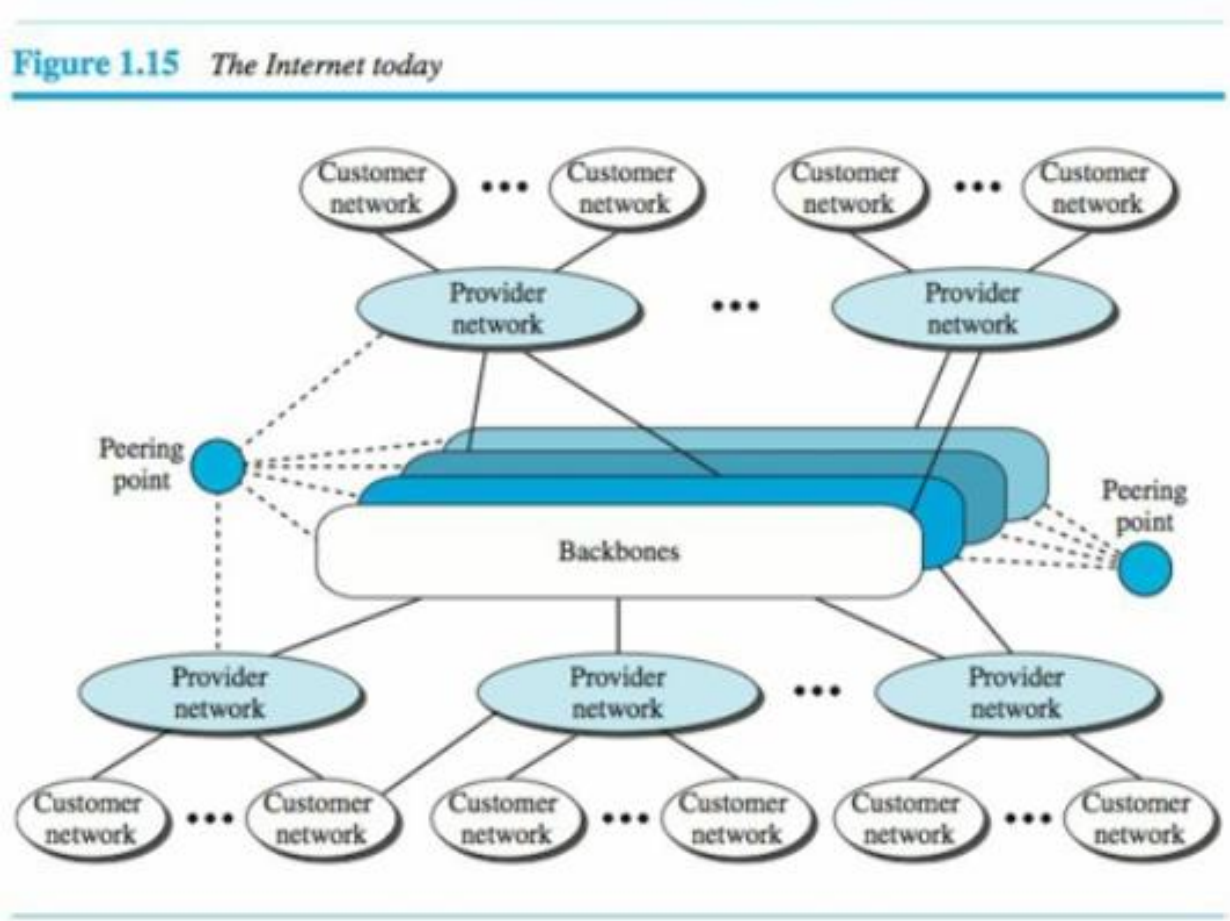
A Brief History

- 1961: Kleinrock - queueing theory shows effectiveness of packet-switching
- 1964: Baran - packet-switching in military nets
- 1967: ARPAnet conceived by Advanced Research Projects Agency
- 1969: first ARPAnet node operational
- 1972:
  - ARPAnet demonstrated publicly
  - NCP (Network Control Protocol) first host-host
  - protocol
  - first e-mail program
  - ARPAnet has 15 nodes



THE ARPA NETWORK

Figure 1.15 *Hierarchical organization of the Internet now*



In this section, we define two widely used terms: protocols and standards. First, we define protocol, which is synonymous with rule. Then we discuss standards, which are agreed-upon rules.

Topics discussed in this section:

Protocols – similar to human language
(syntax, semantics, timing)
Standards – public recognized protocols for open market
Standards Organizations
Internet Standards – Internet draft (work in progress)
Request for Comment (RFC) (published, final standard)

CONCLUSION

1. Now everything is interconnected to some type of network (even appliances, outlets, and more).

2. Understanding the foundation of communications is key to understanding how every device communicates with other devices.

3. The five parts of communications include: the Message, Sender, Receiver, Transmission Media, and Protocol.

4. Networks come in different types; from PANs (Personal Area networks), to WANs (Wide Area Networks – like the Internet).

5. Protocols and Standards are important for understanding how networks are developed, and how data flows in a standardized way.