CMPS1134
Fundamentals of Computing

Networking and the Internet 1

Computer Science: An Overview
Eleventh Edition
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Chapter 4

Chapter 4: Networking & Internet

- **Network Fundamentals**
- **The Internet**

- The World Wide Web
- Internet Protocols
- Security

Network Classifications

- Scope
  - **Personal area network (PAN)**
  - **Local area network (LAN)**
  - **Metropolitan area (MAN)**
  - **Wide area network (WAN)**
- Ownership
  - **Closed** (Proprietary – e.g. Novell) versus **Open** (Public Domain – e.g. Internet, TCP/IP)
- Topology (configuration)
  - **Bus** (Ethernet)
  - **Star** (Wireless networks with central **Access Point**)

Figure 4.1 **Network topologies**

a. Bus

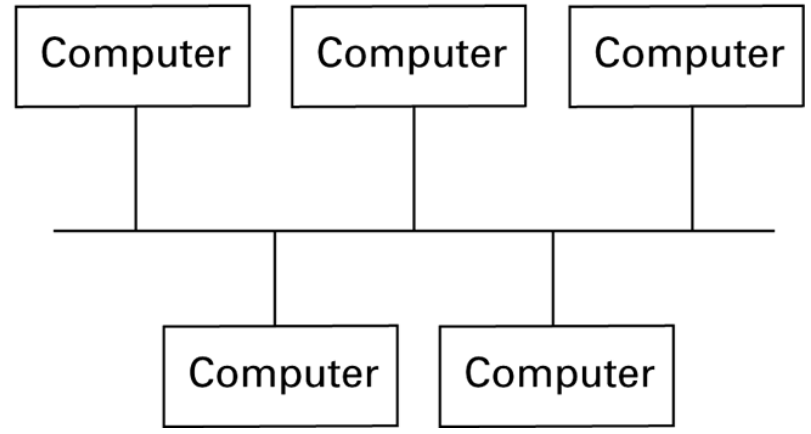
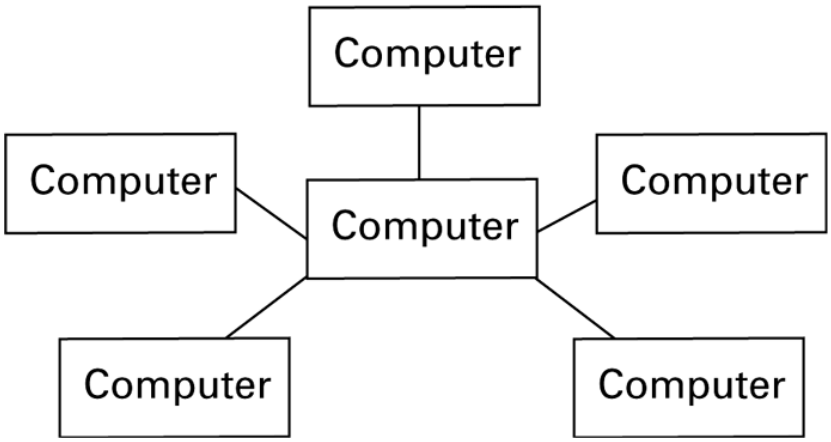


Figure 4.1 **Network topologies (cont)**

b. Star



Protocols

Rules or **protocol** standards are established to ensure networks function reliably. Protocols are indispensable in the development of networking technologies.

- **CSMA/CD**
  Carrier sense multiple access with collision detection
  - A media access control method that uses a carrier sensing scheme in which a transmitting data station detects other signals while transmitting and terminates transmission as soon as a collision is detected.
  - Used in Ethernet
  - Silent bus provides right to introduce new message
- **CSMA/CA**
  Carrier sense multiple access with collision avoidance
  - A network multiple access method in which carrier sensing is used, but nodes attempt to avoid collisions by transmitting only when the channel is sensed to be "idle".
  - Used in WiFi
  - Hidden terminal problem

Figure 4.2 **Communication over a bus network**

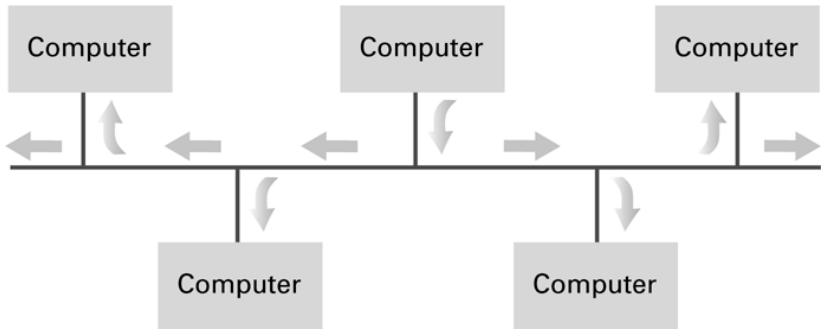


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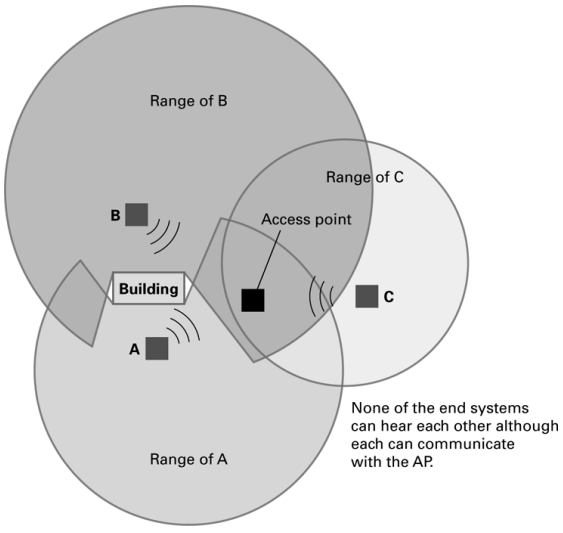
Figure 4.3 **The hidden terminal problem**



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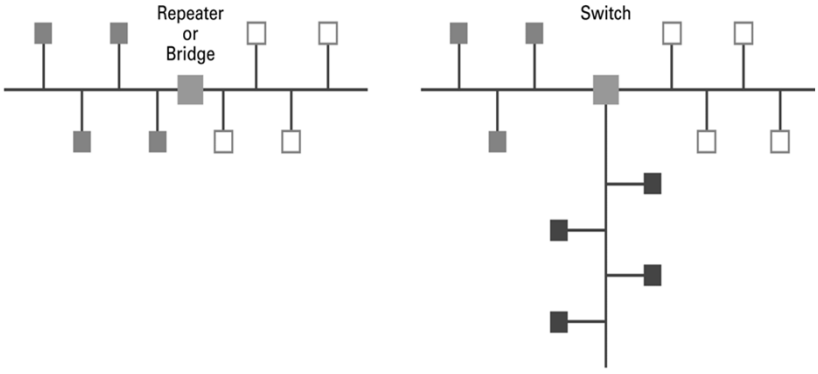
Connecting Networks

- **Repeater:** Extends a network
- **Bridge:** Connects two compatible networks
- **Switch:** Connects several compatible networks
- **Router:** Connects two different networks resulting in a network of networks called an **internet**

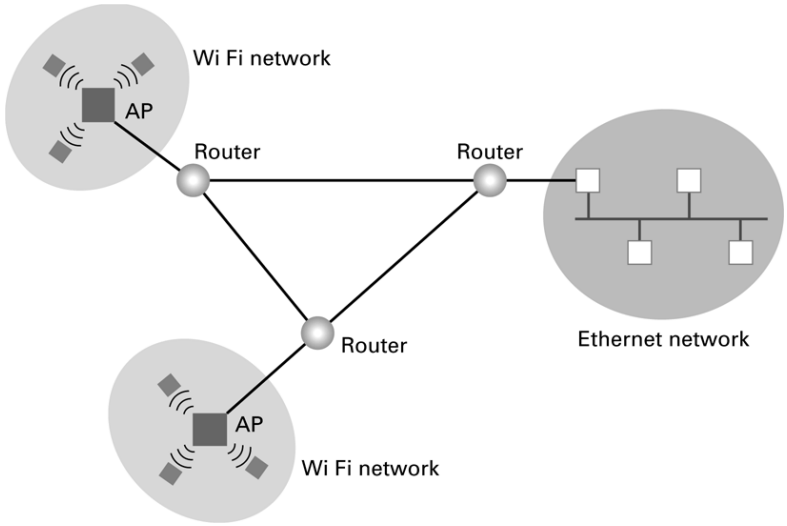
Figure 4.4 **Building a large bus network from smaller ones**



a. A repeater or bridge connecting two buses

b. A switch connecting multiple buses

Fig 4.5 **Routers connecting 2 WiFi nets and an Ethernet network to form an internet**



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Inter-process Communication

- **Client-server**
  - One server, many clients
  - Server must execute continuously
  - Client initiates communication
- **Peer-to-peer (P2P)**
  - Two processes communicating as equals
  - Peer processes can be short-lived

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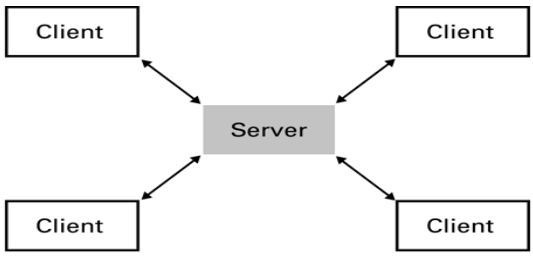
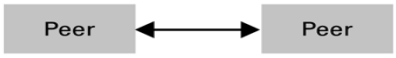
Figure 4.6 **The client/server model compared to the peer-to-peer model**



a. Server must be prepared to serve multiple clients at any time.



b. Peers communicate as equals on a one-to-one basis.

Distributed Systems

- Systems with parts that run on different computers
  - **Cluster computing**
    - Typically homogeneous (tightly coupled)
  - **Grid computing**
    - Geographically distributed (loosely coupled)
  - **Cloud computing**
    - Services provided via the "cloud"
      - Amazon's Elastic Compute Cloud
      - Google Drive

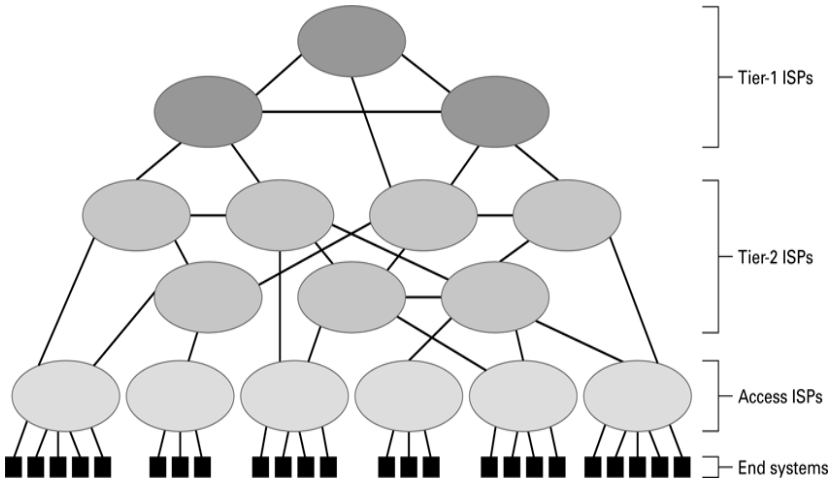
The Internet

- The Internet: An internet that spans the world
  - Original goal was to develop a means of connecting networks that would not be disrupted by local disasters.
  - Today it has shifted from an academic research project to a commercial undertaking that links a worldwide combination of PANs, LANs, MANs, and WANs involving millions of computers

Internet Architecture

- **Internet Service Provider (ISP)**
  - **Tier-1**: Backbone (high-speed, high capacity international WANs)
  - **Tier-2**: Regional providers
  - **Access or tier-3 ISP**: Provides connectivity to the Internet
    - Hot spot (wireless)
    - Traditional telephone (dial up connection)
    - Cable/Satellite systems
    - Digital Subscriber Line (DSL)
    - Fiber optics
    - Wireless

Figure 4.7 **Internet Composition**



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Internet Addressing

- **IP address**: pattern of 32 (**IPV4**) or 128 (**IPV6**) bits often represented in dotted decimal notation
  - IPV4: 192.168.1.1
  - IPV6: 2001:0db8:85a3:0000:0000:8a2e:0370:7334
- Mnemonic address:
  - **Domain** names e.g. ub.edu.bz
  - **Subdomain** names e.g. doit.ub.edu.bz
  - **Top-Level Domains (TLDs)** e.g. .bz
- **Domain Name System (DNS)**
  - **Name servers**: directories that provide address translation services
  - **DNS lookup**: the process of using a DNS to perform a translation

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Internet Corporation for Assigned Names & Numbers (ICANN)

- Allocates IP addresses to ISPs who then assign those addresses within their regions.
- Oversees the registration of domains and domain names.
- Domains must be registered with ICANN. The process is handled by **registrars** who have been assigned this role by ICANN.

Early/ Traditional Internet Applications

- **Network News Transfer Protocol (NNTP)**
- **File Transfer Protocol (FTP)**
- **Telnet and SSH**
- **Hypertext Transfer Protocol (HTTP)**
- **Electronic Mail (email)**
  - Domain **mail server** collects incoming mail and transmits outgoing mail
  - **SMTP** is used to send a new mail or transfer mail between mail servers
  - Mail server delivers collected incoming mail to clients via **POP3** or **IMAP**

More Recent Applications

- **Voice Over IP (VoIP)**
- Internet Multimedia Streaming
  - **N-unicast**
  - **Multicast**
  - On-demand streaming
  - **Content delivery networks (CDNs)**