



CSM 152: NETWORKING AND INTERNET

LESSON 1

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Chapter 4: Networking and the Internet

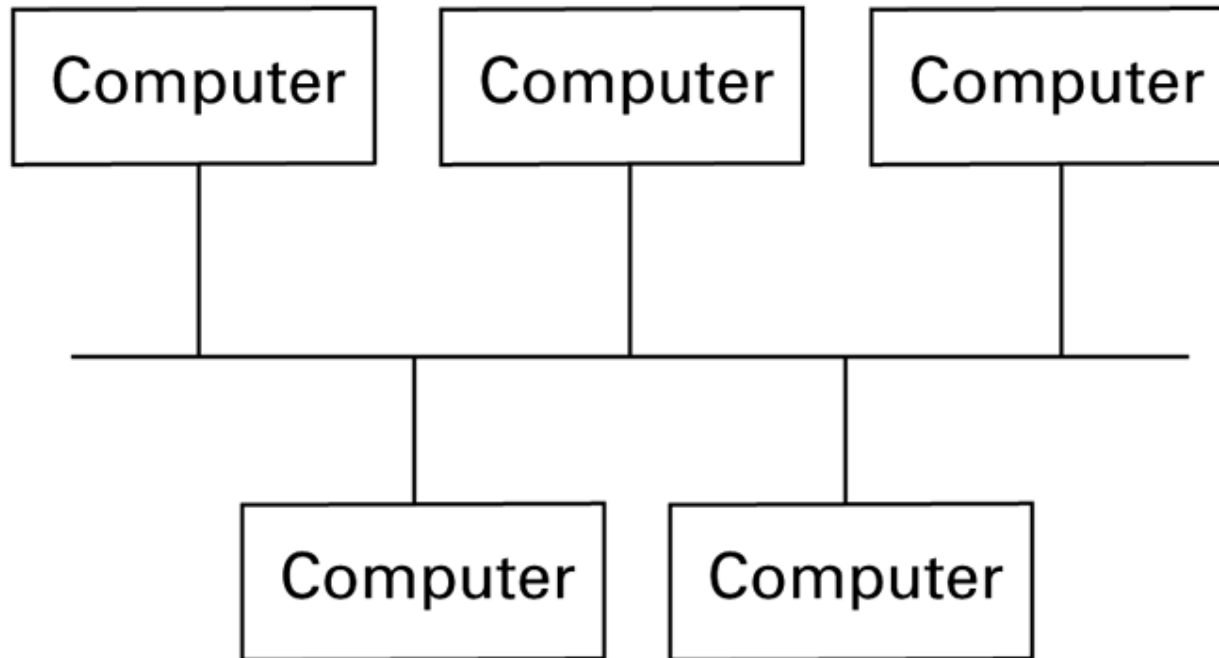
- 4.1 Network Fundamentals
- 4.2 The Internet
- 4.3 The World Wide Web
- 4.4 Internet Protocols
- 4.5 Security

Network Classifications

- Scope
 - Personal area network (PAN)
 - Local area network (LAN)
 - Metropolitan area (MAN)
 - Wide area network (WAN)
- Ownership
 - Closed versus open
- Topology (configuration)
 - Bus (Ethernet)
 - Star (Wireless networks with central Access Point)

Figure 4.1 Network topologies

a. Bus



Bus topology

- All networked nodes are interconnected, peer to peer, using a single, open-ended cable
- Both ends of the bus must be terminated with a terminating resistor to prevent signal bounce

Advantages of Bus topology

- 1) Easy to implement and extend
- 2) Well suited for temporary networks that must be set up in a hurry
- 3) Typically the least cheapest topology to implement
- 4) Failure of one station does not affect others

Disadvantages of Bus topology

- 1) Difficult to administer/troubleshoot
- 2) Limited cable length and number of stations
- 3) A cable break can disable the entire network; no redundancy
- 4) Maintenance costs may be higher in the long run
- 5) Performance degrades as additional computers are added

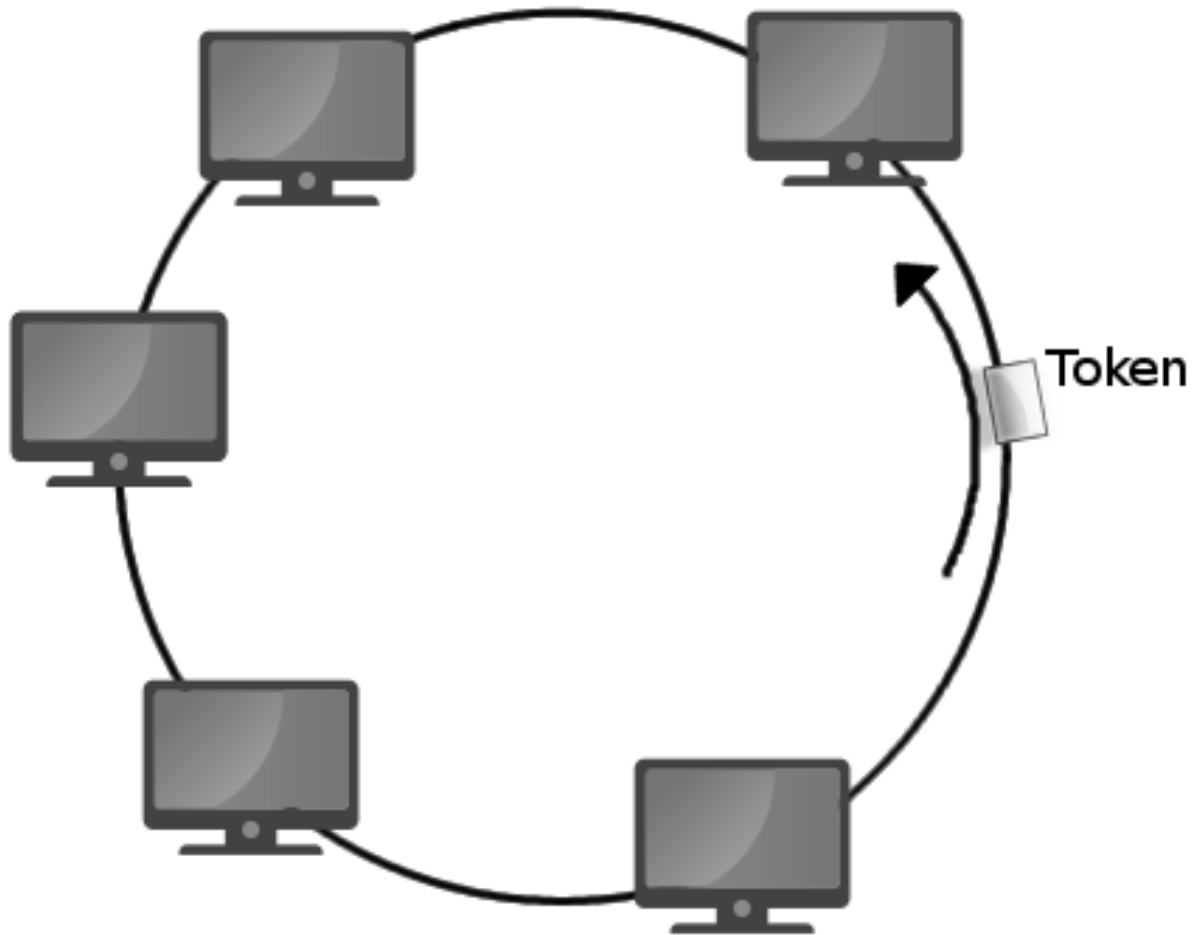
Ring topology

- Started out as a simple peer-to-peer LAN topology
- Each networked workstation had two connections: one to each of its nearest neighbors
- Data was transmitted unidirectionally around the ring
- Sending and receiving of data takes place by the help of Token

Token Passing

- Token contains a piece of information which along with data is sent by the source computer
- This token then passes to next node, which checks if the signal is intended to it
 - If yes, it receives it and passes the empty token into the network
 - otherwise passes token along with the data to next node

Ring topology



Advantages of Ring topology

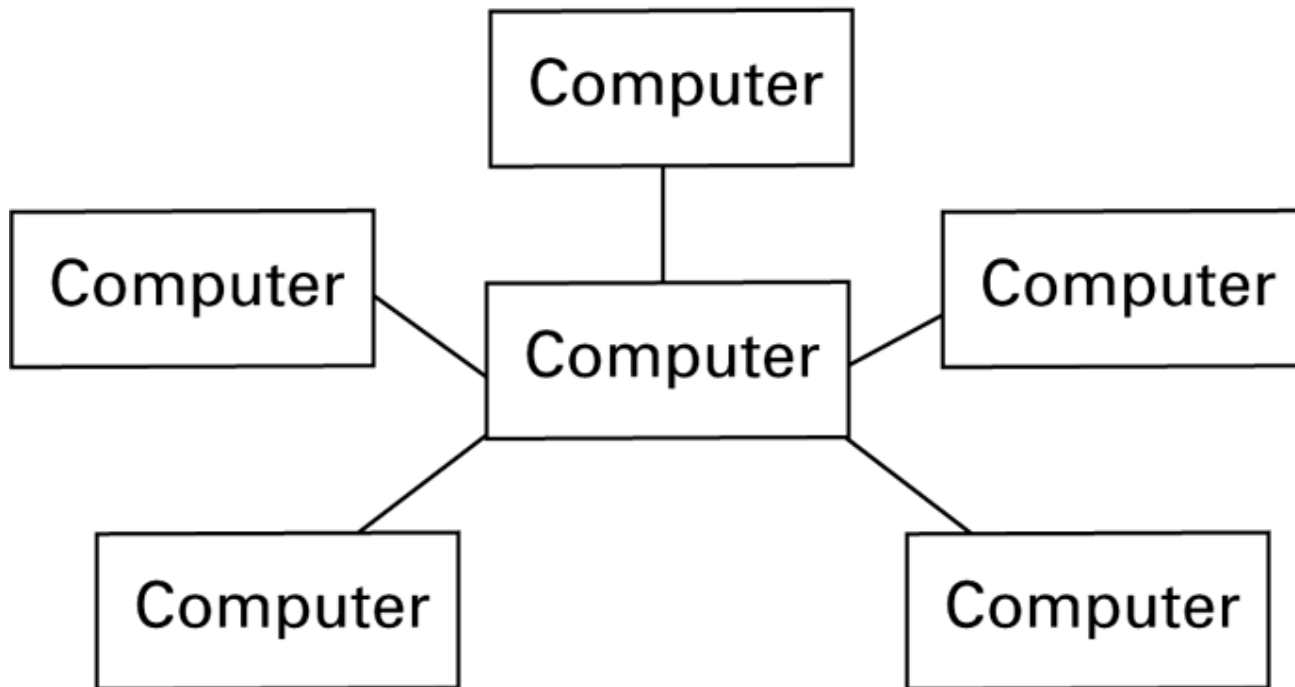
- 1) This type of network topology is very organized
- 2) Performance is better than that of Bus topology
- 3) No need for network server to control the connectivity between workstations
- 4) Additional components do not affect the performance of network
- 5) Each computer has equal access to resources

Disadvantages of Ring topology

- 1) Each packet of data must pass through all the computers between source and destination, slower than star topology
- 2) If one workstation or port goes down, the entire network gets affected
- 3) Network is highly dependent on the wire which connects different components

Figure 4.1 Network topologies (continued)

b. Star



Star topology

- Have connections to networked devices that “radiate” out from a common point
- Each networked device in star topology can access the media independently
- Have become the dominant topology type in contemporary LANs
- Stars have made buses and rings obsolete in LAN topologies

Advantages of star topology

- 1) Compared to Bus topology it gives far much better performance
- 2) Easy to connect new nodes or devices
- 3) Centralized management. It helps in monitoring the network
- 4) Failure of one node or link doesn't affect the rest of network

Disadvantages of star topology

- 1) If central device fails whole network goes down
- 2) The use of hub, a router or a switch as central device increases the overall cost of the network
- 3) Performance and as well number of nodes which can be added in such topology is depended on capacity of central device

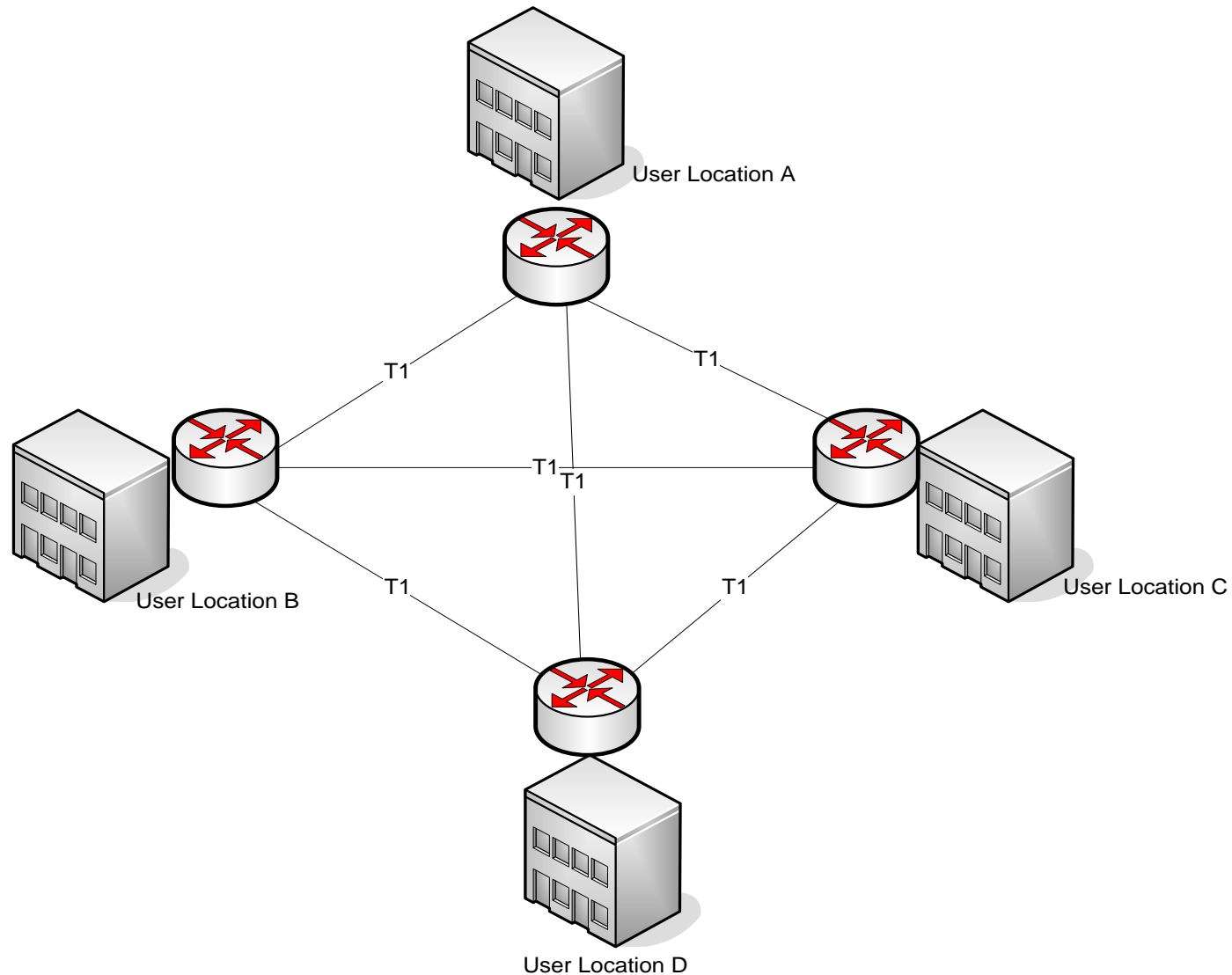
Full-mesh topology

- This topology features the ultimate reliability and fault tolerance
- Every networked node is directly connected to every other networked node
- Redundant routes to each location are plentiful, hence static routing impractical.
- Use dynamic routing protocols
- One application would be to provide interconnectivity for a limited number of routers that require high network availability
- Another potential application is to fully mesh just parts of the WAN, such as the backbone of a multitiered WAN or tightly coupled work centers

Advantages/Disadvantages of full-mesh

- Advantages:
 - Minimizes the number of hops between any two network-connected machines
 - Can be built with virtually any transmission technology
- Disadvantages:
 - These WANs can be fairly expensive to build
 - A finite (although substantial) limit on the scalability of the network

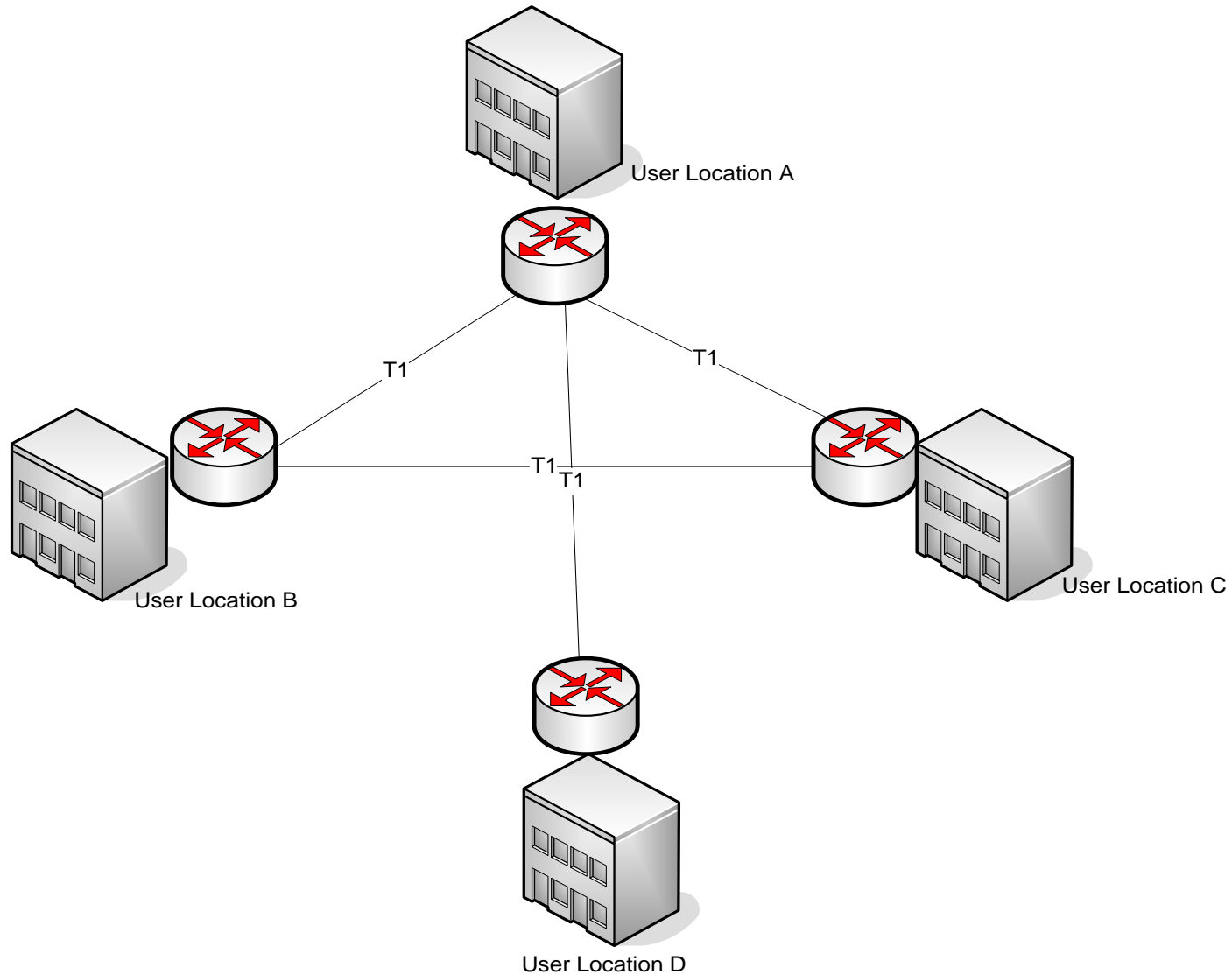
Full-mesh topology



Partial-mesh topology

- Partial meshes are highly flexible topologies that can take a variety of very different configurations
- The routers are much more tightly coupled than any of the basic topologies but are not fully interconnected, as would be the case in a fully meshed network
- A partially meshed WAN topology is readily identified by the almost complete interconnection of every node with every other node in the network

Partial-mesh



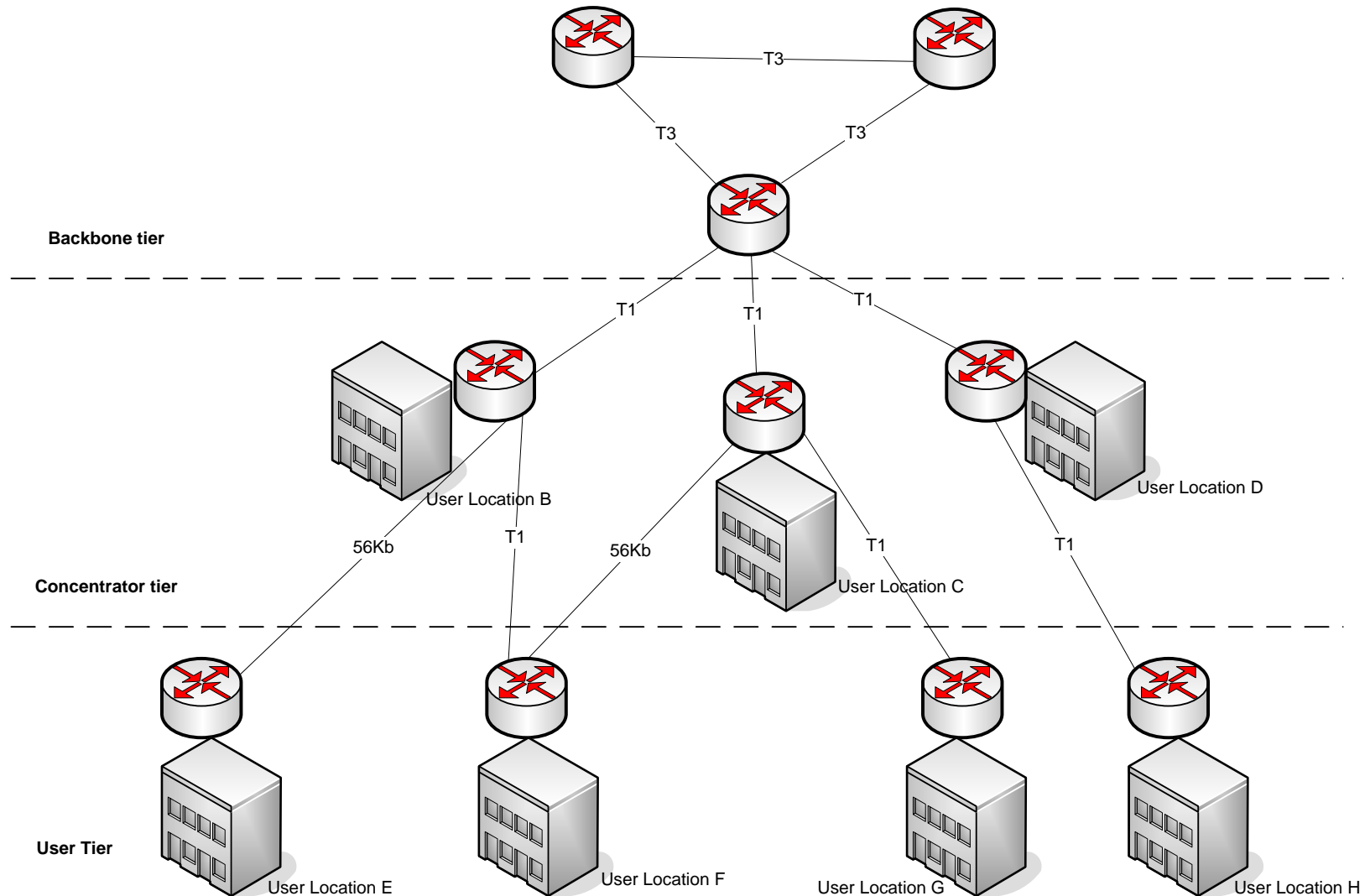
Advantages of partial-mesh

- Partial meshes offer the capability to minimize hops for the bulk of the WAN's users
- Unlike fully meshed networks, a partial mesh can reduce the startup and operational expenses by not interconnecting low-traffic segments of the WAN, hence more affordable and scalable

Hybrid topologies

- Hybridization of multiple topologies is useful in larger, more complex networks
- Multitiered networks, in particular, lend themselves to hybridization. A multitiered WAN can be hybridized by fully or partially meshing the backbone tier of routers
- An effective hybrid topology may be developed in a multitiered WAN by using a fully meshed topology for the backbone nodes only

Hybrid topology



Protocols

- CSMA/CD
 - Used in Ethernet
 - Silent bus provides right to introduce new message
- CSMA/CA
 - Used in WiFi
 - Hidden terminal problem

CSMA/CD in a Bus network

- In a bus network based on the Ethernet standards, the right to transmit messages is controlled by the protocol known as Carrier Sense, Multiple Access with Collision Detection (CSMA/CD). This protocol dictates that each message be broadcast to all the machines on the bus (Figure 4.2). Each machine monitors all the messages but keeps only those addressed to itself.
- To transmit a message, a machine waits until the bus is silent, and at this time it begins transmitting while continuing to monitor the bus. If another machine also begins transmitting, both machines detect the clash and pause for a brief, independently random period of time before trying to transmit again.
- The result is a system similar to that used by a small group of people in a conversation. If two people start to talk at once, they both stop. The difference is that people might go through a series such as, “I’m sorry, what were you going to say?”, “No, no. You go first,” whereas under the CSMA/CD protocol each machine merely tries again later.

CSMA/CA in WiFi

- Note that CSMA/CD is not compatible with wireless star networks in which all machines communicate through a central AP. This is because a machine may be unable to detect that its transmissions are colliding with those of another. For example, the machine may not hear the other because its own signal drowns out that of the other machine.
- Another cause might be that the signals from the different machines are blocked from each other by objects or distance even though they can all communicate with the central AP (a condition known as the hidden terminal problem, Figure 4.3). The result is that wireless networks adopt the policy of trying to avoid collisions rather than trying to detect them.
- Such policies are classified as Carrier Sense, Multiple Access with Collision Avoidance (CSMA/CA), many of which are standardized by IEEE (see the sidebar “Institute of Electrical and Electronics Engineers” in Chapter 7) within the protocols defined in IEEE 802.11 and commonly referred to as WiFi. We emphasize that collision avoidance protocols are designed to avoid collisions and may not eliminate them completely. When collisions do occur, messages must be retransmitted.

Figure 4.2 Communication over a bus network

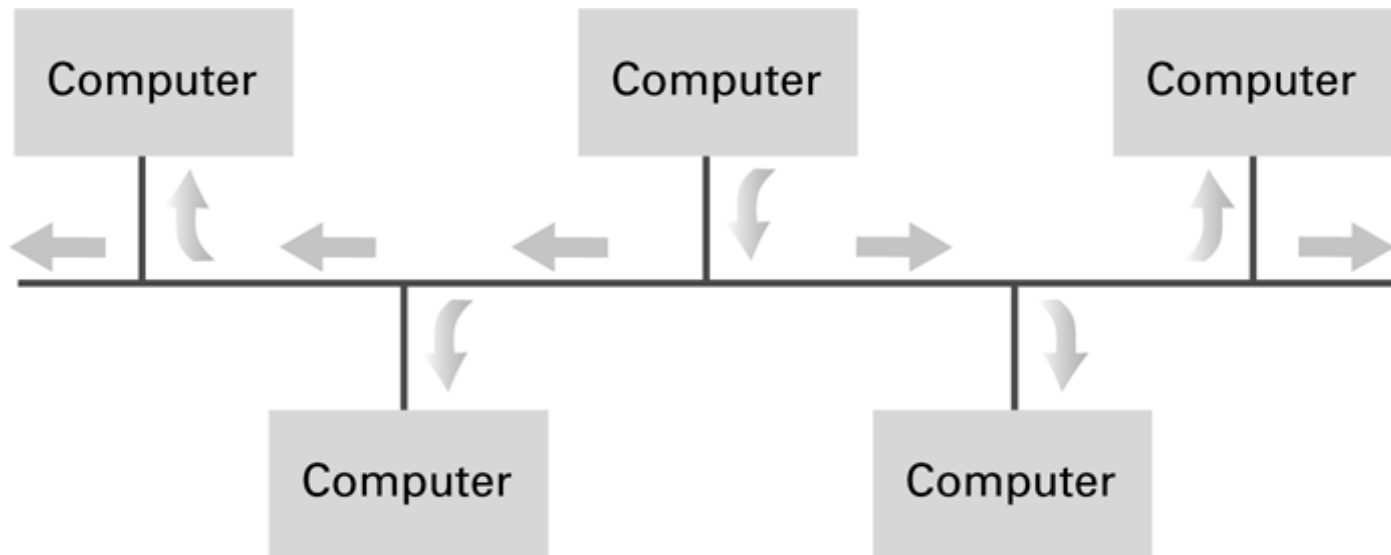
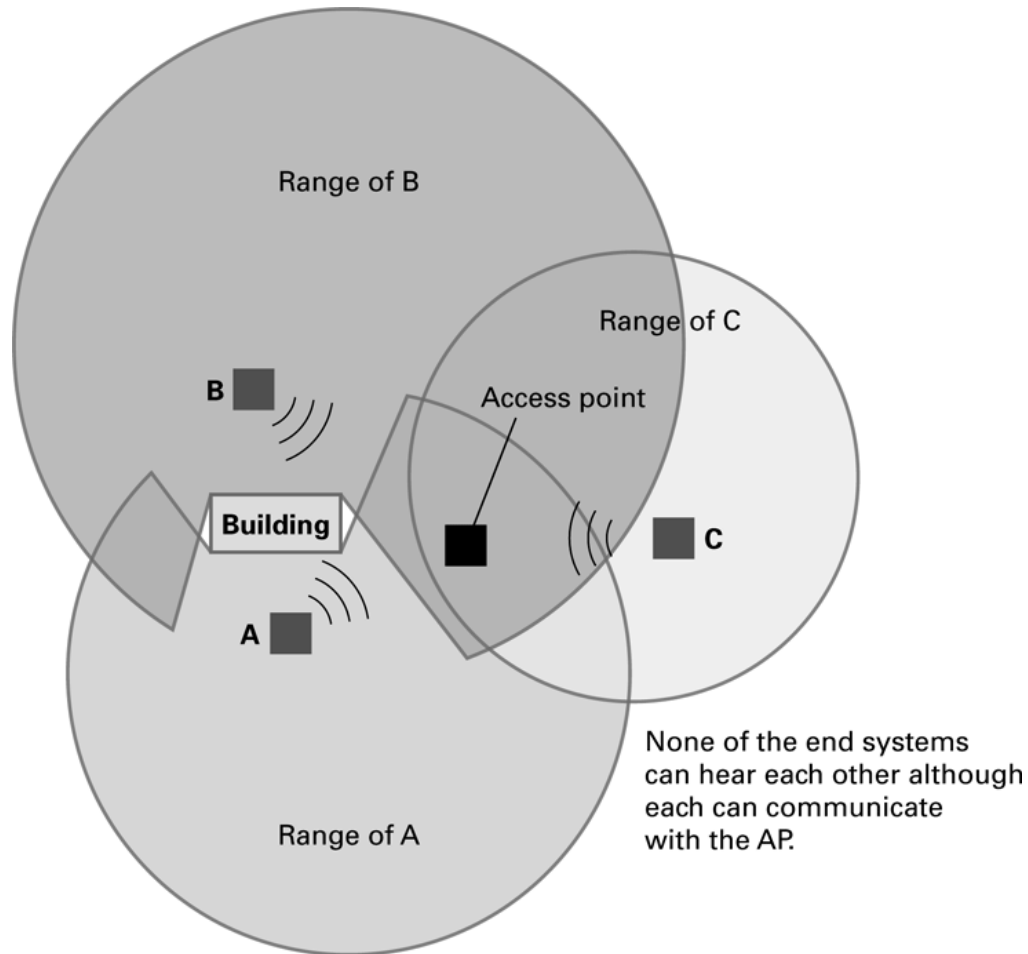


Figure 4.3 The hidden terminal problem



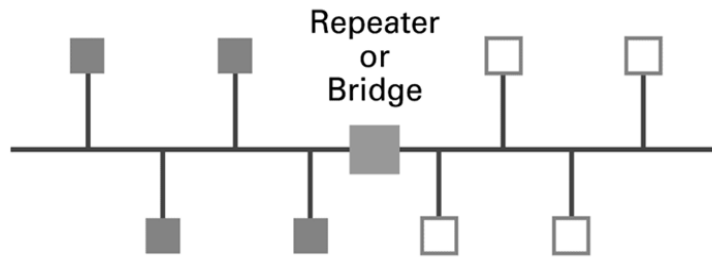
Connecting Networks

- **Repeater:** Extends a network: a device that passes signals back and forth between the two original buses (usually with some form of amplification) without considering the meaning of the signals.
- **Bridge:** Connects two compatible networks. Is similar to, but more complex than, a repeater. Like a repeater, it connects two buses, but it does not necessarily pass all messages across the connection. Instead, it looks at the destination address that accompanies each message and forwards a message across the connection only when that message is destined for a computer on the other side.

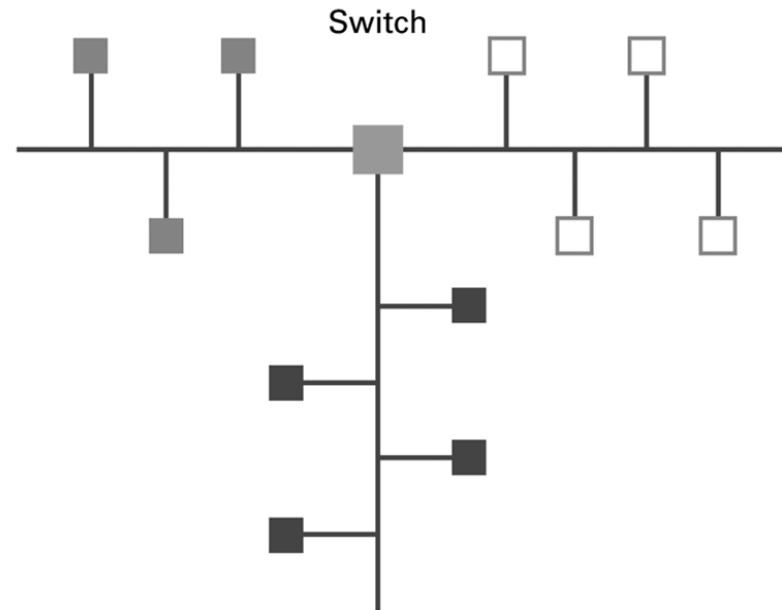
Thus, two machines residing on the same side of a bridge can exchange messages without interfering with communication taking place on the other side. A bridge produces a more efficient system than that produced by a repeater.

- **Switch:** Connects several compatible networks. A switch is essentially a bridge with multiple connections, allowing it to connect several buses rather than just two.
- **Router:** Connects two incompatible 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

Figure 4.5 Routers connecting two WiFi networks and an Ethernet network to form an internet

