L E S S O N **2**

Network strategies and topologies

Lesson objectives

To understand various network strategies and topologies, you will:

a Examine three common strategies used to connect nodes on a network.

b Explore network processing strategies and establish the differences between centralized and distributed processing.

c Identify and compare three common network classifications.

d Identify and define three common network topologies.

a Node connecting strategies

Concepts >

Different types of networks can be characterized by the types of strategies they employ to connect computers. Three common types of relationships that exist among networks are:

- hierarchical
- client/server
- peer-to-peer

Hierarchical networks

Some networks, typically those based on mainframe computers, provide a *host-to-terminal* relationship between nodes. Very little processing, if any, is done by terminals, which simply enable users to enter and view information that is processed by the host. The host, or primary device, initiates and manages all network communication.

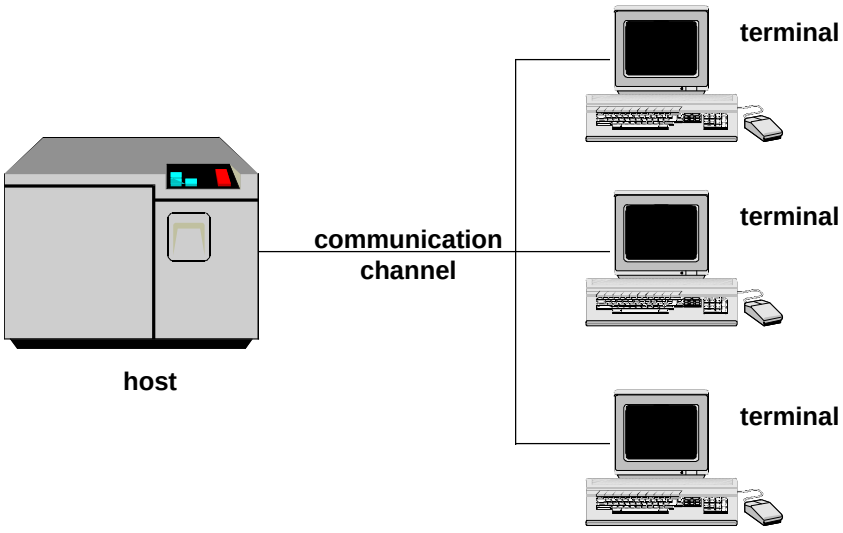


Figure 2-1: Hierarchical network.

Client/server networks

Computers that perform a service on behalf of other network devices are called *servers*. There are several types of servers. For example, a computer that provides other network nodes with access to network storage devices is called a *file server*. *Print servers* provide other network nodes with access to network printers.

Computers that use the services of a server are called *clients*. Networks in which servers control access to network storage and other network resources are called *client/server networks*.

In client/server networks, network users run programs and enter data at client stations (also called workstations). Typically (though not in all cases), the file server is reserved only for network-management functions and is not used as a

workstation. Unlike the terminals used in hierarchical networks, workstations in client/server networks perform data-processing functions.

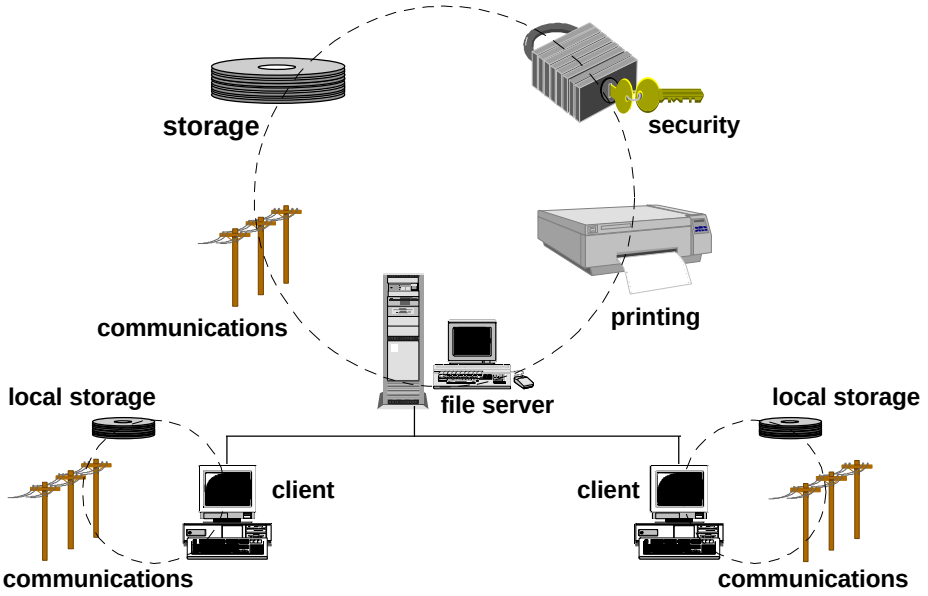


Figure 2-2: Basic components of a client/server network.

Peer-to-peer networks

Computers that perform similar functions on a network are called *peers*. Networks in which no single, centralized computer controls network functions are called *peer-to-peer networks*.

The idea of peer-to-peer networking is that each computer on the network can be both a server and a client. Users can configure their computers so that they can share directories or printers with other users on the network. Because any computer on the network can be a file server and a client concurrently, all computers are considered to have equal, or peer, status.

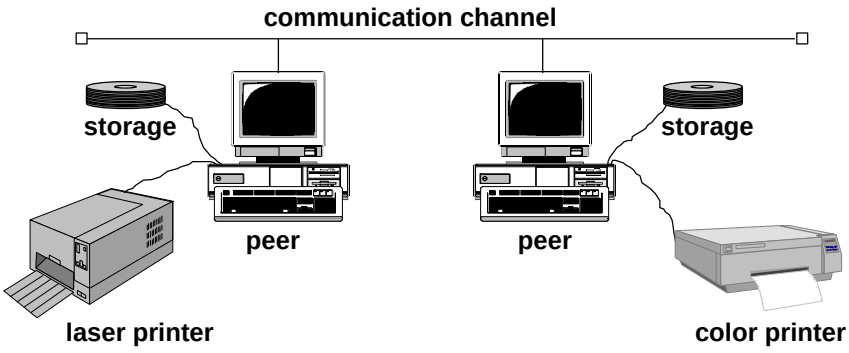


Figure 2-3: Basic components of a peer-to-peer network.

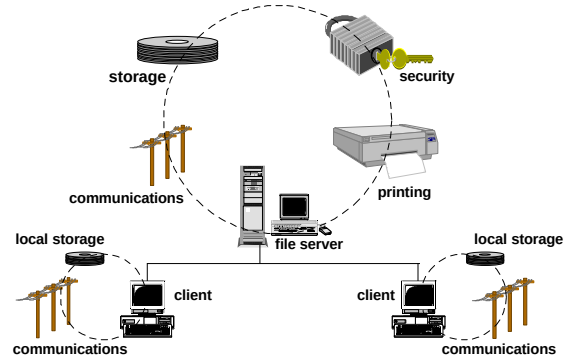
Mixed relationships

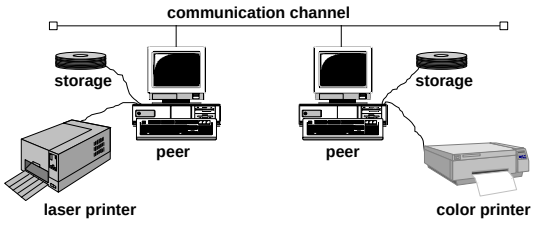
Concepts >

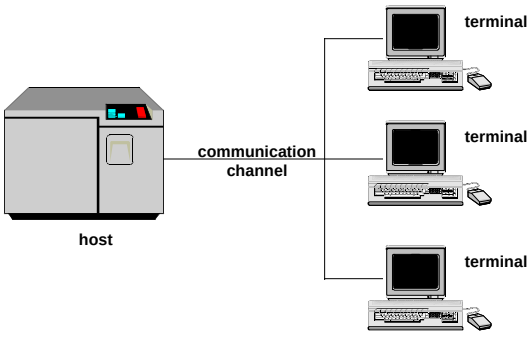
It is possible for a network to support a combination of relationships. For example, you might have a network that supports client/server and peer-to-peer access. In such an environment, a user would be able to access files and other shared resources from a file server and from another user's workstation.

Task A-1: Identifying node-connecting strategies

What you do	*Comments/Prompts*
1. Identify each of the node connecting strategies illustrated below	







Comparison of node-connecting strategies

Strategy	Advantages	Disadvantages
Hierarchical	• Centralized administration. • Additional nodes are generally inexpensive.	• Purchasing or upgrading a host is expensive. • The host requires a "clean room" (dust-free and air-conditioned). • Processing power diminishes with each user login.
Client/server	• Heavy processing power can be localized when needed. • Overall installation costs are less than a hierarchical network. • Servers provide clients with access to shared printers, network storage (including shared applications), network security features, and other network resources.	• Administrative tasks not entirely centralized. • Expensive to add nodes.
Peer-to-peer	• Relatively inexpensive to implement, can often be implemented on existing equipment. • Potentially, all resources can be made available over a network. • Processing power can be localized to the point of need.	• Decentralized administration. • Security can be difficult to control

b Network computing strategies

Concepts >

Networks are sometimes also classified according to the way that processing is performed. A variety of processing schemes is possible. This section examines common network processing strategies.

Networking technologies have developed over time because of the requirements of the following computing models:

Centralized computing uses a large, centralized computer (mainframe) to store and organize large amounts of data. This data is entered by using local devices, or terminals. These terminals have an input device (keyboard) and some type of communications hardware so that a single mainframe could service requests from multiple remote users. With centralized computing, the mainframe provides all of the data storage and computational abilities; the terminal is simply a remote input/output device.

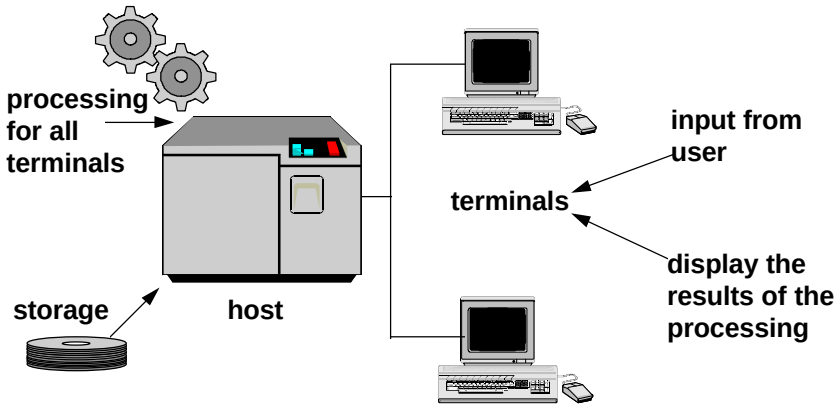


Figure 2-4: Centralized computing.

Distributed computing uses a server, or servers, and multiple personal computers to achieve the same processing goals as a mainframe. Separate computers work on a subset of tasks without relying on a single mainframe for processing. For example, applications designed for client/server networks are typically stored on the network. When a user runs the application from a workstation, the application is loaded into the workstation's memory. The application's processing occurs not at the server, but at the client workstations.

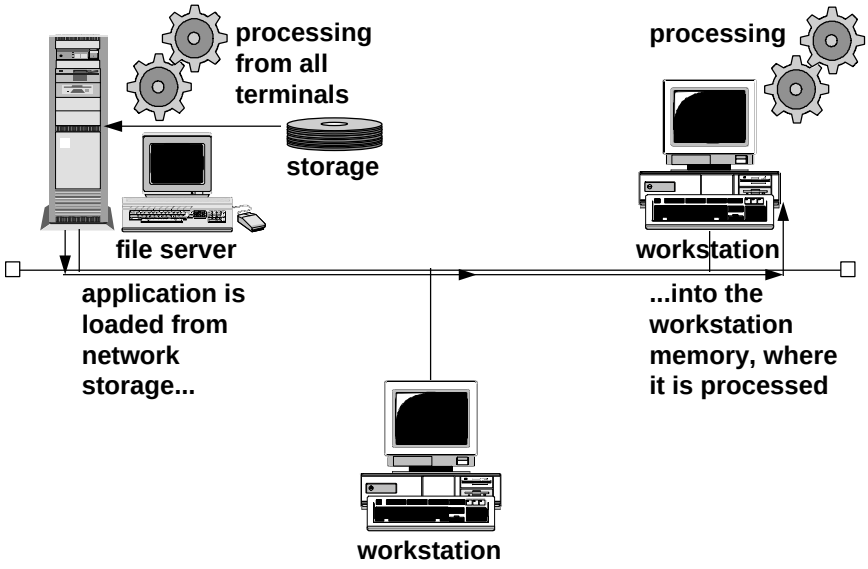


Figure 2-5: Distributed computing.

Collaborative computing is a relatively new model and is becoming an important trend. Collaborative computing is a synergistic type of distributed computing where networked computers actually share processing abilities. Instead of simply communicating data between computers, collaborative computing uses the processing power of two or more computers to accomplish the same processing task. For more information, see the Suggested Reading list.

Task B-1: Understanding network computing strategies

What you do	*Comments/Prompts*
1. For each model below, describe where the processing is done	
Distributed computing	_____
Centralized computing	_____
Collaborative computing	_____
2. If you currently have a network installed in your workplace, what model do you think was used to design your network?	_____

Centralized versus distributed computing

Concepts > The following table compares advantages and disadvantages of the centralized and distributed computing models:

Model	Advantages	Disadvantages
Centralized computing	User terminals are relatively inexpensive. Security is typically easy to control. Global performance increases can often be realized by upgrading only the host (mainframe).	Installation and upgrade of processor (mainframe) costs can typically be expensive. Processing is dependent on the host; if there is a problem, the terminals are useless. Adding nodes (terminals) decreases the global processing performance.
Distributed computing	Processing upgrades can be performed to each node separately over a period of time. The server is not burdened with applications processing. Processing power can be used where it is most needed.	Installation and global processing upgrades can be expensive and time-consuming.

Distributed applications

Some network applications divide processing tasks among various computers that are attached to the network. For example, a Structured Query Language (SQL) server provides processing services for network clients that require database lookups to be performed. While the client station manages the user interface and other processing, the SQL server handles the intensive database processing. An application that works in this manner is called a *distributed application*.

Distributed applications enable you to put heavy processing power where it is most needed, as well as dramatically improve the performance of applications. However, the disadvantages of using distributed applications are that they require extensive initial setup before the application works, and continual optimization on both ends of the application. Additional hardware may be required to function as processing servers. Administration is centralized, usually via the application.

Task B-2: Determining the most appropriate type of network computing for a particular need

What you do	*Comments/Prompts*
1. For each of the following scenarios, identify which of the computing models is described.	(Centralized or distributed.)

You work at an attorney's office, and it is your responsibility to type regular correspondence to clients. The word processing application is stored on the network, but it is processed at your workstation.	_____
You work at an insurance company in the claims department. It is your responsibility to enter each claim. Information is processed and stored on the network.	_____
You work at an accounting firm, doing data entry. Data is entered from a terminal and processed overnight. The next day a report is printed.	_____
You work at an advertising agency, and you create slides that must be shared with other people in the office. The application and the slides are stored on the network. Due to the nature of the application, processing is done at your workstation.	_____

C Network coverage

Concepts >

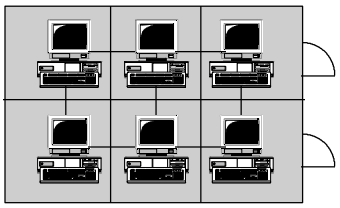
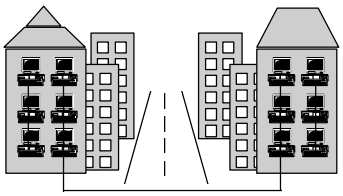
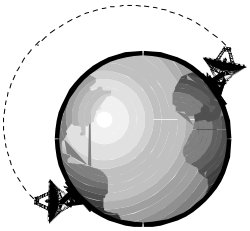
Today's computer networks include computers and operating systems associated with all of the computing models described earlier in this lesson. A typical network can include mainframes, personal computers, printers, and other communication devices. Computer networks fit the general definition of networking, since they share electronic data and computing services.

Networks are generally described by their size or geographic distance covered. Even though the distinctions are rapidly fading, the following network designations are commonly used:

- *Local area network* (LAN) is a relatively small computer network which is contained within a single building or campus.
- *Metropolitan area network* (MAN) is slightly larger than a LAN and is contained within a single city or metropolitan area.
- *Wide area network* (WAN) is relatively large and spans across countries and continents. Wide area networks can be separated into two categories: enterprise-wide networks (EWN) and global area networks (GAN).
  - The purpose of an EWN is to connect all of a single organization's computers, regardless of the geographic layout of the organization.
  - A GAN spans the earth; it might not cover the entire globe, but it crosses multiple national boundaries and includes networks of several organizations.

Comparing types of network coverage

The table below compares the three types of networks:

 **LAN**	 **MAN**	 **WAN**
Relatively small. Contained within a single building or campus. Generally inexpensive to implement and maintain. Typically owned privately.	Can incorporate multiple LANs. Contained within a single city or metropolitan area. Expensive to implement and maintain. Typically owned by private providers.	Uses data transmission networks to incorporate LANs and MANs. Essentially unlimited geographic area. Cost varies widely, depending on how it is configured.

Many industry experts believe that these classifications of networks will eventually disappear. Ultimately, all networks will be able to link together to form a single computer communication infrastructure, similar to what has happened with telephone networks.

Task C-1: Identifying types of networks

What you do	*Comments/Prompts*
1. From the types of networks listed on the right, identify which would be most suitable for the needs described below. Explain why you chose that type of network.	LAN Local area network MAN Metropolitan area network WAN Wide area network EWN Enterprise-wide network GAN Global area network
You need to exchange files and electronic mail with other employees in your company—many are located in offices throughout the United States.	_____
You need to share network applications and printers with everyone in your department, whose desks are all within 100 feet of each other.	_____
You need to exchange files with other departments in your company. All departments are in different buildings throughout the city.	_____
You need to exchange electronic mail with members of a different organization, located overseas.	_____

d Network topologies

Definition of “network topology”

Concepts >

A *topology* is a description of the layout of a specific region or area. A *network topology* is a description of the layout of the region or area covered by that network.

There are two types of connections that describe how many devices connect to a single cable or segment of transmission media. They are: point-to-point and multi-point. *Point-to-point connections* provide a direct link between two devices; for example, a computer connected directly to a printer, or a modem to a mainframe. *Multi-point connections* provide a link between three or more devices on a network.

All computer networks rely upon point-to-point and multi-point connections. However, the complete physical structure of the cable (or transmission media) is called the *physical topology*. The way data flows through the network (or transmission media) is called the *logical topology*.

Common topologies

A bus topology uses one long cable (backbone) to which network devices are either directly attached or are attached by using short drop cables. Because all workstations share this bus, a workstation checks for any information that might be coming down the backbone before sending their messages. All messages pass the other workstations on the way to their destinations. Each workstation then checks the address of each message to see if it matches its own.

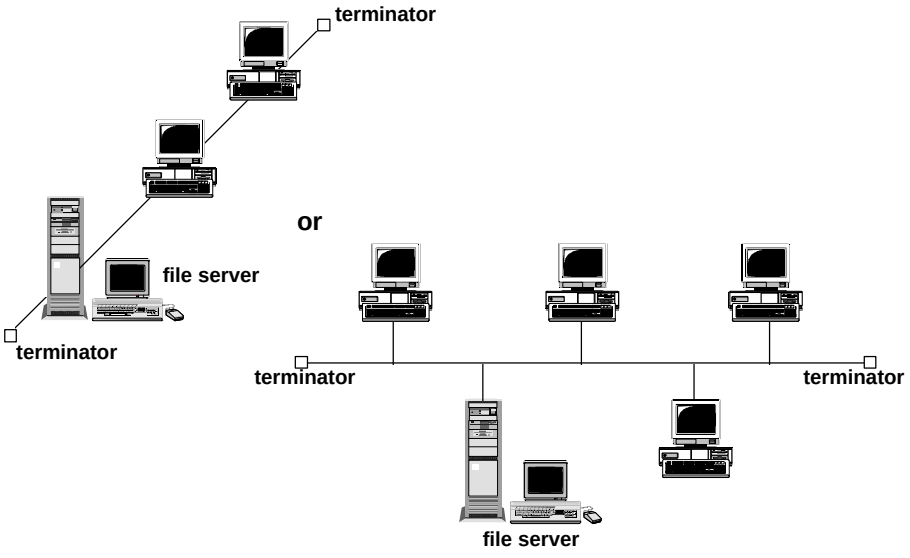


Figure 2-6: Bus network topologies.

Note that bus network topologies, the backbone must be terminated at both ends to remove the signal from the wire after it has passed all devices on the network.

Ring topologies consist of several nodes joined together to form a circle. Messages move from one node to the next, in one direction only. When a node receives a message that is addressed to itself, the message is copied and sent back with a modification that indicates it was received.

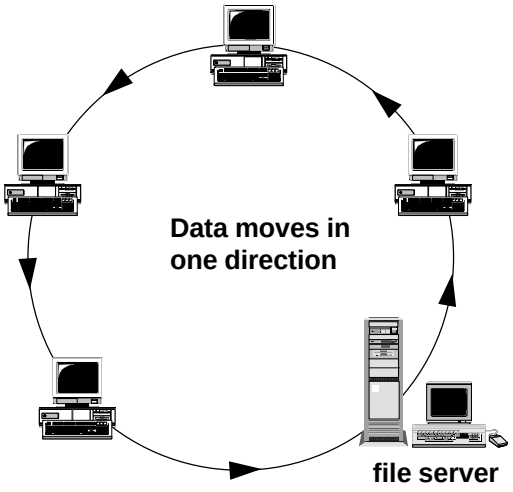


Figure 2-7: A ring topology.

The *star topology* uses a central device with drop cables extending in all directions. Each networked device is connected point-to-point to the central device, or *hub*. All messages in a star topology must go through the central device before reaching their destination.

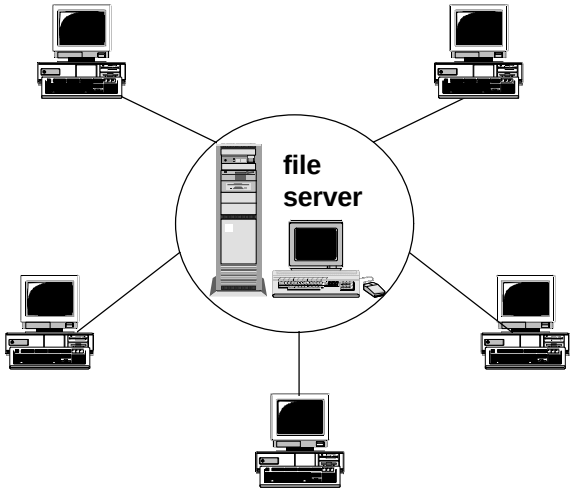


Figure 2-8: A star topology.

Hybrid topologies are a combination of two or more different topologies. WANs sometimes have hybrid topologies because they connect a variety of LAN topologies. The big advantage of hybrid topologies is that they connect disparate topologies. However, the disadvantage of hybrid topologies is that they are potentially complex to establish and manage.

	Bus topology	Ring topology	Star topology
Reconfiguration	Reconfiguration is difficult especially when distance or number of taps are at the maximum allowable levels.	Reconfiguration becomes more difficult as the scale of relocation increases.	Reconfiguration is relatively easy. Moves, additions, or changes do not involve more than the connection between the device and the central computer.
Troubleshooting	Troubleshooting is difficult, because all nodes on the network must be tested to locate the problem.	Because each device incorporates a *repeater* (device that regenerates a signal), you can easily find cable faults. The downstream repeater from failure identifies the error when it does not receive a signal from upstream within a specified amount of time.	Troubleshooting is easy because all data in a star topology goes through a central point, where it can be distributed to the appropriate address.
Media failure effects	All nodes are affected by a media failure; failure of a single workstation does not affect the rest of the network.	Media failure on a single loop system affects all devices on the network. However, if you have several loops, only the nodes on the affected loop will go down.	Media faults are automatically isolated to the failed segment.

Task D-2: Identifying advantages and disadvantages of network topologies

What you do	*Comments/Prompts*
1. Use the list on the right to identify the topology for each description below	Bus topology Ring topology Star topology
Installation requires less transmission media (cable) than all other topologies	_____
All data goes through a central point, where it is distributed to the appropriate address	_____

Uses one long cable—to which network devices are either directly attached or attached by using short drop cables	_____
Several nodes are joined together to form a circle	_____
Messages move from one node to the next, in one direction only	_____
Messages pass through all other workstations on the way to their destinations	_____
Uses a central computer with drop cables extending in all directions	_____

(Practice Unit for Lesson 2

In this activity, you will fill in the blanks below.

1. Different networks can be characterized by the types of _____ used to interconnect computers.
2. Another name for the _____ is the “prim
3. The _____ provides other network nodes with access to shared printers.
4. Computers that employ the services of a server are called _____.
5. Computers that perform similar functions on a network are called _____.
6. The computing model in which processing is dependent on the host computer is called _____ computing.
7. A remote input/output device: _____.
8. Applications that divide processing tasks among various computers attached to the network are called _____ applications.
9. A _____ area network is usually contained within a single building or campus.
10. Wide area networks can be separated into two categories: _____-wide networks and _____ areas networks.
11. The _____ topology describes the flow of data through the network.
12. The _____ topology uses one cable to connect all devices on a network.
13. All messages in a _____ topology must go through the central device.
14. Relative ease of _____, _____, and _____ are three important characteristics to consider when choosing a physical topology.

) Wrap-up for Lesson 2

a List the three node connecting strategies discussed in this lesson.

b List at least two network computing strategies discussed in this lesson.

c Which two categories can WANs be separated into?

d What is a network topology?