

7	WAN Concepts
7.1	Purpose of WANs
7.1.1	LANs and WANs
7.1.2	Private and Public WANs
7.1.3	WAN Topologies
7.1.4	Carrier Connections
7.1.5	Evolving Networks
7.1.6	Check Your Understanding - Purpose of WANs
7.2	WAN Operations
7.3	Traditional WAN Connectivity
7.4	Modern WAN Connectivity
7.5	Internet-Based Connectivity
7.6	Module Practice and Quiz
8	VPN and IPsec Concepts
9	QoS Concepts
10	Network Management
11	Network Design

Purpose of WANs

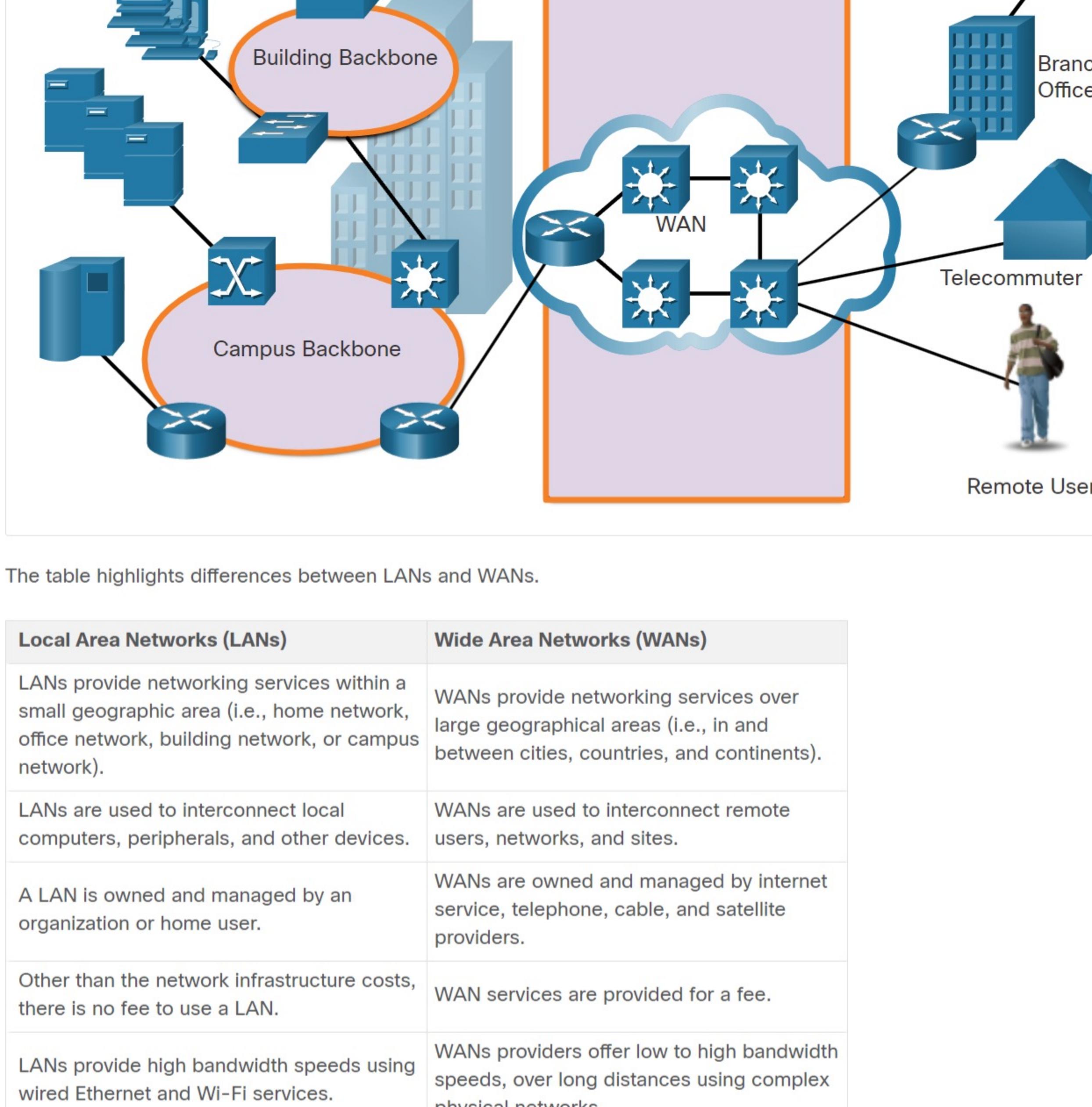
7.1.1

LANs and WANs

Whether at work or at home, we all use Local Area Networks (LANs). However, LANs are limited to a small geographical area.

A Wide Area Network (WAN) is required to connect beyond the boundary of the LAN. A WAN is a telecommunications network that spans over a relatively large geographical area. A WAN operates beyond the geographic scope of a LAN.

In the figure, WAN services are required to interconnect an enterprise campus network to remote LANs at branch sites, telecommuter sites, and remote users.



The table highlights differences between LANs and WANs.

Local Area Networks (LANs)	Wide Area Networks (WANs)
LANs provide networking services within a small geographic area (i.e., home network, office network, building network, or campus network).	WANs provide networking services over large geographical areas (i.e., in and between cities, countries, and continents).
LANs are used to interconnect local computers, peripherals, and other devices.	WANs are used to interconnect remote users, networks, and sites.
A LAN is owned and managed by an organization or home user.	WANs are owned and managed by internet service, telephone, cable, and satellite providers.
Other than the network infrastructure costs, there is no fee to use a LAN.	WAN services are provided for a fee.
LANs provide high bandwidth speeds using wired Ethernet and Wi-Fi services.	WANs providers offer low to high bandwidth speeds, over long distances using complex physical networks.

7.1.2

Private and Public WANs

WANs may be built by a variety of different types of organizations, as follows:

- An organization that wants to connect users in different locations
- An ISP that wants to connect customers to the Internet
- An ISP or telecommunications that wants to interconnect ISPs

A private WAN is a connection that is dedicated to a single customer. This provides for the following:

- Guaranteed service level
- Consistent bandwidth
- Security

A public WAN connection is typically provided by an ISP or telecommunications service provider using the Internet. In this case, the service levels and bandwidth may vary, and the shared connections do not guarantee security.

WAN Topologies

Physical topologies describe the physical network infrastructure used by data when it is travelling from a source to a destination. The physical WAN topology used in WANs is complex and for the most part, unknown to users. Consider a user in New York establishing a video conference call with a user in Tokyo, Japan. Other than the user's Internet connection in New York, it would not be feasible to identify the all of the actual physical connections that are needed to support the video call.

Instead, WAN topologies are described using a logical topology. Logical topologies describe the virtual connection between the source and destination. For example, the video conference call between the user in New York and Japan would be a logical point-to-point connection.

WANs are implemented using the following logical topology designs:

- Point-to-Point Topology
- Hub-and-Spoke Topology
- Dual-homed Topology
- Fully Meshed Topology
- Partially Meshed Topology

Note: Large networks usually deploy a combination of these topologies.

Click each button for an illustration and explanation of each WAN logical topology.

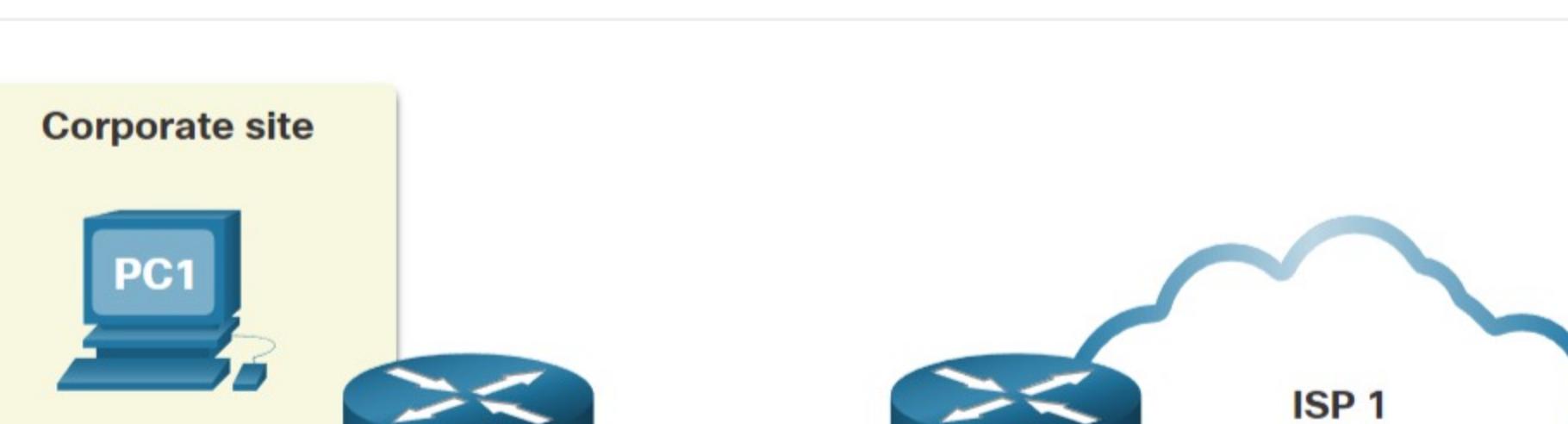
Point-to-Point Topology A point-to-point topology, as shown in the figure, employs a point-to-point circuit between two endpoints.

Hub-and-Spoke Topology Point-to-point links often involve dedicated, leased-line connections from the corporate edge point to the provider networks. A point-to-point connection involves a Layer 2 transport service through the service provider network. Packets sent from one site are delivered to the other site and vice versa. A point-to-point connection is transparent to the customer network. It seems as if there is a direct physical link between two endpoints.

Dual-homed Topology It can become expensive if many point-to-point connections are required.

Fully Meshed Topology

Partially Meshed Topology



7.1.4

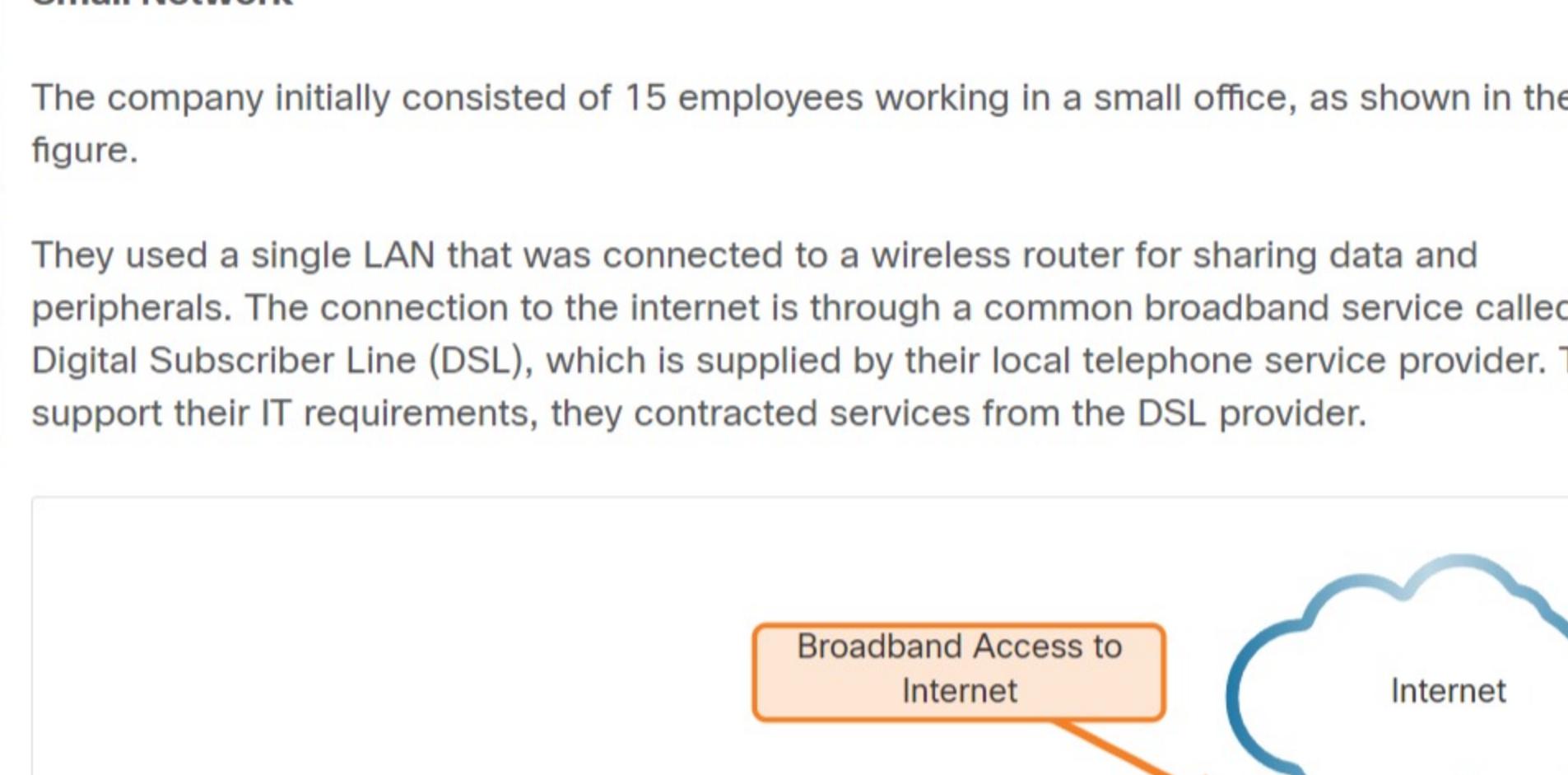
Carrier Connections

Another aspect of WAN design is how an organization connects to the Internet. An organization usually signs a service level agreement (SLA) with a service provider. The SLA outlines the expected services relating to the reliability and availability of the connection. The service provider may or may not be the actual carrier. A carrier owns and maintains the physical connection and equipment between the provider and the customer. Typically, an organization will choose either a single-carrier or dual-carrier WAN connection.

Click each button for an illustration and explanation of each carrier connection type.

Single-Carrier WAN Connection

A single-carrier connection is when an organization connects to only one service provider, as shown in the figure. An SLA is negotiated between the organization and the service provider. The disadvantage of this design is the carrier connection and service provider are both single points of failure. Connectivity to the Internet would be lost if the carrier link or the provider router failed.



7.1.5

Evolving Networks

Network requirements of a company can change dramatically as the company grows over time. Distributing employees saves costs in many ways, but it puts increased demands on the network. Not only must a network meet the day-to-day operational needs of the business, but it must be able to adapt and grow as the company changes. Network designers and administrators meet these challenges by carefully choosing network technologies, protocols, and service providers. They must also optimize their networks by using a variety of network design techniques and architectures.

To illustrate differences between network size, we will use a fictitious company called SPAN Engineering as it grows from a small, local, business into a global enterprise. SPAN Engineering, an environmental consulting firm, has developed a special process for converting household waste into electricity and is developing a small pilot project for a municipal government in its local area.

Click each button for an illustration and description of the SPAN network as it evolves from a small network to a global enterprise.

Small Network

Campus Network

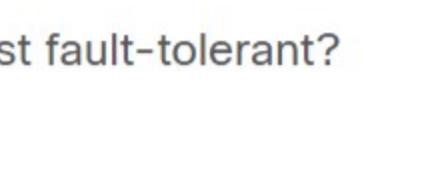
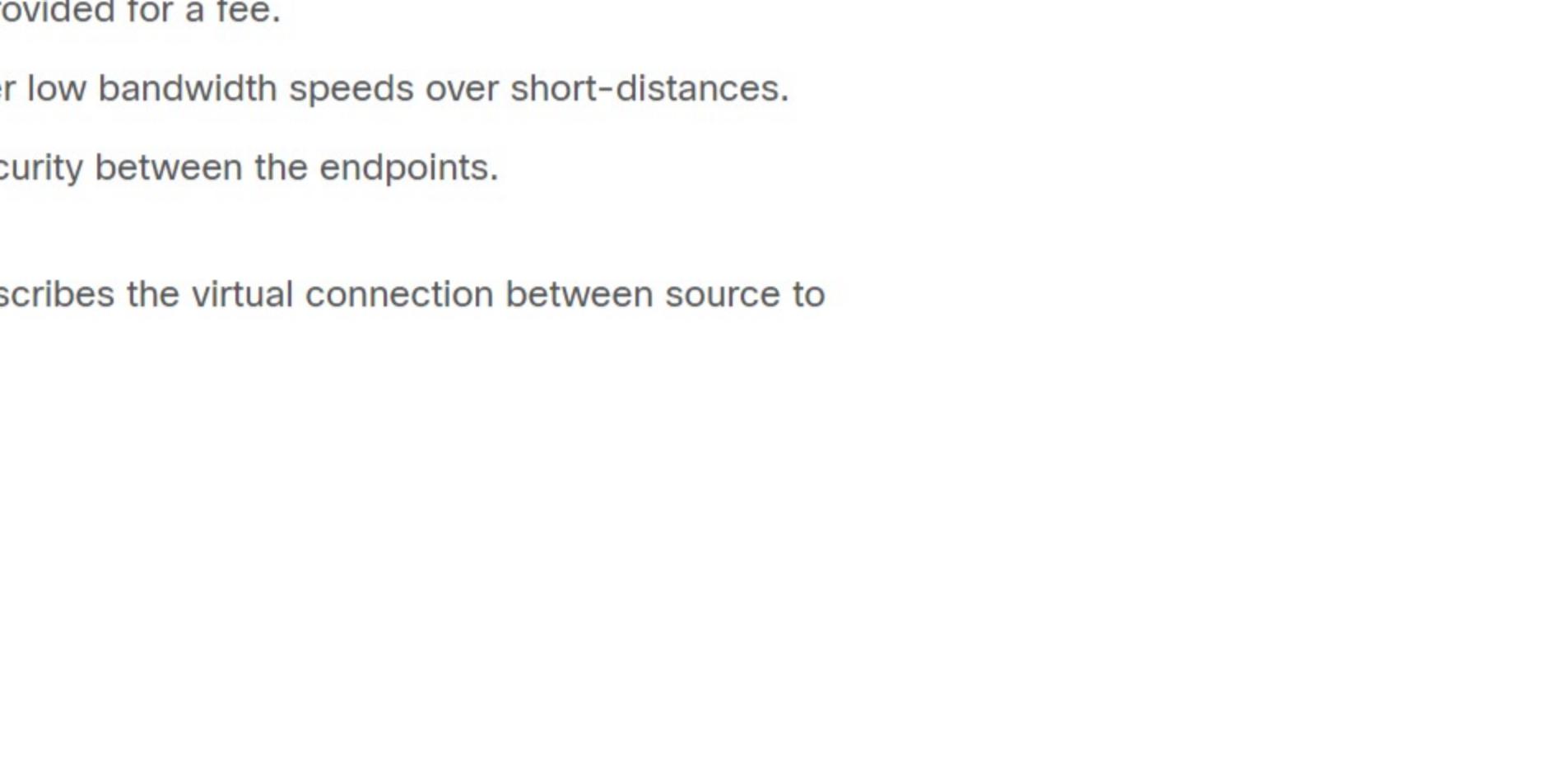
Branch Network

Distributed Network

Small Network

The company initially consisted of 15 employees working in a small office, as shown in the figure.

They used a single LAN that was connected to a wireless router for sharing data and peripherals. The connection to the Internet is through a common broadband service called Digital Subscriber Line (DSL), which is supplied by their local telephone service provider. To support their IT requirements, they contracted services from the DSL provider.



7.1.6

Check Your Understanding - Purpose of WANs

Check your understanding of WANs by choosing the BEST answer to the following questions.

1. Which two options describe a WAN? (Choose two.)

- A WAN is owned and managed by an organization or home user.
- A WAN provides networking services over large geographical areas.
- WAN services are provided for a fee.
- WANs providers offer low bandwidth speeds over short-distances.
- WANs guarantee security between the endpoints.

2. Which topology type describes the virtual connection between source to destination?

- cabling topology
- physical topology
- logical topology
- wired topology

3. Which type of WAN network design is the most fault-tolerant?

- dual-homed topology
- fully meshed topology
- hub-and-spoke topology
- partially meshed topology
- point-to-point topology

4. Which is a type of WAN carrier connection that provides redundancy?

- dual-carrier WAN connection
- single-carrier WAN connection

Check

Show Me

Reset