**Learning Tips for Chapter 8**

This chapter focuses on interconnections between geographically dispersed locations in an enterprise network. Traditionally, businesses used circuits and services from carriers to create private networks for communications and resource sharing. Today, business WANs encompass different locations, networks in employee homes, and cloud services accessed via the Internet. This means that it is most realistic to consider business WANs from an inclusive perspective that also encompasses protecting the privacy of inter-location connections.

Point-to-point connections between business locations are fundamental components of WAN architectures and topologies. Ring, hub-and-spoke, and partial mesh topologies have been most common in business WANs and it is important for you to consider the pros and cons of each.

T-carrier services, SONET services, and wireless point-to-point services such as terrestrial microwave links have been traditionally used to provide dedicated circuit connections between business locations. Today, virtual circuits in packet switching networks (PSNs) are more commonly used for location-to-location connections.

Dedicated circuit WAN services primarily reside at the Data Link and Physical layers of the OSI and TCP/IP models. HDLC and its variants, including PPP, has traditionally been the best-known WAN Data Link layer protocol. Physical layer framing is used in T-carrier services and SONET services.

It is important to remember that T-carrier services are used on copper cable connections to and within carrier networks; SONET services are used on fiber optic connections. Costs for both of these services is more reasonable in urban areas than in rural areas.

Carrier packet-switching networks (PSNs) are alternatives to dedicated circuit WANs. With these, PAD devices at business locations reformat or encapsulate subscriber network frames (e.g. Ethernet frames) in PSN Network layer packets for transmittal over the PSN; IP packets are most common.

The Internet is a PSN, but carrier PSNs may rely on non-Internet circuits. MPLS, and Carrier Ethernet are examples of PSN services. VPN services leverage Internet connections to interconnect business locations.

Connection-oriented MPLS services were popular among businesses from the 1990s through the 2010s because of their ability to optimize the performance of mission critical applications. These have given way to less expensive Carrier Ethernet, VPN, and SD-WAN.

Wireless WAN (WWAN) is a WAN created using cellular services. Because private cellular networks (private 5G RANs) are increasingly common in factories, warehouses, and other business facilities. It is important for you to understand their basic components and the various ways these can be deployed.

SD-WAN has emerged as a dominant player in business WANs, and you are encouraged to spend time on this chapter’s description.

Because businesses do not own the circuits or services used to interconnect locations, due diligence is needed to ensure that carriers and service providers have adequate security mechanisms to protect their subscriber’s data and information.

Do not ignore the Key Concepts in Chapter 8 Presentation.

You are also encouraged to leverage the supplement videos and readings for this chapter.

Use the Chapter 8 Problems and Exercises tips to assist with any problems and exercises that you may be assigned.

The appendices for Chapter 8 provide additional information on numerous topics in this chapter.

**Especially Important Sections**

Section 8.0

Section 8.1

Sections 8.2.2 and 8.2.3

Sections 8.3.1, 8.3.2, and 8.3.4

Section 8.4 and each of its subsections

Sections 8.5 and 8.6

**Especially Important Figures and Tables**

*Note:* It is important to read/study the discussion related to each figure and table that is identified.

Figure 8.3

Tables 8-1 and 8-2

Figures 8-4, 8-5a, 8-5b, 8-6, 8-7a and 8-7b

Figure 8-8

Figures 8-10 and 8-11

Table 8-3

Figure 8-13

Table 8-4

Figures 8-15 and 8-16

Table 8-5

Figures 8-17 and 8-18

Figure 8-19

Figure 8-20

Figures 8-21a and 8-21b

Figure 8-23

Figures 8-25 and 8-26

Figures 8-27 and 8-28

**Especially Important Key Terms**

Channel service unit/Data service unit (CSU/DSU)

Common carriers

Dedicated circuit

Packet-switched network (PSN)

Permanent virtual circuit (PVC)

Private mobile network

Software-defined wide area network (SD-WAN)

WAN architecture

WAN topology

Wireless WAN (WWAN)

**Especially Important Review Questions**

Questions 2-5, 7-21, 23-30, 32

**Especially Valuable Problems and Exercises**

Exercises 8.1, 8.3, and 8.3