**Learning Tips for Chapter 9**

This chapter describes the intersection of enterprise networks and the IoT. Businesses are deploying IoT systems at accelerating rates and enterprise networks are evolving to accommodate IoT networks and deployments. The chapter primarily focuses on IoT deployments in business facilities, especially factories and warehouses.

IoT technologies are being used to automate a wide range of business processes in a wide range of industries. IoT sensor data contributes to Big Data and feeds AI and ML algorithms. It is also being used to optimize network performance and to make enterprise networks more secure.

Industry 4.0 and Warehouse 4.0 are featured as examples of arenas in which Industrial IoT (IIoT) technologies are converging with AI and other digital technologies to transform industrial and warehouse processes and operations.

In factories, IIoT deployments are taking place alongside older entrenched SCADA systems and this reality cannot be overlooked.

M2M communications are critical elements of smart factories and warehouses. V2V and V2X communication is a subset of M2M that is featured in the chapter to provide a clearer picture of the communication elements and challenges associated with both autonomous vehicles in business facilities and driverless vehicles on streets and highways.

Because of the rapid emergence of IoT systems, descriptions of a variety of IoT architectures can be found online. This chapter focuses on the IoT World Forum’s seven-layer reference model. Section 9.3 describes these layers from the bottom up. Here, it is important to consider the technologies and functions of each layer.

IoT platforms play important roles in IoT architectures, and it is important for you to have a general understanding of what they do.

IoT devices, including their sensors and actuators, are in the Physical (bottom) layer of the seven-layer IoT architecture. It is important to understand their capabilities.

The connectivity layer of the seven-layer reference model focuses on both communications within local IoT networks and communications between those networks and the cloud. It is important for you to understand that instead of Wi-Fi or Ethernet, NFC, Bluetooth or Zigbee, and cellular LTE-M may be used with local IoT networks and LPWAN may be used for geographically dispersed IoT devices. It is also important to understand that IoT gateways are widely used for IoT local network to cloud communications.

A variety of specialized protocols are used within IoT networks. It is more important to understand that these exist than to understand them in detail. There are also several IoT “helper” protocols in the TCP/IP protocol stack. Again, it is more important to know that these exist than to understand how they differ.

Edge computing and edge device capabilities are the most important elements of the edge computing layer of the seven-layer model.

IoT platforms are involved in activities performed at the data accumulation, data aggregation, and applications layers of the seven-layer reference model. Collectively these handle the massive volumes of data generated by IoT devices and enable them to be used to automate processes and facilitate decision-making. It is important for you to have a general understanding of what occurs at each layer. It is also important for you to understand why the collaboration and processes layer is often considered the “business layer” of the reference model.

Adding IoT deployments to enterprise networks increases the latter’s attack surface. Devices, connections, and IoT applications are common attack targets. Several specialized IoT defenses are commonly used and numerous businesses are leveraging SD-WAN to isolate/segregate IoT data traffic.

Do not ignore the Key Concepts in Chapter 9 Presentation.

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

Use the Chapter 9 Problems and Exercises tips to assist with any problems and exercises that you may be assigned.

The appendices for Chapter 9 provide additional information on numerous topics in this chapter.

**Especially Important Sections**

Section 9.0

Section 9.1.1 and each of its subsections

Section 9.1.2 and each of its subsections

The Digital Twins, Facility Management, and Network Management subsections of Section 9.1.3

Section 9.2 and each of its subsections

Section 9.3 and each of its subsections

Section 9.4 and each of its subsections

**Especially Important Figures and Tables**

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

Figure 9-1

Table 9-1

Figure 9-2

Table 9-3

Figure 9-4

Table 9-4

Figure 9-7

Figure 9-9

Figure 9-11 and Table 9-5

Figure 9-12

Figure 9-13

Figure 9-14

Figure 9-15

Figure 9-16

Figure 9-17

Figure 9-18

Table 9-6

Figure 9-19

**Especially Important Key Terms**

Actuator

Digital twin

Edge computing

Edge devices

Industrial IoT

Industry 4.0

IoT gateway

IoT platform

M2M communication

Sensor

Warehouse 4.0

V2X communication

V2V communication

**Especially Important Review Questions**

Questions 1-3, 5-7, 9-20, 22-31

**Especially Valuable Problems and Exercises**

Exercises 9-3, 9-4, 9-9