CompTIA Network Guide to Networks 9th edition West Solutions Manual

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Solution and Answer Guide

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Text

Applying Concepts

Activity 1-1: Explore Network Operating Systems

It's easier to understand what a network operating system is if you've seen one or two in action. For each of the NOSs listed previously (Windows Server 2019, Ubuntu Server, and Red Hat Enterprise Linux), use your favorite search engine to complete the following steps:

1. Search for information about the NOS and write down a short description based on your findings. Include a few features and advantages and identify who develops and publishes each NOS.

   Answer: Responses should include a basic description of Windows Server 2019, Ubuntu Server, and Red Hat Enterprise Linux that covers some or all of the following points: a few main features of each OS, the OS publisher, and advantages offered by that OS.

2. Search for images of screenshots for the NOS. What are some major elements that you notice on these screens? How are these NOSs managed?

   Answer: Responses should note whether the NOS offers GUI or CLI controls and should include a description of tools or information shown on the screenshots of Windows Server 2019, Ubuntu Server, and Red Hat Enterprise Linux.

3. Find one or two introductory videos for each NOS and watch the videos. What are some similarities between each NOS? What are some of the differences?

   Answer: Responses should show evidence of having viewed at least one video for each NOS and should include two to three similarities and two to three differences comparing Windows Server 2019, Ubuntu Server, and Red Hat Enterprise Linux.

Activity 1-2: Troubleshoot a Failed Network Connection

This is a step-by-step activity. It does not require any solutions.

Suppose your computer cannot connect to the Internet. Here's a simple process for troubleshooting this problem that demonstrates all seven steps in the troubleshooting model. This is a step-by-step activity. It does not require any solutions.

Step 1: *Identify the problem and its symptoms*—You open your browser on your desktop computer, discover you can't reach any website, and you see an error message on the browser screen. You open File Explorer and find that you can't navigate to resources

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normally available on your local network. You check with coworkers nearby, who say they're not having problems.

Step 2: *Establish a theory of probable cause*—Because a network technician was working near your desk when you left the evening before, you suspect your network cable might have been left unplugged. In the OSI model, you've started at the bottom layer by suspecting the problem is hardware related.

Step 3: *Test your theory to determine the cause*—You check the cable and discover it is lying on the floor, not connected to your desktop.

Step 4: *Establish a plan for resolving the problem*—You decide to plug in the network cable. This is a very simple resolution that does not affect other users. In other situations, your plan might involve informing coworkers of what is about to happen or possibly filing a request for formal change management.

Step 5: *Implement the solution or escalate the problem*—You plug in the cable.

Step 6: *Verify functionality and implement preventive measures*—You open your browser and find you can surf the web. You verify local network resources are available from File Explorer.

Step 7: *Document findings, actions, and outcomes*—This simple problem and solution don't require formal documentation. However, network technicians are generally expected to document troubleshooting tasks and solutions. In this case, you simply inform your coworkers that your network connection is working now.

Review Questions

1. In the client-server model, what is the primary secure protocol used for communication between a browser and web server?

    a. HTTPS

    b. TLS

    c. HTTP

    d. SSL

    Answer: a. HTTPS

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Explanation: The primary protocol used by web servers and browsers (clients) is HTTP (Hypertext Transfer Protocol). When HTTP is layered on top of an encryption protocol, such as SSL (Secure Sockets Layer) or TLS (Transport Layer Security), the result is **HTTPS (HTTP Secure)**, which gives a secure transmission.

2. Which two encryption protocols might be used to provide secure transmissions for email services?

    a. HTTP and HTTPS

    b. SSL and TLS

    c. FTP and SFTP

    d. SSH and RDP

Answer: b. SSL and TLS

Explanation: The email protocols SMTP, POP3, and IMAP4 are all available over **SSL or TLS** for security. HTTP and HTTPS provide communication between web servers and browsers. FTP and SFTP support the transfer of files between two computers. SSH and RDP provide secure, encrypted remote access from one computer to another.

3. Which of the following applications could be used to run a website from a server?

    a. Hypertext Transfer Protocol

    b. FileZilla

    c. Microsoft Exchange Server

    d. Ngnix

Answer: d. Ngnix

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Explanation: **Ngnix** is one of the most popular web server applications in the world. Hypertext Transfer Protocol is a protocol used to communicate between web servers and web clients. FileZilla is an FTP client application. Microsoft Exchange Server is a popular email server application.

4. As you're working to fix a problem with an application, you make multiple changes at once hoping that something will solve the issues you're having. You end up with more problems than when you started. Which step, if followed correctly, would have prevented this complication?

    a. Identify the problem.

    b. Test the theory to determine the cause.

    c. Establish a plan of action to resolve the problem and identify potential effects.

    d. Document findings, actions, outcomes, and lessons learned.

Answer: a. Identify the problem.

Explanation: While **identifying the problem**, approach each problem individually and solve it before moving on to the next. By the time you reach the steps of testing the theory, establishing a plan of action, and documenting results, solving multiple problems at once is likely already causing more problems.

5. In the event of a fire, the most appropriate failure policy is a _____ policy.

    a. Power-off

    b. Fail-close

    c. Fail-open

    d. Shutdown

Answer: c. Fail-open

Explanation: During a fire alert using a **fail-open** policy, all exit doors stay unlocked so that people can safely leave the building and firefighters can enter the building, even though this

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might present a security risk for thieves entering the building. A fail-close policy would lock people inside the burning building. An emergency power-off switch can quickly shut down a data center's computers, although improper shutdowns are hard on computers and their data.

6. A network consists of five computers, all running Windows 10 Professional. All the computers are connected to a switch, which is connected to a router, which is connected to the Internet. Which logical networking model does the network use?

    a. Hub-and-spoke
    b. Ring
    c. Hybrid
    d. Peer-to-peer

    Answer: d. Peer-to-peer

    Explanation: Using a **P2P (peer-to-peer) network model**, the operating system of each computer on the network is responsible for controlling access to its resources without centralized control. The computers, called nodes or hosts on the network, form a logical group of computers and users that share resources. The hub-and-spoke, ring, and hybrid models are all physical topologies, not logical topologies.

7. In Question 6, suppose one computer is upgraded from Windows 10 Professional to Windows Server 2019. Which networking model can the network now support that it could not support without the upgrade?

    a. Hybrid
    b. Client-server
    c. Hub-and-spoke
    d. Peer-to-peer

    Answer: b. Client-server

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Explanation: In the **client-server** network model, resources can be managed by Windows Server 2019 via a centralized directory database called AD (Active Directory). The peer-to-peer network model is possible without Windows Server 2019 or any other NOS. Hybrid and hub-and-spoke models are physical topologies, not logical topologies.

8. A network consists of seven computers and a network printer, all connected directly to one switch. Which network topology does this network use?

    a. Client-server

    b. Mesh

    c. Hub-and-spoke

    d. Star

Answer: d. Star

Explanation: In a **star** topology, all devices connect to one central device such as a switch. In a mesh topology, each device connects to multiple other devices. In a hub-and-spoke topology, a central switch connects to multiple peripheral switches that each connect to computers in their areas. A client-server network model is a logical topology, not a physical topology.

9. You need to access customer records in a database as you're planning a marketing campaign. What language can you use to pull the records most relevant to the campaign?

    a. FTP

    b. SQL

    c. SMTP

    d. TLS

Answer: b. SQL

Explanation: Many DBMSs use the programming language **SQL (Structured Query Language)** to configure and interact with the database's objects and data. FTP (File Transfer

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Protocol) service is a client-server application that transfers files between two computers. Email clients use SMTP (Simple Mail Transfer Protocol) to send email message to an email server, which then uses SMTP again to transfer email to the recipient's email server. TLS (Transport Layer Security) is an encryption protocol used to secure other protocols.

10. Which of the following is an application layer protocol?

    a. IP

    b. RDP

    c. TCP

    d. Apache

    Answer: b. RDP

    Explanation: Several protocols are used at the application layer, including HTTP (Hypertext Transfer Protocol), SMTP (Simple Mail Transfer Protocol), POP3 (Post Office Protocol, version 3), IMAP4 (Internet Message Access Protocol, version 4), FTP (File Transfer Protocol), Telnet, and **RDP (Remote Desktop Protocol)**. Application layer protocols are used by applications and system utilities. IP (Internet Protocol) is a network layer protocol. TCP (Transmission Control Protocol) is a transport layer protocol. Apache is a web server application.

11. What is the name of the domain controller database that Windows Server 2019 uses to store data about user access and resources on the network?

    Answer: Active Directory

12. What is the fundamental distinction between a layer 2 switch and a router?

    Answer: A layer 2 switch belongs only to its local network, and a router belongs to two or more networks.

13. What is the fundamental distinction between a node and a host?

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Answer: A host is an endpoint device that hosts or accesses a resource on the network, and a node is any computer or device that can be addressed on the network.

14. What is the fundamental distinction between a MAN and a WAN?

    Answer: A WAN covers a large geographical area, and a MAN covers a smaller, more defined geographical area.

15. List two protocols that function at the transport layer of the OSI model. What type of address do these protocols add to their headers, and what element does that address identify?

    Answer: TCP (Transmission Control Protocol) and UDP (User Datagram Protocol)

    Answer: The port addresses the receiving application.

16. At the network layer, what type of address is used to identify the receiving host?

    Answer: IP address

17. At the data link layer, which type of network address is used to identify the receiving node?

    Answer: Physical address, MAC address, hardware address, or data link layer address

18. A computer is unable to access the network. When you check the LED lights near the computer's network port, you discover the lights are not lit. Which layer of the OSI model are you using to troubleshoot this problem? At which two layers does the network adapter work?

    Answer: Physical layer

    Answer: Data link layer and physical layer

19. A user complains that their computer cannot access email, although the computer can access websites. At which layer of the OSI model should you begin troubleshooting this problem and why?

    Answer: Application layer—Email protocols such as SMTP, POP3, and IMAP4 all function at the application layer.

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20. While troubleshooting a problem, you realize the problem is caused by a complex series of issues that will affect a large number of users even to test your theory as to the cause, and that process won't even solve the problem. What should you do next in the troubleshooting process?

    Answer: Escalate the problem

Hands-On Projects

Note 1-18

Websites and applications change often. While the instructions given in these projects were accurate at the time of writing, you might need to adjust the steps or options according to later changes.

Project 1-1: IT and Networking Certifications

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 20 minutes (+10 minutes for group work, if assigned)

Objective: Explain basic corporate and datacenter network architecture. (Obj. 1.7)

Group work: This project includes enhancements when assigned as a group project.

Resources:

- Internet access

Context:

This course prepares you to take the CompTIA Network+ N10-008 exam, which is considered a fundamental benchmark toward a career in IT. Many other IT certifications will also promote success in your IT and networking career. Use the web to research and answer the following questions:

4. Which certification does CompTIA recommend a candidate for the CompTIA Network+ certification to already have before taking this exam? Include the web address of your authoritative source along with your answer.

   Answer: CompTIA A+ certification. Authoritative source: https://www.comptia.org/certifications/network

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5. How long does CompTIA recommend you work in networking before you take the CompTIA Network+ exam? Include the web address of your authoritative source along with your answer.

   Answer: At least nine to 12 months of work experience. Authoritative source: https://www.comptia.org/certifications/network

6. Cisco offers a full range of certifications focused on all aspects of networking. How long does Cisco recommend you work in networking before you take the most current CCNA exam for certification? Include the web address of your authoritative source along with your answer.

   Answer: One or more years of experience implementing and administering Cisco solutions. Authoritative source: https://www.cisco.com/c/en/us/training-events/training-certifications/certifications/associate/ccna.html#~webinars

7. Microsoft network-related certifications have shifted focus toward their cloud-based Azure platform. The entry-level Azure certification is called Azure Fundamentals. Which technology concepts should Azure Fundamentals certification candidates be familiar with before taking the exam? Include the web address of your authoritative source along with your answer.

   Answer: Concepts of networking, storage, compute, application support, and application development. Authoritative source: https://docs.microsoft.com/en-us/learn/certifications/azure-fundamentals?WT.mc_id=certposter_poster-wwl

8. AWS (Amazon Web Services) offers extensive certification options in various areas of cloud computing expertise. The entry-level AWS exam is the Cloud Practitioner certification. How long and in what roles does AWS recommend you work with the AWS cloud before you take the Cloud Practitioner exam? Include the web address of your authoritative source along with your answer.

   Answer: Six months of experience with the AWS cloud in any role, including technical, managerial, sales, purchasing, or financial. Authoritative source: https://aws.amazon.com/certification/certified-cloud-practitioner/

9. Search online for a job opening in IT networking in your geographical area that requires or recommends a degree, specific IT skills, and at least one IT certification. **Take a screenshot** of the job description and requirements; submit this visual with your answers to this project's questions. (Excellent sites that post IT jobs are Indeed.com and Monster.com.)

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Answer: Screenshot should show a job listing that includes details of required and recommended qualifications, including at least one IT certification.

10. Answer the following questions about the job listed:

    a. Which degrees are required or recommended?
    b. What types of skills are required or recommended?
    c. What work experience is required or recommended?
    d. Which IT certifications are required or recommended?
    e. What is the advertised salary range?

    Answer: Answers may vary widely and should include required degrees for the job, required and recommended skills, required or recommended work experience, at least one required or recommended IT certification, and advertised salary range.

11. **For group assignments:** Each member of the group should research online for practice questions for one of the IT certifications discussed in this project. Group members should compare their sources to ensure no one uses the same source as someone else. Each group member quizzes the other group members with the practice questions and tallies their performance. Each group member then lists which exam objectives the group collectively demonstrates sufficient knowledge as required by each objective covered by that exam. Submit the name of the exam, the source of the practice questions, a brief summary of the group's performance on the practice questions, and the list of exam objectives currently mastered by the group collectively.

    Answer: Each group member submits the name of a networking or cloud certification exam (CompTIA Network+, Cisco CCNA, Azure Fundamentals, or AWS Cloud Practitioner), the source of practice questions, and a list—which is likely to be very short—of which exam objectives the group collectively demonstrates sufficient knowledge as required by each objective.

Project 1-2: Explore Network Types on a Smartphone

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 10 minutes (+10 minutes for group work, if assigned)

Objective: Explain the characteristics of network topologies and network types. (Obj. 1.2)

Group work: This project includes enhancements when assigned as a group project.

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Resources:

- Smartphone with cellular, Wi-Fi, and Bluetooth connection capabilities (you can borrow one from a classmate, friend, or family member)
- Access to a Wi-Fi network, such as at home, school, or a café
- Bluetooth device, such as earbuds, speaker, fitness tracker, vehicle

Context:

At first, it can be a little difficult to understand the differences between PANs, LANs, and WANs. However, you most likely own a device that accesses all three of these network types: your smartphone. In this project, you'll explore the various network types your phone can connect to. Complete the following steps:

12. On the smartphone, turn on Airplane mode. Navigate to the network connections screen showing the types of connections available on the smartphone. **Take a screenshot**; submit this visual with your answers to this project's questions.

    Answer: Screenshot should show no active network connections and Airplane mode turned on.

13. Within range of a Wi-Fi network that you have permission to connect to, turn on Wi-Fi on the smartphone and connect to the network. Using the phone's browser, navigate to *cengage.com*. Does it work? What kind of network are you using to access the web page?

    Answer: Yes, it should work. Wi-Fi uses a LAN.

14. Turn off Wi-Fi and turn on Bluetooth. Connect to a nearby Bluetooth device. Does it work? What kind of network are you using to access the Bluetooth device?

    Answer: Yes, it should work. Bluetooth uses a PAN.

15. Without changing any other settings, use the phone's browser to navigate to *google.com*. Does it work? Why or why not?

    Answer: No, it does not work. The smartphone does not have Internet access through Bluetooth and has no other active network connections.

16. Turn off Bluetooth. Turn off Airplane mode and, if necessary, turn Wi-Fi and Bluetooth off again. Using the phone's browser, try again to navigate to *google.com*. Does it work? Why or why not?

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Answer: Yes, it should work. The smartphone is using a cellular connection to access the Internet.

17. What kind of network are you using to access the Internet when Wi-Fi is turned off?

    Answer: A cellular connection uses a WAN.

18. **For group assignments:** Select one group member to set up a mobile hotspot using their smartphone. All other group members turn on their Airplane mode. What network connection type is required to connect to the mobile hotspot?

    Answer: Answers may vary. Most answers will list Wi-Fi or Bluetooth.

19. **For group assignments:** Each group member turns on the needed network connection for the mobile hotspot and then connects to the mobile hotspot. What network topology is the group using?

    Answer: Star topology

Project 1-3: Create a Password Manager

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 20 minutes

Objective: Explain common security concepts. (Obj. 4.1)

Resources:

- Internet access
- (Optional) Personal cell phone capable of receiving a text message

Context:

Throughout this course, you will create several accounts at different websites to access tools for various projects. As you read in the module, a password manager can help you document those passwords and store them securely.

In this project, you create a LastPass account where you can store all your account information for the projects in this course. LastPass provides a free subscription option, and you can access your information from any device. If you want, you can also store account

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information for your other school and personal accounts in LastPass. Just remember to always keep your master password secure.

1. Go to **lastpass.com** and click **Get LastPass Free**.
2. Enter your email address and create a master password (the longer, the better—just make sure you can remember it or store it somewhere else safely because there is only one, somewhat unreliable way to recover the account if you forget the password). Confirm your master password and give yourself a reminder if it's helpful. When you're ready, click **Sign Up – It's Free**.
3. If you're working on your own computer, you can install the LastPass browser extension and log in through the extension. If you're not working on your own computer, you can navigate again to lastpass.com and log into your account through the website. Either way, click through to get to your LastPass vault. **Take a screenshot** of your empty vault; submit this visual with your answers to this project's questions. If you already have a LastPass account that you will be using for this course, be sure to obscure any private information from your screenshot. Note that no one, not even your instructor, will need access to your LastPass account for this course.

   Answer: Screenshot should show an empty LastPass vault with a signed-in user account.

4. You can take the offered tour or explore the vault on your own. The LastPass vault is shown in Figure 1-25. Click through each menu option in the left pane. Answer the following questions:

   a. What is the difference between saving a note and saving a password?

   Answer: A password contains information for a website, app, or web service—something that launches within a web browser. A note contains other private information, such as contracts, legal documents, or account information that is not launched from a browser.

   b. What is the purpose of the Emergency Access tool? When might this feature become relevant to you?

   Answer: Emergency Access allows a trusted friend or family member to access the user's vault if the user is incapacitated in some way, such as through illness, injury, or death. It's an important component of digital afterlife planning.

5. When you get to Account Settings, scroll down to SMS Account Recovery and click **Update Phone**. If you have a personal cell phone, add a phone number where you can receive a recovery text message should you forget your master password. The phone must be in your possession to complete this step. Send the test code to your phone and verify your phone in

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LastPass after you receive the code. Close the SMS Account Recovery tab in your browser. Close the Account Settings dialog box.

Note 1-20

Whenever you change your phone number, be sure to update this information in LastPass right away.

6. Click the **Add Item** button, as shown in the lower right corner of Figure 1-25. Enter information for a site you visit often, such as a social media site or an email service. If you want, you can make up information for this entry and then delete it later.
7. If you added a real account for a real website, move the mouse pointer over the site's tile and click **Launch** to automatically open and sign into that site.
8. Log out of LastPass in your browser. Always remember to log out of your account before walking away from your computer. Store a copy of your master password in a very secure place, such as a lockbox in your home, a safe deposit box at a bank, or an encrypted file on your computer.

Note 1-21

You can download and install LastPass as an extension in your favorite browser on each computer that you own. LastPass is compatible with Chrome, Firefox, Safari, Opera, Edge, and Internet Explorer. You can also install the LastPass app on your smartphone (Android or iPhone).

Project 1-4: Apply Troubleshooting Methodology

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 20 minutes

Objective: Explain the network troubleshooting methodology. (Obj. 5.1)

Group work: This project includes enhancements when assigned as a group project.

Resources:

- A drawing app, such as Paint in Windows or a web app such as jspaint.app, kleki.com, or app.diagrams.net

Context:

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Most likely at this point in your IT career, you've already encountered some challenging troubleshooting scenarios with computers, mobile devices, and perhaps even with networks. Interestingly, you probably intuitively applied some sound troubleshooting principles to the problem-solving process, and you might even have incorporated a basic understanding of networking layers as you worked through to a solution. Complete the following steps:

1. Think back to one of the more interesting scenarios you've faced, one where you were able to solve the problem. Take a few moments to write down the symptoms you encountered, the information you gathered, and the questions you asked. Try to remember the sense of confusion or concern that this unknowing created.

2. Think through what theories you developed on the possible causes of the problem as well as what attempts you made to solve the problem. Write down as many details as you can remember about how you finally discovered the solution, and how you arrived at that conclusion.

3. Look back at the troubleshooting flowchart in Figure 1-24. Using a drawing app such as Microsoft Paint in Windows or a free web app such as jspaint.app, kleki.com, or app.diagrams.net, map your problem-solving experience to the steps shown in the flowchart and include additional details as they come to you. **Save this image** as a .png file; submit this visual with your answers to this project's questions.

   Answer: Diagram should show a resemblance to the troubleshooting flowchart in Figure 1-24 and should indicate the progress of the troubleshooting process in the student's specific scenario.

4. What do you notice about your progression through the OSI model layers? Even without necessarily knowing what the OSI model is, did you naturally take a top-to-bottom or a bottom-to-top approach to the problem?

   Answer: Answers will vary and should indicate whether the student notices their intuitive use of a top-to-bottom or bottom-to-top OSI layers approach to the problem as well as evidence of this pattern from the student's recall of the troubleshooting experience.

5. What theories did you test that turned out to be wrong? What information or insights did you learn from those dead ends?

   Answer: Answers will vary and should include at least one theory that turned out to be wrong as well as information or insights gleaned from those dead ends.

6. Did you involve anyone else in the problem-solving process? If so, who was that person and how did they help?

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Answer: Answers will vary and should indicate who, if anyone, helped with troubleshooting the problem and how that person helped.

7. What did you do to test your solution? What measures did you take to ensure the problem didn't happen again?

   Answer: Answers will vary and should list attempts at testing solutions and measures taken to prevent future problems.

8. Considering what you've now learned about troubleshooting methodology, what could you have reasonably done differently to discover the solution more quickly?

   Answer: Answers will vary and should explore options to handle similar problems more efficiently in the future.

9. **For group assignments:** Each member of the group should write a summary of the problem experienced in their scenario, steps taken, and outcome of the issue as if they were documenting this information in a knowledge base. Next, exchange this documentation with another member of the group. Each member then reads through the information written by their classmate and lists questions they still have about the events or information gaps that could cause problems in the future. Discuss your concerns with the author of the scenario. Submit this information and a summary of the group discussion.

   Answer: Each group member submits their notes on a classmate's troubleshooting documentation along with a summary of the group discussion addressing any concerns raised about that documentation.

Capstone Projects

Note 1-22

The Capstone Projects in this course are designed to give you a "big picture" experience of networking. While the Capstones don't always map closely to a module's learning objectives, each Capstone adds resources and skills to your toolkit while building on Capstones you completed in earlier modules. For example, in this module, you will create at least one VM (virtual machine) in a hypervisor. In later Capstones, you will revisit this VM to complete other tasks on it. For those Capstones, you won't start from scratch—you'll build on resources you worked on in earlier modules. Over time, your stream of learning will build momentum so that you will accomplish complex tasks in later Capstones that you could not have completed in a single, isolated project.

Sometimes the Capstones will introduce you to concepts you haven't yet learned much about. Don't worry—detailed steps will guide you through each project. Then, when you study these concepts in later modules, you'll already have some familiarity with the concepts. For example, you haven't yet

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learned about virtualization in this course, and yet, you're working with a hypervisor in this module's Capstone Projects. By the time you get to the virtualization module, you'll have a decent understanding of what a hypervisor is and basically how it works, and that module's material will make a lot more sense to you.

Overall, these Capstones are intended to challenge you and also to provide a fun opportunity to apply what you're learning over time—to link concepts from module to module. In the study of learning science, this technique is called interleaving. Take good notes as you go, think creatively about what you're doing in each Capstone, and look for the ways each module's Capstones connect to other modules. Enjoy!

Note 1-23

Websites and applications change often. While the instructions given in these projects were accurate at the time of writing, you might need to adjust the steps or options according to later changes.

Capstone Project 1-1: Set Up a Windows Virtual Machine Using Hyper-V

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 45 minutes

Objective: Explain the characteristics of network topologies and network types. (Obj. 1.2)

Resources:

- Windows 10 Pro (64-bit version) host computer
- Windows ISO file to install in a guest VM

Context:

In this project, you enable and use Client Hyper-V, which is software embedded in Windows 10 Professional, 64-bit version, to create and manage VMs (virtual machines) and virtual networks on a single workstation. You'll first enable the workstation UEFI to support virtualization and enable Hyper-V. You'll then create a VM in Hyper-V and install a Windows OS in the VM.

Note 1-24

If you complete this project, your instructor might not require you to complete Capstone Project 1-2, "Set Up a Windows Virtual Machine Using Oracle VirtualBox." You'll use one of these two hypervisors and its VMs for multiple projects throughout this course, but you won't need both. Be sure to save

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any user account information or other important information in your LastPass vault for future reference.

1. For Hyper-V to work, HAV (hardware-assisted virtualization) must be enabled in UEFI setup. If you are not sure it is enabled, click **Start** and **Power**. Hold down the **Shift** key and click **Restart**. When the computer reboots, click **Troubleshoot, Advanced options**, and **UEFI Firmware settings**. The computer reboots again, this time into UEFI setup.

Note 1-25

Some motherboards might not show "UEFI Firmware settings" as an option on the Advanced options screen. If this is the case for you, you'll need to do a little experimenting and troubleshooting. First, determine your motherboard manufacturer and model. To do this, continue the boot to Windows, press **Win+R**, and enter **msinfo32**, which will list the motherboard manufacturer and model on the System Summary page. Find the motherboard's documentation online to ensure it supports UEFI. If it does, you can try entering the UEFI settings during boot by pressing the required key, such as Esc, Del, F2, F4, F8, or F12. (If you're not sure which key to try, check your motherboard documentation or watch for a message during boot.) Before pressing the key to successfully access UEFI, you might first need to disable fast startup in the Windows Control Panel's Power Options menu. If you have trouble with any this, be sure to do a search online for the problem you're having and look for information to help you figure it out. Learning how to research a problem online is an important skill for any IT technician.

2. Make sure hardware-assisted virtualization (HAV) is enabled. For the system shown in Figure 1-26, that's done on the CPU Configuration screen. Also make sure that any subcategory items under HAV are enabled. Save your changes, exit UEFI setup, and allow the system to restart to Windows.

3. Hyper-V is disabled in Windows 10 Pro by default. To enable it, right-click **Start** and click **Apps and Features**. Scroll down to Related settings and click **Programs and Features**. In the left pane, click **Turn Windows features on or off**. Check **Hyper-V** and click **OK**. When Windows finishes applying changes, click **Restart now** for the changes to take effect.

4. From the Windows Administrative Tools folder on the Start menu, launch the **Hyper-V Manager** application. In the left pane of the Hyper-V Manager, select the name of the host computer, which will be listed underneath Hyper-V Manager.

5. To make sure your VMs have access to the network or the Internet, you need to first install a virtual switch in Hyper-V. To create a new virtual network switch, click **Virtual Switch Manager** in the Actions pane.

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6. In the Virtual Switch Manager dialog box, verify **New virtual network switch** is selected in the left pane. Give the switch a name, such as ProjectSwitch. To bind the virtual switch to the physical network adapter so the VMs can access the physical network, select **External** in the right pane. Then click **Create Virtual Switch**. In the next dialog box, make sure **Allow management operating system to share this network adapter** is checked and click **Apply**. In the Apply Networking Changes dialog box, click **Yes**. Your virtual LAN now has a virtual switch. Close the Virtual Switch Manager dialog box.

Note 1-26

Your instructor might have special instructions for the following steps. Check with your instructor before proceeding.

7. In the Actions pane, click **Quick Create**. Use these parameters for the new VM:

   - Click **Local installation source**, and then click **Change installation source**. Browse to the location of the ISO file that contains the Windows operating system setup files made available by your instructor. Select the ISO file and click **Open**.
   - Make sure Windows Secure Boot is enabled.
   - Click **More options** and enter a name for your VM. When naming resources like VMs, be sure to think through what information the resource's name should provide, and think about how this name will compare to other resource names when appearing in a list together. For example, you might want to include the VM's OS in the name, such as "Windows10-64bit," or you might want to reference the project in which you created the VM, such as "CapProj1-1." What did you name your VM?

   Answer: Answers will vary and should show evidence of some thought given to the value of the VM's name. For example, information about the VM should appear in its name, such as the VM's OS or the lab in which the VM was created.

8. After the VM is created, click **Edit** settings and answer the following questions:

   a. How much memory will the VM have?

   Answer: Answers may vary. By default, Hyper-V allocates 2048 MB of RAM to a Windows 10 64-bit VM.

   b. How many virtual processors will the VM have?

   Answer: Answers may vary. By default, Hyper-V allocates four virtual processors.

   c. What device will the VM boot from?

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Answer: Unless different instructions were used, the VM should be set to boot from a DVD drive.

9. Click **Cancel**, click **Connect**, and then click **Start**. If you used an ISO file as the installation source, when you see *Press any key to boot from CD or DVD*, press the spacebar so the VM will boot from the ISO file. Figure 1-27 shows where a Windows 10 installation has begun.

Note 1-28

If you have trouble booting to the ISO file, consider increasing the VM's available memory in the Settings menu. For example, 64-bit Windows installs more easily with 4 GB of RAM rather than the minimum 2 GB. Keep in mind, though, that any RAM dedicated to a running VM is not available to the host machine.

10. During setup, choose the following options:

    a. Check with your instructor for specific instructions on how to handle the Windows product key.

    b. When prompted, choose the **Windows 10 Home** or **Windows 10 Professional** operating system unless your instructor directs otherwise.

    c. When prompted, choose the **Custom: Install Windows only (advanced)** option.

    d. Otherwise, follow the prompts on-screen and make any adjustments to default settings only as directed by your instructor. How much space is allocated to the VM's Drive 0?

    Answer: Answers may vary. By default, Hyper-V allocates 127 GB to Drive 0.

11. After you have installed Windows in the VM, and the VM boots into Windows, you should receive a message asking if you want to allow this computer to be discoverable by other devices on the network. Click **Yes**. Then open the Edge browser to confirm the VM has a good Internet connection. **Take a screenshot** of your desktop showing your Hyper-V Manager, your running VM, and the VM's successful connection with the Internet; submit this visual with your answers to this project's questions. When you're finished, be sure to shut down the VM properly—just like a physical machine, a virtual machine can be corrupted by improper shutdowns.

    Answer: Screenshot should show the host computer's desktop, the VirtualBox Manager window, the VM running in a VirtualBox window, and the Edge browser open on the VM showing a web page.

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Capstone Project 1-2: Set Up a Windows Virtual Machine Using Oracle VirtualBox

[A rubric that provides guidance on evaluating answers to the Hands-on Projects and Capstone project is provided here.]

Estimated time: 45 minutes

Objective: Explain the characteristics of network topologies and network types. (Obj. 1.2)

Resources:

- Any edition of Windows 10 installed on a computer that supports UEFI. Note that instructions for projects using VirtualBox are written for Windows 10 hosts. However, Oracle VirtualBox can also be installed on a Windows 7/8/8.1, Linux, macOS, or Solaris host.
- Windows ISO file to install in a guest VM

Context:

In this project, you download and install Oracle VirtualBox, which is a free hypervisor, to create VMs (virtual machines) and a virtual network on a single workstation.

Note 1-29

If you completed Capstone Project 1-1, "Set Up a Windows Virtual Machine Using Hyper-V," your instructor might not require you to complete this project. You'll use one of these two hypervisors and its VMs for multiple projects throughout this course, but you won't need both. Be sure to save any user account information or other important information in your LastPass vault for future reference.

1. If you are using a 64-bit host computer and want to install a 64-bit OS in the VM, HAV (hardware-assisted virtualization) must be enabled in UEFI setup. If you are not sure it is enabled, click **Start** and **Power**. Hold down the **Shift** key and click **Restart**. When the computer reboots, click **Troubleshoot, Advanced options**, and **UEFI Firmware settings**. The computer reboots again, this time into UEFI setup.

Note 1-30

Some motherboards might not show "UEFI Firmware settings" as an option on the Advanced options screen. If this is the case for you, you'll need to do a little experimenting and troubleshooting. First, determine your motherboard manufacturer and model. To do this, continue the boot to Windows, press **Win+R**, and enter **msinfo32**, which will list the motherboard manufacturer and model on the System Summary page. Find the motherboard's documentation online to ensure it supports UEFI. If

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it does, you can try entering the UEFI settings during boot by pressing the required key, such as Esc, Del, F2, F4, F8, or F12. (If you're not sure which key to try, check your motherboard documentation or watch for a message during boot.) For this to work, you might first need to disable fast startup in the Windows Control Panel's Power Options menu. If you have trouble with any this, be sure to do a search online for the problem you're having and look for information to help you figure it out. Learning how to research a problem online is an important skill for any IT technician.

2. Make sure hardware-assisted virtualization (HAV) is enabled. For the system shown earlier in Figure 1-26, that's done on the CPU Configuration screen. Also make sure that any subcategory items under HAV are enabled. Save your changes, exit UEFI setup, and allow the system to restart to Windows.

3. Go to **www.virtualbox.org/wiki/Downloads** and download the most current **VirtualBox platform package** for Windows hosts to your desktop or other folder on your hard drive. Install the software, accepting default settings during the installation. The Oracle VM VirtualBox Manager window opens (see Figure 1-28).

Note 1-31

Your instructor might have special instructions for the following steps. Check with your instructor before proceeding.

To create a virtual machine using VirtualBox, complete the following steps:

4. Click **New** in the toolbar and follow the wizard to create a VM. Give your VM a name. When naming resources like VMs, be sure to think through what information the resource's name should provide, and think about how this name will compare to other resource names when appearing in a list together. For example, you might want to include the VM's OS in the name, such as "Windows10-64bit," or you might want to reference the project in which you created the VM, such as "CapProj1-2." What did you name your VM?

   Answer: Answers will vary and should show evidence of some thought given to the value of the VM's name. For example, information about the VM should appear in its name, such as the VM's OS or the lab in which the VM was created.

5. Select the Windows OS you will install in the VM, such as Windows 10 (64-bit). You can accept all default settings for the VM unless directed otherwise by your instructor. As you go, notice the resources allocated to the VM and answer the following questions:

   a. How much memory will the VM have?

   Answer: Answers may vary. By default, VirtualBox allocates 2048 MB of RAM to a Windows 10 64-bit VM.

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b. What kind of file will hold the VM's virtual hard disk?

Answer: Answers may vary. By default, VirtualBox creates a VDI (VirtualBox Disk Image) file type.

c. How much space will the VM's hard disk have?

Answer: Answers may vary. By default, VirtualBox creates a 50 GB virtual hard disk.

With the VM selected, click **Settings** in the VirtualBox Manager window. In the VM's Settings window, click **Storage** in the left pane.

In the Storage Tree area, to the right of *Controller: SATA*, click the **Adds optical drive** icon, which looks like a CD with a plus (+) symbol, as shown in Figure 1-29.

The Optical Disk Selector window appears. Click **Add**. Browse to the location of the ISO file that contains the Windows operating system setup files made available by your instructor. Select the ISO fileclick **Open**, click **Choose**, and click **OK**. You will now return to the VirtualBox Manager window.

Note 1-32

An ISO file (which has the .iso file extension) is a disc image file. It contains all the files and folders of a virtual CD or DVD merged into a single file. The file can be burned to a physical disc, or it can be mounted to a virtual device, such as a VM.

Click **Start** on the toolbar. When you see *Press any key to boot from CD or DVD*, press the spacebar so the VM will boot from the ISO file. Your VM starts up and begins the process of installing the operating system.

Note 1-33

If you have trouble booting to the ISO file, you might need to enable EFI. To do this, go to the VM's **Settings** window and click **System**. In the Extended Features section, select the checkbox for **Enable EFI (special OSs only)**.

Also, if the VM struggles to install Windows, consider increasing the VM's available memory in the Settings menu. For example, 64-bit Windows installs more easily with 4 GB of RAM rather than the minimum 2 GB. Keep in mind, though, that any RAM dedicated to a running VM is not available to the host machine.

During setup, choose the following options:

a. Check with your instructor for specific instructions on how to handle the Windows product key.

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b. When prompted, choose the **Windows 10 Home** operating system unless your instructor directs otherwise.

c. When prompted, choose the **Custom: Install Windows only (advanced)** option.

d. Otherwise, follow the prompts on-screen and make any adjustments to default settings only as directed by your instructor.

11. After you have installed Windows in the VM, and the VM boots into Windows, you should receive a message asking if you want to allow this computer to be discoverable by other devices on the network. Click **Yes**. Then open the Edge browser to confirm the VM has a good Internet connection. **Take a screenshot** of your desktop showing your VirtualBox app, your running VM, and the VM's successful connection with the Internet; submit this visual with your answers to this project's questions. When you're finished, be sure to shut down the VM properly—just like a physical machine, a virtual machine can be corrupted by improper shutdowns.

    Answer: Screenshot should show the host computer's desktop, the VirtualBox Manager window, the VM running in a VirtualBox window, and the Edge browser open on the VM showing a web page.

MindTap

Reflection Discussion 1: Communication Layers

In this module, you learned about a foundational organizing principle in networking: layers of communication. The OSI model and the TCP/IP model are both commonly used to guide network design, maintenance, and troubleshooting tasks.

This text gave the analogy of a letter being mailed via the post office to illustrate the nature of each layer in the OSI model. Many other analogies can be used to further describe how communications layers function in a system. What examples can you think of? Consider in what ways you notice one person, company, or other entity communicate with another person, company, or other entity indirectly through multiple layers. Then answer the following questions:

- What is a real-life example of how layers in a system indirectly connect two entities (such as a person or company) in communication?
- What layers can you identify in this system?
- How are these layers similar to the layers of the OSI model?

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Go to the discussion forum in your school's LMS (learning management system). Write a post of at least 100 words discussing your thoughts about these questions. Then respond to two of your classmates' threads with posts of at least 50 words discussing their comments and ideas. Use complete sentences, and check your grammar and spelling. Try to ask open-ended questions that encourage discussion, and remember to respond to people who post on your thread.

Answer: Use the following rubric to evaluate answers to these discussion questions.

Networking for Life Discussion 1: CompTIA Resources

If you've chosen a career related to IT, you're committing yourself to a career-long learning path. IT changes quickly, as you probably know, and it will be part of your responsibility as a professional to keep up with these changes as they relate to your job duties. Earning and maintaining certifications is one of the most assured ways to know you're on track with the progression of technology.

In this course, you're studying the concepts and skills required for the CompTIA Network+ exam, which is updated every three years to keep pace with the industry. In addition to these exams, CompTIA publishes blogs and other resource articles, as well as hosting webinars and conferences. Check the CompTIA website for upcoming events (*comptia.org/events*) and try to attend one or more events if possible, especially the free events offered online. Next, visit the CompTIA blog (*comptia.org/blog*) and find a current post addressing updates in networking. Then answer the following questions:

- Which CompTIA event did you find that looks interesting? Do you plan to attend?
- What networking update did you read about? How does this information apply to your career interests?
- What other sources do you think will be helpful to you in keeping pace with the progression of technology?

Go to the discussion forum in your school's LMS (learning management system). Write a post of at least 100 words discussing your thoughts about these questions. Then respond to two of your classmates' threads with posts of at least 50 words discussing their comments and ideas. Use complete sentences and check your grammar and spelling. Try to ask open-ended questions that encourage discussion, and remember to respond to people who post on your thread.

Answer: Use the following rubric to evaluate answers to these discussion questions.

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Rubric for Hands-on Projects and Capstone Projects

Criteria	Beginning	Developing	Proficient	Exemplary	Score
Responses to questions	All missing or incorrect **[0 points]**	Most missing or incorrect **[15 points]**	Little missing or incorrect **[20 points]**	All complete **[25 points]**	
Other deliverables	Missing **[0 points]**	Present but missing most or all the required information **[15 points]**	Present but missing some of the required information **[20 points]**	Present and contains all the required information **[25 points]**	
Critical thinking and engagement	Student shows little to no evidence of attempting to meet the performance requirements of the assignment **[0 points]**	Student retains their existing understanding while attempting to meet the performance requirements of the assignment **[15 points]**	Student challenges their existing understanding and shows evidence of new learning **[20 points]**	Student challenges their existing understanding and displays creative and original insights **[25 points]**	
Mechanics	Grammar, spelling, punctuation, and formatting make student's message difficult to understand **[0 points]**	Grammar, spelling, punctuation, and formatting detract from student's message **[15 points]**	Grammar, spelling, punctuation, and formatting support student's message **[20 points]**	Grammar, spelling, punctuation, and formatting enhance student's message **[25 points]**	
				Total	

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Rubric for Discussion Assignments

Task	***Developing***	***Proficient***	***Exemplary***	***Score***
Initial post	Generalized statements **[30 points]**	Some specific statements with supporting evidence **[40 points]**	Self-reflective discussion with specific and thoughtful statements and supporting evidence **[50 points]**	
Initial post: Mechanics	· Length < 100 words · Several grammar and spelling errors **[5 points]**	· Length = 100 words · Occasional grammar and spelling errors **[7 points]**	· Length > 100 words · Appropriate grammar and spelling **[10 points]**	
Response 1	Brief response showing little engagement or critical thinking **[5 points]**	Detailed response with specific contributions to the discussion **[10 points]**	Thoughtful response with specific examples or details and open-ended questions that invite deeper discussion of the topic **[15 points]**	
Response 2	Brief response showing little engagement or critical thinking **[5 points]**	Detailed response with specific contributions to the discussion **[10 points]**	Thoughtful response with specific examples or details and open-ended questions that invite deeper discussion of the topic **[15 points]**	
Both responses: Mechanics	· Length < 50 words each · Several grammar and	· Length = 50 words each	· Length > 50 words each	

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	spelling errors **[5 points]**	· Occasional grammar and spelling errors **[7 points]**	· Appropriate grammar and spelling **[10 points]**	
			Total	

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Instructor Manual
Module 1

Jill West, CompTIA Network+ Guide to Networks 9th edition, ISBN 9780357508138, Module 1: Introduction to Networking

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Purpose and Perspective of the Module

This module introduces you to the fundamentals of networks and how technicians support them. Topics include peer-to-peer vs client-server networks, applications and protocols, network devices and topologies, the OSI model, safety, and troubleshooting.

Cengage Supplements

The following product-level supplements provide additional information that may help you in preparing your course. They are available in the Instructor Companion Site.

- Transition Guide (provides information about what's new from edition to edition)
- Test Bank (contains assessment questions and problems)
- Solution and Answer Guide (offers solutions, answers, and feedback)
- PowerPoint (provides text-based lectures and presentations)
- MindTap Educator Guide (provides information about the activities included in MindTap)
- MindTap Transition Guide (compares what has changed or been renamed from edition to edition)

List of Student Downloads

Students should download the following items from the Student Companion Center to complete the activities and assignments related to this module:

-

Module Objectives

The following objectives are addressed in this module:

1. Distinguish between peer-to-peer and client-server networks
2. Identify types of applications and protocols used on a network
3. Describe various networking hardware devices and the most common physical topologies
4. Describe the seven layers of the OSI model
5. Explain best practices for safety when working with networks and computers
6. Describe the seven-step troubleshooting model for troubleshooting network problems

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This edition adds an introduction to databases and SQL and coverage of fire suppression.

Some new activities, review questions, and case projects have been created to reinforce the concepts and techniques presented in the module and to help you apply these concepts to real-world scenarios. In addition, the following new components and content have been added to this module and all modules in this edition:

- Remember this… feature
- Self-Check questions
- You're Ready feature
- Updated to new technologies
- Updated to new objectives

[return to top]

Teaching Tips

Consider the following teaching tips when assigning this module to your students.

[Network Models]

1. Define and describe the term topology. Discuss the two types of topology students will need to understand:
    - physical topology
    - logical topology

2. Explain that controlling how users and programs get access to the resources on a network is a function of the OS used on the network.

3. Introduce students to the peer-to-peer and the client-server network models. Point out that the client-server model requires one or more network operating systems (NOS).

[Peer-to-Peer Network Model]

1. Discuss the characteristics of a P2P (peer-to-peer) network model.

2. Describe the characteristics of a traditional peer-to-peer network.

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4. Discuss the three ways resources can be shared if all computers in a P2P network are running a Windows OS.

5. Describe the advantages of peer-to-peer networks.

6. Describe the disadvantages of peer-to-peer networks.

[Client-Server Network Model]

1. Introduce the client/server model. Use Figure 1-2 in your discussion.

2. Define and describe a Windows domain. Point out the centralized database that contains user account information and security for the entire group of computers is called Active Directory (AD).

3. Point out that a Microsoft account links local domain resources with Microsoft cloud resources. Compare this type of account to a local account, which is specific to a domain.

4. Describe how clients and servers communicate.

5. Provide examples of current Network Operating Systems and discuss some of the tasks that a NOS is responsible.

6. Describe the disadvantage of a client/server network relative to a peer-to-peer network.

7. Describe the advantages of a client/server network relative to a peer-to-peer network.

[Client-Server Applications]

1. Define network services.

2. Explain that a client-server application involves two computers:

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3. Use Figure 1-3 to demonstrate how a client and server communicate across a network.

4. Define and discuss protocols.

[Network Services and Their Protocols]

1. Discuss several popular client-server applications used on networks and the Internet:
   - Web service
   - Email services
   - DNS service
   - FTP service
   - Database services
   - Remote access services

[Network Hardware]

1. Introduce this section by using Figure 1-7 to discuss networking hardware and how that hardware is connected together.

[LANs and Their Hardware]

1. Define and describe a LAN. Mention that LANs are usually contained in a small space, such as an office or building.

2. Define and describe a switch.

3. Compare a star topology to a mesh topology, where each device connects to multiple other devices. Use Figure 1-1 to illustrate a mesh topology.

4. Use Figure 1-9 to discuss the concept of a network port.

5. Define and describe NICs (network interface cards). Use Figure 1-10 in your discussion. Point out that a NIC may also be called a network adapter.

7. Note the cabling needs for a network backbone and discuss why they are important.

8. Define and describe a router as a device that manages traffic between two or more networks. Mention that a very important function of a router is to determine the best path for traffic to go through in order to reach its destination.

9. Use Figures 1-14 and 1-15 to discuss the difference between a switch and a router.

10. Bes sure to define the following terms as they relate to the components of a LAN: bus topology, hybrid topology, host, and node.

11. As an aside, quickly discuss legacy technologies such as hubs and ring topologies.

[MANs and WANs]

1. Define and describe a WAN as a group of LANs that spread over a wide

2. Define and describe a MAN. Point out that a MAN may also be called a CAN.

3. Use Figure 1-17 to illustrate a WAN connecting two LANs in different geographical areas.

4. Mention other network types: BAN, SAN, and WLAN.

[The Seven-Layer OSI Model]

1. Mention that hacktivists are a group strongly motivated by ideology. They are likely to break into a website and change the contents as a means of making a political statement.

2. Point out that it is estimated that there are thousands of hacktivist groups worldwide supporting a wide variety of causes.

2. Explain how the Application Layer facilitates communication between software applications and lower-layer network services.

3. Point out that data passed between applications or utility programs and the OS is called a payload.

[Layer 6: Presentation Layer]

1. Introduce and describe the Presentation layer as being responsible for reformatting, compressing, and/or encrypting data in a way that the application on the receiving end can read.

2. Explain how the Presentation layer services also manage data encryption (such as the scrambling of passwords) and decryption.

[Layer 5: Session Layer]

1. Introduce and describe the function of the Session layer.

2. Explain how the term session is used to describe an established connection between two end points.

3. Point out that most tasks are performed by the OS when an application makes an API call to the OS.

[Layer 4: Transport Layer]

1. Introduce and describe the function of the Transport layer.

2. Define and describe TCP and the characteristics of a connection-oriented protocol.

3. Define and describe UDP and the characteristics of a connectionless protocol.

5. Discuss the Transport layer's use of ports numbers.

6. Point out that TCP messages are divided into smaller messages called segments and UDP messages are known as a datagram.

[Layer 3: Network Layer]

1. Introduce and describe the function of the Network layer.

2. Note that the IP protocol is the most common Network layer protocol.

3. Explain how the data unit accepted from the Transport layer is transformed into a packet.

4. Define and discuss an IP address. Mention that because an IP address is used by the Network layer, it may also be known as a network address.

5. Point out that IP relies on several routing protocols to find the best route for a packet when traversing several networks on its way to its destination.

6. Define and discuss fragmentation, which is a process that divides a packet into smaller packets.

[Layer 2: Data Link Layer]

1. Introduce and describe the function of the Data Link layer.

2. Point out that switches and NICs operate at this layer.

3. Explain that the Data Link layer puts its own control information in a header and attaches control information to the end of the packet (called a trailer) that was received from the Network layer above. The entire Data Link layer message is then called a frame.

5. Describe a MAC address as a Layer 2 address that is found on every network adapter on the globe. Mention that a MAC address may also be referred to as a physical address, hardware address, or a Data Link layer address.

[Layer 1: Physical Layer]

1. Introduce and describe the function of the Physical layer.

2. Explain the different signal types corresponding to the different transmission media.

[Protocol Data Unit or PDU]

1. Describe a PDU (protocol data units) and explain how it flows through the model.

2. Use Table 1-1 to discuss the different names for a PDU as it moves from one layer to another.

[Summary of How the Layers Work Together]

1. Use Figure 1-20 and Table 1-2 to describe the steps through the OSI layers during a browser-to-Web server transmission.

2. Be sure to mention the idea of encapsulation as data moves down the layers on the sending side and decapsulation as data moves up the layers on the receiving side.

[Safety Procedures and Policies]

1. Introduce this section, explaining that while working in IT is relatively safe, there are some safety precautions you should be aware of to protect sensitive electronics and yourself.

[Emergency Procedures]

1. Discuss the importance of knowing the best escape route in the event of an emergency.

3. Describe the components of a fire suppression system:
    a. Emergency alert system
    b. Portable fire extinguishers
    c. Emergency power-off switch

4. Discuss the difference between a fail open and a fail close. Point out that a fail-open policy is often based on common sense so as to ensure that, in an emergency, no one is harmed when a system is not working.

5. Explain that a safety data sheet (SDS) explains how to properly handle substances such as chemical solvents and how to dispose of them.

[Safety Precautions]

1. Explain that electrical and tool safety in workplaces is generally regulated by OSHA.

2. Discuss the general OSHA guidelines that should be followed when using power tools or other hand tools in the workplace:
    a. Wear PPE (personal protective equipment)
    b. Keep all tools in good condition and properly stored
    c. Use the right tool for the job
    d. Watch out for trip hazards

3. Describe the guidelines that should be followed when lifting heavy objects.

4. Define and describe grounding.

5. Discuss the negative effects that static electricity (ESD) can have on electronic components.

6. Describe the steps that should be followed before touching a component.

[Troubleshooting Network Problems]

1. Introduce basic troubleshooting methodology.

2. Use Figure 1-24 to describe each of the seven steps of the troubleshooting methodology:

    a. Step 1: Identify the problem and its symptoms
    b. Step 2: Establish a theory of probable cause
    c. Step 3: Test your theory to determine the cause
    d. Step 4: Establish a plan for resolving the problem
    e. Step 5: Implement the solution or escalate the problem
    f. Step 6: Verify functionality and implement preventive measures
    g. Step 7: Document findings, actions, and outcomes

3. Demonstrate using the seven steps to troubleshoot a failed network connection (see "Applying Concepts 1-2: Troubleshoot a Failed Network Connection").

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Complete List of Module Activities and Assessments

This table lists all of the activities and assessments available in this module that will help you enhance your students' learning experience as they move through the course.

Activity/Assessment	Module Objective	Certification Exam Objective	Source: Book, MindTap, or Instructor Resources	Estimated Completion Time
Self-Check Questions 1-3	LO 1	1.2	Book	3 min
Self-Check Questions 4-6	LO 2	1.5	Book	3 min
Self-Check Questions 7-9	LO 3	1.2, 2.1	Book	3 min
Self-Check	LO 4	1.1	Book	3 min

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Self-Check Questions 15-16	LO 6	5.1, 5.5	Book	3 min
Applying Concepts: Explore Network Operating Systems	LO 1	1.2	Book	[ask Au or DE]
Applying Concepts 1-2: Troubleshoot a Failed Network Connection	LO 6	5.1, 5.5	Book	[ask Au or DE]
Review Questions 10 Multiple Choice 10 Short Answer	LOs 1-6	1.1, 1.2, 1.3, 1.4, 1.5, 1.6	Book	20-30 min
Hands-On Project 1-1: IT and Networking Certifications	N/A	1.7	Book	20 min
Project 1-2: Explore Network Types on a Smartphone	LOs 2, 3	1.2	Book	10 min
Project 1-3: Create a Password Manager Account	N/A	4.1	Book	20 min
Project 1-4: Apply Troubleshooting Methodology	LO 6	5.1	Book	20 min
Capstone Project 1-1: Set Up a Windows Virtual Machine Using Hyper-V	N/A	1.2	Book	45 min
Capstone Project 1-2: Set Up a Windows Virtual Machine Using Oracle VirtualBox	N/A	1.2	Book	45 min
Knowledge Check: CompTIA Network+	[CM or LD to fill in	[CM or LD to fill in once assessment	MindTap	30 min

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	creates this quiz]			
Networking for Life	[ask the Au or DE]	[ask the Au or DE]	MindTap	[ask the Au or DE]
Practice Test	LOs 1-6	1.1, 1.2, 1.3, 1.4, 1.5, 1.6	MindTap	10-15 min
Simulation Lab 1-1: [enter name of lab]	[ask the Au or DE]	[ask the Au or DE]	MindTap	[ask the Au or DE]
[list the other simulation labs]			MindTap	
Live Virtual Machine Lab 1-1: [enter name of lab]	[ask the Au or DE]	[ask the Au or DE]	MindTap	[ask the Au or DE]
[list the other live virtual machine labs]			MindTap	
Module Quiz	[ask the Au or DE]	[ask the Au or DE]	MindTap	10-15 min
Reflection	[ask the Au or DE]	[ask the Au or DE]	MindTap	[ask the Au or DE]
Lab Manual Lab 1-1: [enter lab title]	[ask the Au or DE]	[ask the Au or DE]	MindTap	[check the page proof for the lab for Estimated Completion Time]
[list the other lab manual labs]	[ask the Au or DE]	[ask the Au or DE]	MindTap	[check the page proof for the lab for Estimated Completion Time]
Quiz: CompTIA Network+ N10-008 Post-Assessment	All LOs for the course	All CompTIA Network+ N10-008 exam objectives	MindTap	90 min

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40 Multiple Choice questions				
Knowledge Check Activity 1-1	LO 2	1.6	PPT deck: Instructor Resources, MindTap	1 min
Knowledge Check Activity 1-2	LO 4	1.1	PPT deck: Instructor Resources, MindTap	1 min

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Note About Live Virtual Machine Labs

The live virtual machine labs provide hands-on practice that will help students learn the material covered in each module. Throughout the labs students will encounter gradable assessments in the form of multiple-choice questions, short answer questions, as well as requests to use lab functionality and record screenshots of their live virtual machine lab desktop, noting their progress in the lab.

The first content pane in each live virtual machine lab provides a list of learning outcomes that students should be able to do after they complete the module. There is also a list of the CompTIA exam objectives that each lab covers. The main focus of the live virtual machine labs is to cover the practical, hands-on aspects of the exam objectives. The labs do not map directly back to the topics covered in each module of the book or MindTap course. It is recommended that students refer to course materials to research theoretical topics in more detail.

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Key Terms

AD (Active Directory) The centralized directory database that contains user account information and security for the entire group of computers on a network.

AD DS (Active Directory Domain Services) The Active Directory service that manages the process allowing a user to sign on to a network from any computer on the network and get access to the resources that Active Directory manages.

application layer The seventh layer of the OSI model. Application layer protocols enable software programs to negotiate formatting, procedural, security, synchronization, and other requirements with the network.

backbone The central conduit of a network that connects network segments and significant shared devices (such as routers, switches, and servers) and is sometimes referred to as "a network of networks."

bus topology A topology in which a single cable connects all nodes on a network without intervening connectivity devices.

CAN (campus area network) A network of connected LANs within a limited geographical area, such as the buildings on a university campus.

change management Carefully defined processes to evaluate the need for a change, the cost of the change, a plan for making the change with minimal disruption, and a backup plan if the change doesn't work as expected.

client A computer or application that makes a request from another computer or application.

client-server application Data or a service requested by one computer from another.

client-server network model A network where resources are managed by the NOS (network operating system) via a centralized directory database.

connectionless protocol A type of transport layer protocol that services a request without requiring a verified session and without guaranteeing delivery of data.

connection-oriented protocol A type of transport layer protocol that requires the establishment of a connection between communicating nodes before it will transmit data.

data link layer The second layer in the OSI model. The data link layer, also called the link layer, bridges the physical layer's networking media with network layer processes.

datagram A UDP message at the transport layer.

DBMS (database management system) Software installed on a database server that is responsible for making requested changes to data and organizing data for viewing, reporting, or exporting.

decapsulation Removing a header or trailer from a lower OSI layer.

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DNS (Domain Name System) A hierarchical system for tracking domain names and their

encapsulation The process of adding a header to data inherited from the layer above.

ESD (electrostatic discharge) The transfer of electrical charge between two bodies, such as when a technician touches a computer component.

fail close System default that denies access during a system or network failure.

fail open System default that allows access during a system or network failure.

fire suppression system Any system designed to combat the outbreak of a fire. A fire suppression system might include an emergency alert system, fire extinguishers, emergency power-off switch, and/or a suppression agent such as a foaming chemical, gas, or water.

firewall A device (either a router, a dedicated device, or a computer running special software) that selectively filters or blocks traffic between networks.

firmware Programs embedded into hardware devices.

fragmentation A network layer service that subdivides packets into smaller packets when those packets exceed the maximum size for the network.

frame The entire data link layer message, including the header, payload, and trailer.

FTP (File Transfer Protocol) An application layer protocol used to send and receive files via TCP/IP.

grounding Connecting a device directly to the earth so that, in the event of a short circuit, the electricity flows into the earth rather than out of control through the device.

header An area at the beginning of a payload where protocols add control information.

host (1) Any computer or device on a network that provides or uses a resource such as an application or data. (2) In the context of virtualization, the physical computer on which virtualization software operates and manages guests.

HTTP (Hypertext Transfer Protocol) An application layer protocol that formulates and interprets requests between web clients and servers.

HTTPS (HTTP Secure) An extension to HTTP that requires data be exchanged between client and server using SSL or TLS encryption.

hub An outdated connectivity device that belongs to the physical layer of the OSI model and retransmits incoming data signals to its other ports.

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hybrid topology A physical topology that combines characteristics of more than one simple physical topology.

IMAP4 (Internet Message Access Protocol, version 4) A mail retrieval protocol that allows users to store messages on the mail server while reading, responding to, and organizing the messages. The most current version of IMAP is version 4 (IMAP4).

IP (Internet Protocol) A core protocol in the TCP/IP suite that operates in the network layer of the OSI model and provides information about how and where data should be delivered. IP is the subprotocol that enables TCP/IP to internetwork.

IP address A unique network layer address assigned to each node on a TCP/IP network. IPv4 addresses consist of 32 bits divided into four octets, or bytes. IPv6 addresses are composed of eight 16-bit fields, for a total of 128 bits.

ISP (Internet service provider) A company that provides Internet connectivity.

knowledge base A collection of accumulated insights and solutions to the problems encountered on a particular network.

LAN (local area network) A network of computers and other devices that typically is confined to a relatively small space, such as one building or even one office. Each node on a LAN can communicate directly with others on the same LAN.

logical topology A characteristic of network transmission that reflects the way in which data is transmitted between nodes, including how access to the network is controlled and how specific resources are shared on the network. A network's logical topology may differ from its physical topology.

MAC (Media Access Control) address A 48- or 64-bit network interface identifier that includes two parts: the OUI, assigned by IEEE to the manufacturer, and the extension identifier, a unique number assigned to each NIC by the manufacturer.

MAN (metropolitan area network) A network of connected LANs within a limited geographical area, such as multiple city government buildings around a city's center.

mesh topology (1) A type of network in which several nodes are directly interconnected and no single node controls communications on the network. (2) A wireless network in which multiple APs work as peer devices on the same network, thereby providing more fault-tolerant network access to clients.

Microsoft SQL Server A DBMS (database management system) produced by Microsoft that is designed to handle large volumes of data.

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network A group of computers and other devices (such as printers) that are connected by and can exchange data via wired or wireless transmission media.

network layer The third layer in the OSI model. The network layer, sometimes called the Internet layer, is responsible for moving messages between networks.

network service A resource the network makes available to its users, including applications and the data provided by these applications.

NIC (network interface card) The component in a computer or other networking device that enables the device to connect to the network and communicate with other devices. Also called network adapters.

node Any computer or other device on a network that can be addressed on the local network.

NOS (network operating system) The software that runs on a server and enables the server to manage data, users, groups, security, applications, and other networking functions. Popular examples of network operating systems are Windows Server, Ubuntu Server, and Red Hat Enterprise Linux.

open source Software whose code is publicly available for use and modification.

Oracle Database A proprietary DBMS (database management system) offered by Oracle.

OSHA (Occupational Safety and Health Administration) The main federal agency charged with regulating safety and health in the workplace.

OSI (Open Systems Interconnection) reference model A model for understanding, developing, and troubleshooting computer-to-computer communication that was developed in the 1980s by ISO. It divides networking functions among seven layers: physical, data link, network, transport, session, presentation, and application.

P2P (peer-to-peer) network model A network in which every computer can communicate directly with every other computer. By default, no computer on a P2P network has more authority than another.

packet The entire network layer message, which includes the segment (TCP) or datagram (UDP) from the transport layer, plus the network layer header.

PAN (personal area network) A network of personal devices, such as a smartphone, laptop, and Bluetooth printer.

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physical layer The lowest, or first, layer of the OSI model. The physical layer is responsible only for sending bits via a wired or wireless transmission.

physical topology The physical layout of the media, nodes, and devices on a network. A physical topology does not specify device types, connectivity methods, or addressing schemes. A network's physical topology may differ from its logical topology.

POP3 (Post Office Protocol, version 3) An application layer protocol used to retrieve messages from a mail server. When a client retrieves mail via POP, messages previously stored on the mail server are downloaded to the client's workstation, and then deleted from the mail server. The most commonly used form of POP is POP3.

port A number that identifies a process, such as an application or service, running on a computer. TCP and UDP ports ensure that data is transmitted to the correct process among multiple processes running on a computer.

PPE (personal protective equipment) Wearable equipment such as goggles that might be required in the workplace to increase safety of workers.

presentation layer The sixth layer of the OSI model. Protocols in the presentation layer are responsible for reformatting, compressing, and/or encrypting data in a way that the application on the receiving end can read.

protocol A standard method or format for communication between network devices.

RDP (Remote Desktop Protocol) An application layer protocol that uses TCP/IP to transmit graphics and text quickly over a remote client-host connection. RDP also carries session, licensing, and encryption information.

ring topology A network layout in which each node is connected to the two nearest nodes so that the entire network forms a circle. Data is transmitted in one direction around the ring. Each node accepts and responds to packets addressed to it, then forwards the other packets to the next node in the ring.

router A network layer device that uses logical addressing information to direct data between two or more networks and can help find the best path for traffic to get from one network to another.

SAN (storage area network) A distinct network of storage devices that communicate directly with each other and with other networks.

scalable The property of a network that allows the addition of nodes or increasing its size easily

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segment (1) A TCP message at the transport layer. (2) A part of a network.

server Any computer or application that provides a service, such as data or other resources, to other devices.

server operating system An operating system designed to run on a server and provide network services to networked clients.

session layer The fifth layer in the OSI model. The session layer describes how data between applications is synced and recovered if messages don't arrive intact at the receiving application.

SFTP (Secure File Transfer Protocol) A protocol available with the proprietary version of SSH (Secure Shell) that securely copies files between hosts.

SMTP (Simple Mail Transfer Protocol) An application layer protocol responsible for moving messages from one email server to another.

SNMP (Simple Network Management Protocol) An application layer protocol in the TCP/IP suite used to monitor and manage devices on a network.

SOHO (small office/home office) network A network consisting of fewer than 10 networked devices.

SQL (Structured Query Language) A programming language used to configure and interact with a database's objects and data.

SSH (Secure Shell) A remote connection utility that provides authentication and encryption. SSH is often used to log onto a host, execute commands on that host, and copy files to or from the host.

SSL (Secure Sockets Layer) A method of encrypting TCP/IP transmissions—including web pages and data entered into web forms—en route between the client and server using public key encryption technology.

star topology A physical topology in which every node on the network is connected through a central device.

static electricity An electrical charge at rest. When that charge is transferred between two bodies, it creates an electrostatic discharge, or ESD.

switch A connectivity device that logically subdivides a network into smaller, individual collision domains.

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TCP/IP (Transmission Control Protocol/Internet Protocol) suite A suite of networking protocols that includes TCP, IP, UDP, and many others. TCP/IP provides the foundation for data exchange across the Internet.

Telnet A terminal emulation protocol used to log on to remote hosts using the TCP/IP protocol.

TLS (Transport Layer Security) An update to SSL (Secure Sockets Layer) standardized by the IETF (Internet Engineering Task Force). TLS uses slightly different encryption algorithms than SSL and is more secure, but otherwise is very similar to the most recent version of SSL.

topology How the parts of a whole work together.

trailer Control information attached to the end of a packet by a data link layer protocol.

transport layer The fourth layer of the OSI model. The transport layer is responsible for transporting application layer payloads from one application to another.

UDP (User Datagram Protocol) A core protocol in the TCP/ IP suite that does not guarantee delivery because it does not first make the connection before sending data or check to confirm that data is received.

WAN (wide area network) A network that spans a long distance and connects two or more LANs.

WLAN (wireless local area network) A LAN that uses wireless connections for some or all of its transmissions.

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Discussion Questions

You can assign these questions several ways: in a discussion forum in your LMS; as whole-class discussions in person; or as a partner or group activity in class.

1. Discussion: Peer-to-peer vs Client Server Network (Network Models, p. 3-6) Duration 15 minutes.
    a. Two categories of network model are peer-to-peer and client-server. Discuss the key differences between these two models.
        i. Answer: In a peer-to-peer network, user accounts, login, and shared resources are controlled in a distributed fashion where the user of

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hundreds of users while peer-to-peer networks operate best with fewer than 10 users.

b. What are some network scenarios in which peer-to-peer might be a good solution?
    i. Answer: Small networks where little expertise exists in server configuration or where there is a benefit to users maintaining their own data and controlling access to their shared files.

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Additional Activities and Assignments

1. **TCP/IP vs OSI**: Research the TCP/IP model for networking versus the OSI model.
    a. Write a short paper outlining how closely the TCP/IP model follow the OSI model and where the two models differ.
2. **Legacy Topology/Protocol**: Research the Token Ring network architecture.
    a. Based on your research findings, write a paper explaining why you think Token Ring lost the battle to Ethernet.

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Additional Resources

External Videos or Playlist

- 5 Basic Networking commands for everyone (2021): How to troubleshoot network issues on Windows? https://www.youtube.com/watch?v=SK8D1bdJh7s
- OSI Model Explained https://www.youtube.com/watch?v=vv4y_uOneC0

Internet Resources

- Computer Network Topologies https://www.tutorialspoint.com/data_communication_computer_network/computer_network_topologies.htm
- Understanding Client-Server Applications https://www.experts-exchange.com/articles/11271/Understanding-Client-Server-Protocols-and-Web-Applications.html
- Troubleshooting Overview https://www.cisco.com/en/US/docs/internetworking/troubleshooting/guide/tr1901.ht

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http://www.tomshardware.com/reviews/local-area-network-wi-fi-wireless,3020-2.html

- The Seven Layers of the OSI Model The Seven Layers of the OSI Model http://www.webopedia.com/quick_ref/OSI_Layers.asp

- How Stuff Works – Networking Library http://computer.howstuffworks.com/computer-networking-channel.htm

External Audio Resources

- Packet Pushers Podcast: https://packetpushers.net/podcast/

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Appendix

Generic Rubrics

Providing students with rubrics helps them understand expectations and components of assignments. Rubrics help students become more aware of their learning process and progress, and they improve students' work through timely and detailed feedback.

Customize these rubric templates as you wish. The writing rubric indicates 40 points and the discussion rubric indicates 30 points.

Standard Writing Rubric

Criteria	Meets Requirements	Needs Improvement	Incomplete
Content	The assignment clearly and comprehensively addresses all questions in the assignment. 15 points	The assignment partially addresses some or all questions in the assignment. 8 points	The assignment does not address the questions in the assignment. 0 points
Organization and Clarity	The assignment presents ideas in a clear manner and with strong organizational structure. The assignment includes an appropriate introduction, content, and conclusion. Coverage of facts,	The assignment presents ideas in a mostly clear manner and with a mostly strong organizational structure. The assignment includes an appropriate introduction, content, and conclusion. Coverage of facts,	The assignment does not present ideas in a clear manner and with strong organizational structure. The assignment includes an introduction, content, and conclusion, but coverage of facts, arguments, and conclusions are not

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		7 points	
Research	The assignment is based upon appropriate and adequate academic literature, including peer reviewed journals and other scholarly work. 5 points	The assignment is based upon adequate academic literature but does not include peer reviewed journals and other scholarly work. 3 points	The assignment is not based upon appropriate and adequate academic literature and does not include peer reviewed journals and other scholarly work. 0 points
Research	The assignment follows the required citation guidelines. 5 points	The assignment follows some of the required citation guidelines. 3 points	The assignment does not follow the required citation guidelines. 0 points
Grammar and Spelling	The assignment has two or fewer grammatical and spelling errors. 5 points	The assignment has three to five grammatical and spelling errors. 3 points	The assignment is incomplete or unintelligible. 0 points

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Standard Discussion Rubric

Criteria	Meets Requirements	Needs Improvement	Incomplete
Participation	Submits or participates in discussion by the posted deadlines. Follows all assignment. instructions for initial post and responses. 5 points	Does not participate or submit discussion by the posted deadlines. Does not follow instructions for initial post and responses. 3 points	Does not participate in discussion. 0 points
Contribution Quality	Comments stay on task. Comments add value to discussion topic. Comments motivate other students to respond. 20 points	Comments may not stay on task. Comments may not add value to discussion topic. Comments may not motivate other students to respond. 10 points	Does not participate in discussion. 0 points
Etiquette	Maintains appropriate language. Offers criticism in a constructive manner. Provides both positive and negative feedback. 5 points	Does not always maintain appropriate language. Offers criticism in an offensive manner. Provides only negative feedback. 3 points	Does not participate in discussion. 0 points

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