

Computer Network Software Operations (6650)

Teacher Resources

Instructional Scenarios

Designing a Secure and Functional Home Network

Duty Area: Introducing Desktop Systems Concepts

Scenario:

You have been retained to design a home network. (See the resource link below, Cyber.Org, for the complete lesson plan). You must map out a home network using the following:

- cable (ISP)
- modem
- router
- firewall
- repeater
- desktop computer
- all-in-one printer
- PlayStation (PS5)
- 3 cell phones
- a smart appliance
- one other device of your choice.

Big Question:

How can a home network function securely and seamlessly using wired and wireless devices?

Focused Questions:

- What is the difference between a wired and wireless device?
- What are the advantages and disadvantages of using wireless?
- What are the advantages and disadvantages of using wired?
- What is a repeater? Why is it important in a home network?
- What is a wireless access point (WAP)?

Project-Based Assessment:

Complete the design of your home network according to the resource guidelines provided and follow the scenario above.

Resources:

- <https://cyber.org/>
- <https://cyber.instructure.com/courses/61>

Instructional scenario submitted Jennifer Marden, Loudoun County High School, Loudoun County Public Schools, 2021; Kristi Rice, Spotsylvania High School, Spotsylvania County Public Schools, 2021, and Katrina Riggleman, Riverbend High School, Spotsylvania County Public Schools, 2021.

Capturing ARP and ICMP Packets

Duty Areas: Understanding Network Standards and Models

Scenario:

This is a lab that allows students to work with Wireshark to capture address resolution protocol (ARP) and Internet control message protocol (ICMP) packets.

Time Required: 30 minutes

Instructions

1. If required, log on to your computer as **NetAdmin** and open a command prompt window.
2. Type **arp -d** and press **Enter** to clear your ARP cache.
3. Start Wireshark and click **Capture Options**.

In the Capture Filter text box, type **arp or icmp**, and then click **Start**.

4. At the command prompt, type **tracert books.tomsho.com** and press **Enter**.
5. When tracert is finished, click the **Stop the running live capture** toolbar icon in Wireshark to stop the capture.

Scroll to the first packet summary line, if necessary.

Find the ARP packets your computer has generated by looking in the Info column for “Who has *A.B.C.D*, Tell 192.168.100.*XX*” (replacing *A.B.C.D* with the address of your default gateway and *XX* with your student number). Click this packet summary line.

Notice that the Dst (for destination) address is ff:ff:ff:ff:ff:ff, indicating a broadcast. Next:

1. In the middle pane, click to expand the **Ethernet II** line. Notice that the Type field is ARP (0x806), which tells the Network access layer which Internetwork-layer protocol should receive the packet.

Click again to collapse this line.

2. Click to expand the **Address Resolution Protocol (request)** line. Examine the information in the ARP header. The ARP message has fields to indicate what technology is used in the Network access layer (Ethernet) and the protocol type that needs the MAC address (IP, in this case).

Click again to collapse this line.

3. In the top pane, click the ARP reply message immediately following the ARP request. The Info column should be similar to “*A.B.C.D* is at 0A:1B:2C:3D:4E:5F.” The MAC address in the ARP reply is the MAC address of your default gateway. Explore the Network access and Internetwork headers for this frame.
(*Note*: You might also find an ARP request and ARP reply for your DNS server if it’s in the same network as your computer.)
4. In the top pane, click the first **ICMP Echo (ping) request** message from your computer to the destination computer at *books.tomsho.com*. The IP address should be 67.210.126.125, but IP addresses can change, so it might be different.
5. In the middle pane, click to expand the **Internet Protocol** line.
Notice that the value in the “Time to live” line is 1.
6. In the top pane, click the **ICMP Time-to-live exceeded** message that follows the ping request. This message was generated by the first router en route to *books.tomsho.com*.
Notice that the source address is the address of your default gateway.
7. Find the next ICMP Echo (ping) request message and view the TTL value. Tracert sends three Echo (ping) request messages for each TTL value, so the first three messages have a TTL value of 1.
Find the fourth ICMP Echo (ping) request message and view the TTL value, which should be 2. The “Time-to-live exceeded” message following it is from the next router down the line. Tracert follows this pattern until reaching the destination device (*books.tomsho.com*).
8. Exit Wireshark but leave the command prompt window open if you’re continuing to the next project.

Instructional scenario submitted by Jennifer Marden, Loudoun County High School, Loudoun County Public Schools, 2021.

Design Your Companies Authentication Backend

Duty/Concept Area(s): Using Desktop Systems Concepts

Scenario:

You are currently employed at WebWidgets Incorporated as a security consultant working on the redesign and development of their authentication systems. Your job is to design the backend authentication systems for a variety of outward-facing services. You need to provide compelling arguments as to what type of authentication and authorization solutions can satisfy the security and usability needs.

WebWidgets Incorporated has the following services that their employees need to access when outside the company network:

- Webmail service
- Gitlab repositories
- Team management system
- Web admin panels

The team has already had an initial briefing where they discussed the possibility of hosting all services on their internal network or using software-as-a-service (SaaS) solutions. The CEO has expressed concerns over security, but also knows they cannot sacrifice major accessibility.

You need to explore popular methods for managing multiple services through a single-sign on (SSO) either provided by a service or housed locally. You will also have to consider the possible vulnerabilities that an SSO introduces and how those can be mitigated.

After weighing the possibilities and choosing a design, you will need to prepare a presentation for the CEO consisting of two options for your team.

Big Question:

How do modern-day systems manage network accounts for authentication and authorization through a variety of services?

Focused Questions:

- What is SSO?
- What is SaaS?
- What are common industry solutions for SSO (internal or provided) and SaaS?
- What types of threats should be considered when implementing SSO or SaaS?
- How can these threats be mitigated?

SOL Correlation:

C/T 9-12.2, C/T 9-12.3, C/T 9-12.4, C/T 9-12.5

Project-Based Assessment:

Student(s) will work to create a presentation to compare to possible designs for the company's new infrastructure.

Instructional scenario submitted by Karl Meister, Norview High School, Norfolk Public Schools, 2021.

Trade Secrets

Duty/Concept areas addressed:

Installing Network OS and Services

Performing Network Administration Functions

Introducing Basic Server Systems Concepts

Performing Network Management and Security Functions

Providing Basic User Training and Support

Note: This Cybersecurity Software Operations (CSO) scenario could be an ongoing project or culminating project.

A national ad agency has just set up a local office in your town. The agency has a small network that consists of three personal computers with Windows XP operating systems, a file server, two printers, and a main server. The network has been constructed and connected, but no user accounts or permissions have been initiated. The receptionist should be able to view the contact information of current clients, to enter contact information for new clients, and to enter appointments on a shared calendar. The account associate should have higher-level access in order to check the status of jobs and payment histories in the course of handling customer and vendor questions. The account manager should have access to all data available. Everyone in the office shares the two printers. The account manager would also like to have some sort of interoffice "chat" program so that associates can communicate without the distraction of phones or intercoms.

The account manager is concerned about network security, given that client files are kept online and the main server has a secure connection to the parent company. Data is confidential, personal, and sensitive. Therefore, any breach in security could damage the entire company's reputation.

Big Question: How will you set up the network with the various levels of access while protecting important confidential information?

Focused Questions:

1. What are the various levels of access needed?
2. How many user accounts will be needed?
3. How should the printers be shared?
4. What plan will you create to ensure that the ad agency's data is secure?
5. What is the timeline attached to the implementation of the plan?
6. What elements should be involved in the design of the backup plan?

Project-Based Assessment

1. Construct a model or diagram for the office, including network design and access levels.
2. Conduct research to find information about network security.
3. Write a report on a network security breach.

Resource

Microsoft Tech Net

<http://technet.microsoft.com/en-us/default.aspx>

Next Step: Certification

Duty/Concept areas addressed:

Performing Legal and Ethical Functions

Preparing for Industry Certification

Developing Employability Skills

Note: This Cybersecurity Software Operations (CSO) scenario could be an ongoing project or culminating project.

You have just been hired as a network administrator-in-training for a small real estate company. You only work part-time, keeping the small office running, but the real estate agent has plans to double office space within the next 15 months and add three more assistants to help serve his growing client base. Currently you have four PCs, two network printers, and one server. You have already set up network access for each of the four current users and all equipment is working fine. Now, you must implement a new network design for all components.

One condition of your employment is that you obtain industry certification as a systems administrator within six months. In your spare time, you begin to research certifications in your field and try to decide which certification would most complement the role you want to fill.

Because your boss is always interested in new technology, you often have conversations about the latest and greatest technology tools. In a recent chat, you talked about the explosion of file sharing on peer-to-peer networks and the legal and ethical implications. Each month, your boss hosts a dinner meeting of area real estate brokers and he asks you to give an informal presentation on the certification you are pursuing and the security implications for file sharing, namely, unlicensed software on company computers, in the real estate industry.

Big Question: What information will your presentation contain?

Focused Questions:

1. Which certification is most appropriate to the functions you will be performing as a network systems administrator?
2. What is a peer-to-peer file sharing network?
3. How could the peer-to-peer file sharing network affect businesses?
4. What are the network security risks?
5. Should company computers be protected from workers downloading unauthorized software? Why or why not?
6. How will anyone know your employees are using unlicensed software?
7. What would happen if the authorities discovered your employees are using unlicensed software?
8. What key elements will go into your presentation outline?

Project-Based Assessment

Oral presentation and critique

Resources

- Featured Cisco Certification Schools in Virginia:
<http://www.computertrainingschools.com/search/VA/C/>
- Directory of Virginia Computer Training Institutes & Computer Schools
<http://www.computerschools.com/states/virginia-computer-training-institutes-schools.html>
- Advanced Technology Systems (Virginia Beach)
<http://www.vbatc.com/a-infotech.html>
- Industry Certification Programs Offered at Virginia Western Community College
<http://www.vw.vccs.edu/Pages/BREW/Certification.html>
- Free Certification Tutorials, Articles, and Online Courses
<http://www.learnthat.com/certification/>

The Insurance Agent

Duty/Concept areas addressed:

Introducing Basic Server Systems Concepts

Introducing Network Design Essentials

Exploring Network Media

Understanding Networking Standards and Models

Installing Network OS and Services

Providing Basic User Training and Support

Note: This Cybersecurity Software Operations (CSO) scenario could be an ongoing project or culminating project.

Your best friend's father is an insurance agent. He just discovered that you are learning about computer networking. One day he calls you and invites you to stop by his new office. He tells you he would like your help setting up a network for his office. He would also like to learn enough about networking in the process to address problems that may arise.

Upon arriving at the office, you learn that the small building was constructed 15 years ago and does not have any network wiring. Your friend's dad has three personal computers with Windows XP operating systems, a network printer, an all-in-one copier/fax/printer, a file server, and a server that connects to each of the three computers and has a remote access connection to the agency's parent company.

Your friend's father employs an assistant and an office receptionist. Each has a separate office. There is also a small utility-type room that currently doubles as a break room and storage closet.

Not only will you be setting up the network, but you will also be setting up the three computers, the printer, and the server.

Big Question: How would you design a network for this insurance office and how will you teach the agent about the essentials of computer networking?

Focused Questions

1. What is the first thing you would do in this situation?
2. What would a sketch of the network design look like?
3. What hardware and software might be needed?
4. What are the essential networking concepts that you will teach your friend's father?
5. What is your plan for installing and connecting the network?

Project-Based Assessment

1. Sketch of the network
2. PowerPoint explaining the terminology and the essentials of computer networking

Cyber Security and Cyber Forensics Infusion Units

Cyber Security and Cyber Forensic Infusion Units (CYBR) were designed to be infused with designated CTE courses to help students in those programs achieve additional, focused, validated tasks/competencies in personal and professional cyber security skills. These units are not mandatory, and, as such, the tasks/competencies are marked as "optional," to be taught at the instructor's discretion.

Customer Service Infusion Units

Customer Service Infusion Units (CSIU) were designed to be infused with designated CTE courses to help students in those programs achieve additional, focused, validated tasks/competencies in customer service. These units are not mandatory, and, as such, the tasks/competencies are marked as "optional," to be taught at the instructor's discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked "optional."