**Student Learner Outcomes**

* Student will be able to explain basic networking concepts
* Student will know the difference between secure and unsecure network protocols
* Student will know how to observe and analyze network traffic

**Skills Gained**

* How to get assigned IP address using ifconfig
* How to block networking traffic using iptables
* Understand how to find a device’s ‘next hop’ using route
* Understand the difference between ssh and telnet
* Observe and analyze network traffic using wireshark
* Visualize networked devices using zenmap

**Instructional Timeline**

|  |  |  |
| --- | --- | --- |
| Devices at Home | 45 mins | **Hardware**  Basic Home Network   * Used to show what most home networks are like, and the devices used   Home Routers   * A router routes network traffic across the wide internet   Wireless Access Point   * Wireless access point (WAP) is a device that allows other devices to communicate wirelessly using radio waves. More convenient than wired, but slower.   Network Cables   * Network cables allow devices to communicate using electrical pulses. Faster than wireless, but less convenient.   Firewall   * A dedicated hardware device or piece of software that’ll block network traffic based on predetermined rules   Network Interface Card   * A hardware device that allows one computer to communicate with another, wired or wirelessly   Modem   * A network device that converts computer signals into telephone signals   **Documentation:**   * **Skill Purpose:** The ability to identify and understand hardware by using common devices found in the average household is a great first step to learning how the Internet works. It is easier to start with something physical that the students can see and relate to, than to dive directly into the purely conceptual. * **Applies to Document:**  The purpose of this presentation is to teach high school students a variety of networking concepts, as well as demystifying the internet. All computer networks need physical devices.      * **Related to Audience:** It relates to the audience because it is safe to say that everyone uses the internet on a regular basis. It is important to be familiar with the devices we are so dependant on. * **Comparing Skill:** It is best to start with something that the students can see and touch, and have probably seen before instead of diving into the deep end of the pool from the get go.   **Check on Learning**  What does a router do?   * Asked to ensure students are able to deduce device function from the name   What does a firewall do?   * A firewall blocks or allows traffic based on predetermined rules   What is a NIC?   * A NIC is a network interface card that allows a device to communicate with other devices.   How is a switch different from a router?   * A switch differs from a router in that a router routes traffic on the wide internet, while switch directs traffic on an internal network. |
| Wide Internet | 45 mins | **Internet**  Websites & Browser   * A browser is a client-side software application used to access websites. Chrome, Firefox, and Internet Explorer are common examples of these. * A website is an HTML document retrieved from a web server (Port 80, 443) most often from a browser.   NAT   * Network Address Translation allows mapping one external ip address to many internal ip addresses. It is used by all modern home routers so you only need to pay for one ip address, and still have many devices connected to the internet simultaneously.   URI   * URI is an acronym for Uniform Resource Identifier which is a standard used for addressing resources. URL’s which are used to address websites are an example of a type of URI. “All URL’s are URI’s, but not all URI’s are URL’s.”   DNS   * Domain Names are human readable names used to identify websites. Computers cannot use domain names to route packets. * DNS is Domain Name Resolution, which is both a server side application, and a protocol, dedicated to translating domain names into network routable IP addresses.   OSI Model   * Purely conceptual model used as a guide for designing and categorizing network protocols.   TCP/IP Model   * Compared with the OSI model, a more applicable model used to categorize protocols.   TCP three way handshake   * The 3-way handshake is used to establish a TCP connection, and is similar to how people start a conversation. * A client sends a syn packet to the server to request a connection. (Hi, I’m Bob.) * The server receives the syn and responds with a syn-ack. (Hi Bob, I’m Alice.) * The client receives the syn-ack and responds with a final ack to the server. (Nice to meet you, Alice.)   IPv4 & IPv6   * Internet Protocol (IP) is the standard used by the internet to transport packets. * The main difference between v4 and v6 are the total number of addresses possible (address space). V4 is smaller(2^32 possible addresses), v6 is very large (2^128 possible addresses).   Private networks   * A private network is a network that uses a private address space. Devices within a private network can “see each other and outward” while devices outside of the private network cannot “see what’s inside of a private network”.   **Documentation:**   * **Skill Purpose:** The purpose of this skill is to expose the conceptual side of computer networks and how they’re used on the world wide web. * **Applies to Document:** The topics covered in this section cover a simplified version of how the world wide web works. These networking concepts are the prerequisite to application layer protocols and ports presented in the next section. * **Related to Audience:** The technologies covered in this section are a part of today’s digital lifestyle. * **Comparing Skill:** It was the best fit because it eases the transition from the hardware topic into the software concepts.   **Questions**  What is the major difference between IPv6 and IPv4?   * IPv4 is dotted decimal   Why is DNS important?  What are the three steps in a TCP handshake? |
| Break Activity | 10 mins | **Packet Pass**  Students demonstrate their understanding of how routing works.  **Documentation:**   * **Skill Purpose:** Demonstrate understanding of a simple routing algorithm. * **Applies to Document (Did it fit the presentation of the document?):** * **Related to Audience:** It is related to the audience because it shows how well they understand routing. * **Comparing Skill (Why was it the best fit):** One must understand how routing works to understand how the internet works. |
| Protocols | 45 mins | **Protocols**  Ports   * Not to be confused with network interfaces, ports are simply numbers to identify a network connection. Certain services normally use a specific port i.e. web servers often use port 80 for http websites, and 443 for https.     TCP   * Transport protocol used to receive data in the same order it was sent. Checks for lost packets, and resends them if necessary. Ex. file transfers, where every packet is needed.   UDP   * Sends packets as quickly as possible without checking if the receiver got them. Ex. streaming videos, where a lost packet here and there is not detrimental to playback.   Telnet   * Conceived in 1969, telnet is a remote server administration application. All data is sent in clear-text, so it is not used over the WAN.   SSH   * Secure Shell Protocol is used similarly to telnet, but all data is encrypted making it secure enough to use over the WAN.   SMTP  Application layer Simple Mail Transfer Protocol is one of many email protocols.  POP  Application layer Post Office Protocol is one of many email protocols.  HTTP  HyperText Transfer Protocol used to transfer stuff over the web.  **Documentation:**   * **Skill Purpose:** The purpose of this skill is to show how and why we use networking protocols to access things like email and the web. * **Applies to Document (Did it fit the presentation of the document?):** It applies to the document because these protocols are how computers create connections to transfer information at the application level. * **Related to Audience:** It relates to the audience because these protocol are what we use everyday to access things like email and our favorite websites. * **Comparing Skill (Why was it the best fit):** This was the best fit because it’s the last step in understanding how networking and the internet works.   **Questions**  What is a port?  Important concept for lab and exercise, easy first question.  What makes SSH better than telnet?  Introduce the concept of encryption.  What protocol is used for web traffic?  Important info for lab, important info for life.  What port is used for HTTP?  Important info for lab, challenging last question. |
| Class Activity | 90 mins | **Check docs** |
| Computer Lab | 90 mins | **Understanding Networking with Ubuntu Linux**  Understand network topology with zenmap, and Inspect network traffic using wireshark  Students will use wireshark to inspect packet structures.  **Documentation:**   * **Skill Purpose:** To demonstrate understanding of packet structures. * **Applies to Document (Did it fit the presentation of the document?):** It applies to the document because it shows their understanding of packet structures. * **Related to Audience:** It is related to the audience because these technologies are used in normal internet traffic. * **Comparing Skill (Why was it the best fit):** This was the best fit because it shows how well students understand packets. |

**Summary:**

Students first learned how networking works at the hardware level with things like ethernet cables, network interface cards, and physical routers. This primes them for the next step which is learning about the wide area network or the “internet” in a networking sense. Students learned about the Wide Area Network and how we access it using TCP/IP, DNS and internet browsers.