

Practical Hands-on Learning of Computer Networks Towards the Profession of Cybersecurity

Abstract

Cybersecurity attacks such as DDOS (distributed denial of service), DNS (Domain Name System) attack, and intrusion attack are prevalent in modern times. Understanding computer networks is fundamental to understanding cybersecurity attacks and solutions. We have been studying Computer Networking to gain more knowledge in the cybersecurity field and become CCNA (Cisco Certified Network Associate) certified. In this poster we will discuss what we have learned and practiced for an year, including the Internet 5 Layers, network cables, Local Area Network (LAN), and Wide Area Networks (WAN).

Introduction

Cisco Systems Inc. is a key player in Computer Networking and IT industry, innovator in both of these fields. Cisco Certified Network Associate (CCNA) is an associate-level networking certification. The certification is verification of one's Computer Networking skills/knowledge. Our CCNA Research group is currently dedicated to learning about Computer Networking and Cybersecurity through the implementation of several tools and resources to eventually test for and pass the CCNA exam.

- Currently using the Official CCNA Cert Guide book
- Use the Pearson Network Simulator to practice using the CLI to configure Router and Switch Commands
- Work with virtual machines like the Oracle VirtualBox to connect to each other in a network we created using a router and switches.

Pearson | CCNA 200-301 Network Simulator







Internet 5 Layers

When it comes to understanding how the Internet operates it is crucial to know the TCP/IP model which consists of 5 layers, which operate as a blueprint of connection between end users. The 5 layers are:

- (HTTP or HTTPs)



Cables and Hubs (Physical Layer)

The very first layer of the Internet is Physical Layer, which represents the hardware: cables, connectors, and hubs. There are several types of Network (Ethernet) cables, like Unshielded Twisted Pair (UTP) and Shielded Twisted Pairs (STP) cables and Fiber Optic Cable. Some of the most important ones are:

- devices, like computer to router.
- router to router.

Jaime Suarez, Esteban Verdin, and Nina Tkachuk (Advisor: Dr. Daehee Kim) Computer Science, California State University Stanislaus

• Application Layer: makes the communication between user and "Internet" useful, like usage of web-browsers

• Transport Layer: acts as a delivery mechanism • Network Layer: Wide Area Network, uses routers • Data Link Layer: Local Area Network, uses switches. • Physical Layer: the hardware, like physical cables.

• Straight-Through Cable: connects different types of

• Crossover Cable: connects the same devices, like

• Serial Cable: helps to connect different networks, like CSU Stanislaus with UC Merced networks.

Cables and Hubs (Physical Layer) - cont'd



Straight-Through Cable vs Crossover Cable

Local Area Network (Data-Link Layer)

The Data Link Layer is the second layer of the TCP/IP model. Ethernet is a protocol within the Data-Link Layer. It receives data from the Network Layer, encapsulates it, then sends the frames of data to the Physical Layer.

- The layer that surrounds a packet with a header and a trailer.
- Encapsulates the destination MAC address in the header
- Used by both Local Area Networks (LAN) and Wide Area Networks (WAN) for data transmission
- Virtual Local Area Networks (VLAN) also operate within the Data-Link Layer
- VLANs are virtual networks that can divide a physical network into several different virtual ones
- Switches operate within the layer at full duplex
- Network switches are used for packet switching to transfer and receive link layer frames across different networks
- Also contains a Spanning Tree Protocol (STP) that prevents errors such as loops alongside allowing path redundancy

Pictured (Top to Bottom):

- Wireless Access Point 1x(Cisco 141N)
- Router 2x (Cisco 1921)
- Router 1x (Cisco 2811)
- Switch 2x (Cisco 2960)
- Switch 1x (Cisco 3750) • Switch 1x (Cisco 3560)









Wide Area Network (Network Layer)

The third layer in the TCP/IP model is the Network Layer, which is responsible for the packet (data) forwarding. It receives data from the fourth layer, the Transport Layer, and is responsible for sending it to the Data-Link Layer. It is also the layer that finds the shortest path to forward the data, which is also used in Dijkstra's Algorithm.

- Uses Routers to help forward the data
- Wide Area Network (WAN) is used to connect users all across the world, not just in close proximity (LAN)





Future work

We are planning to begin reading volume two that focuses on cybersecurity, taking the CCNA exam, start researching cybersecurity. We will work with universities and companies to gain further expertise in Computer Networking and cybersecurity through Research Experience for Undergraduates (REU) and internships.

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