Capstone Project Documentation Report

Project Title: Basic Network Design for Three Campuses Using Packet Tracer
Course: NET+ Capstone Project
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1. Introduction

1.1 Project Overview

Provide a brief summary of the project, including its objective and the key components involved.

The network is designed to connect three campuses securely while supporting site-to-site communication, VoIP services, and remote administration via SSH. The goal is to ensure efficient inter-campus communication, prioritize voice traffic for high-quality VoIP calls, and secure network access with ACLs and authentication mechanisms.

Key Components include:

- Three Campus Routers with **site-to-site tunnels (Tunnel1, Tunnel2, Tunnel3)** for inter-campus connectivity.
- Access Control Lists for INTER-CAMPUS-FILTERS, ADMIN-ACCESS, and CME-VOIP.
- QoS for VoI.
- Local User Authentication and SSH Configured on All Routers

1.2 Project Scope

Define the scope of the project, such as the number of campuses, devices, and networking features implemented.

The network consists of three interconnected campuses (Campus 1, Campus 2, and Campus 3). Each campus has its own network infrastructure with distinct subnets(VLAN 10,20,30,40) for internal communication. Devices Implemented are Three Core Routers (One per campus), Network Switches (Implied for VLAN and device connectivity), End-user devices (25 Workstations, 8 VoIP phones, 8 printers, 8 security cameras).

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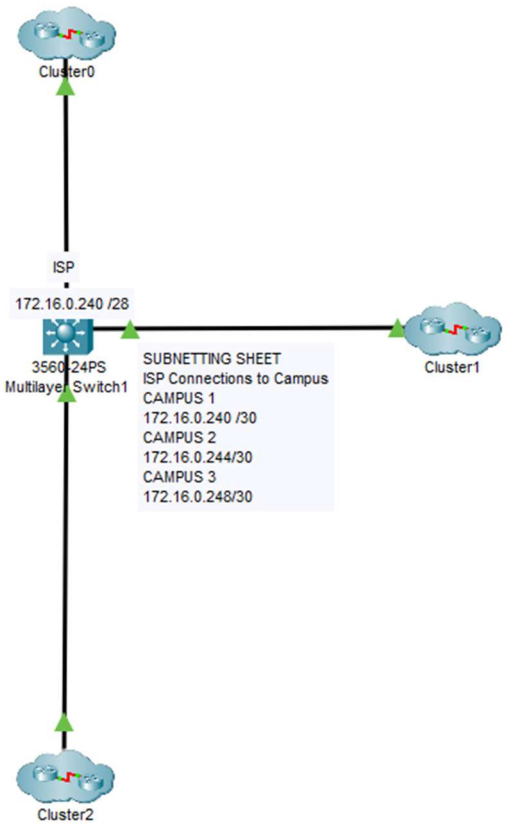
2. Network Design

2.1 Network Topology

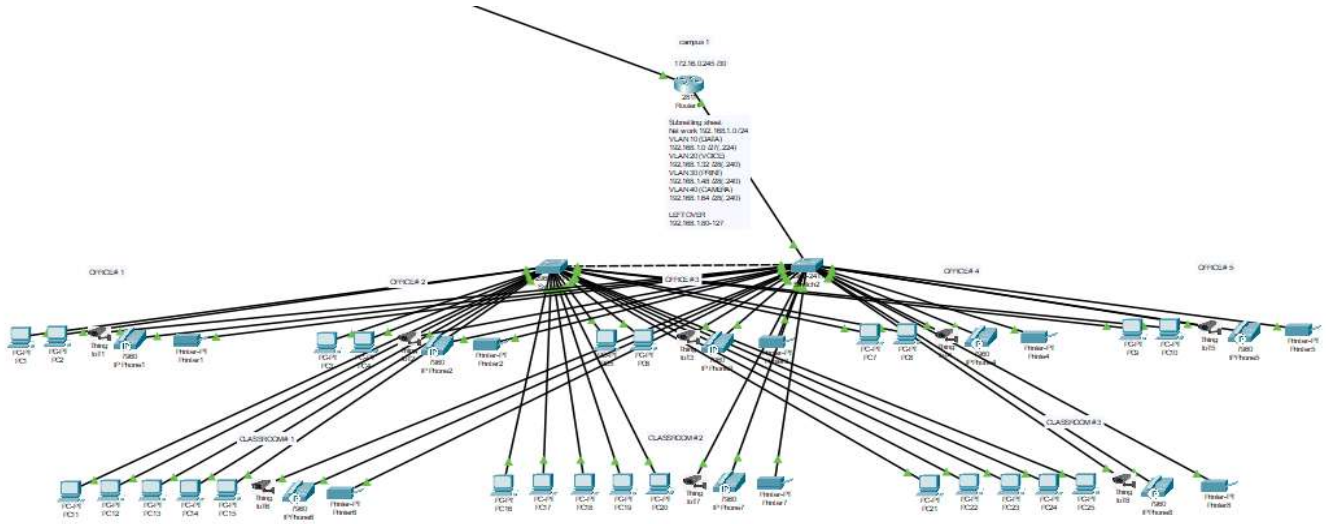
- Each Campus Has 1 Router for the WAN Connection and 2 26 port Switches for the lan Connection. The campus has 5 offices the the following end devies (2 Workstations, 1 VoIP phones, 1 printers, 1 security cameras). There are also 3 Classrooms with the following end devices (5 Workstations, 1 VoIP phones, 1 printers, 1 security cameras)
- The Campus Router has 2 connections, 1 for the back bone and 1 for the LAN. The connection to the lan is a Trunk port using sub interfaces with the encapsulation dot1q trunking protocol for each VLAN. The other end of that connection is a trunk port on Switch1 that allows only the necessary vlan traffic. I then have another trunk port connected to Switch2. On switch 1 I have methodically connected all VoIP's (Ports 1-8), Printers (Ports 9-16) and Cameras (Ports 17-24). Switch 2 was used to connect all workstations.

2.2 Network Diagram

Each cluster is a campus with a /30 connection to the ISP (Multi-layer SW)



All campus's follow same setup



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3. IP Addressing Scheme and Assignments

3.1 Subnetting

- Each Campus has an IP scheme of 192.168.X.0 /24 which is then broken down into 4 subnets based on device type.
- X is replaced with 1 for campus 1, 2 for campus 2, and 3 for campus 3.

IP Range/Subnet Mask

192.168.X.0/27

192.168.X.32/28

192.168.X.48/28

3.2 Address Assignment

- The router was configured as a DHCP Server utilizing DHCP pools to assign addresses dynamically per VLAN.
- **Example DHCP Configuration**
    - ip dhcp pool VLAN10
    - network 192.168.1.0 255.255.255.224
    - default-router 192.168.1.1

- ip dhcp pool VLAN20
- network 192.168.1.32 255.255.255.240
- default-router 192.168.1.33
- option 150 ip 192.168.1.33
- ip dhcp pool VLAN30
- network 192.168.1.48 255.255.255.240
- default-router 192.168.1.49
- ip dhcp pool VLAN40
- network 192.168.1.64 255.255.255.240
- default-router 192.168.1.65

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4. VLAN Setup

Device Type	VLAN
Computers	10
IP Phones	20
Security Cameras	30
Printers	40

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5. Routing Setup

5.1 Router Configuration

To ensure seamless communication between the three campuses, static and dynamic routing has been implemented.

- Static routing was implemented to connect the campus routers to theBackbone (ISP).
- EIGRP was implemented to advertises its local subnets and tunnels to other campuses

Example Routing Configuration for Campus 1:

router eigrp 1
network 192.168.1.0 0.0.0.31
network 192.168.1.32 0.0.0.15
network 192.168.1.48 0.0.0.15

network 192.168.1.64 0.0.0.15
network 10.10.1.0 0.0.0.255
network 10.10.2.0 0.0.0.255
ip route 172.16.0.244 255.255.255.252 172.16.0.242
ip route 172.16.0.248 255.255.255.252 172.16.0.242

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6. Conclusion

6.1 Summary of Implementation

- The Basic Network Design for Three Campuses was successfully implemented using Packet Tracer, integrating VLAN segmentation, secure inter-campus communication, and optimized routing. Each campus was structured with a core router and switches, utilizing VLANs for traffic separation and sub-interface trunking for connectivity. A 192.168.X.0/24 IP scheme was subnetted to allocate addresses efficiently. Routing was managed using static routes for ISP connections, and EIGRP for intra-campus subnets and site-to-site tunnels. ACLs and SSH authentication secured access, while QoS ensured VoIP call quality. This design provides secure, scalable, and efficient communication between all campuses.U

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7 Challenges and Solutions

Throughout this capstone there were a few challenges faced when selecting the right type of equipment i.e routers and security cameras, VoIP CME configurations and ACL Configurations.

- Equipment
    - Router:
        - **Challenge**: Initially I had selected the 4331 router and fully configured everything except the CME. When trying to configure the Telephony-Services, I found out that the 4331 router was not capable of Telephony-Services.
        - **Solution**: I used Microsoft Co-Pilot to figure out that only the 2811 router was capable of Telephony-Services.
    - Security Camera.
        - **Challenge:** I initially selected the webcam found in the Home end-devices. I placed all 8 into my topology and tried to plug them into the switch only to find that they do not have a NIC, so i was unable to connect them to the LAN.
        - **Solution**: I found a video on youtube that walked through how to Create/Modify an IoT Device in cisco packet tracer. The process involved using the device labeled “Thing” in the components tab of devices. When

you open the device you can configure it with a NIC, as well as modify what the device looks like by adding your own picture or selecting an image from the packet tracer system files.

- Configurations
    - CME
        - **Challenge**: I have experience Configuring the CME in a router but on cisco packet tracer it is fairly different from actual application on physical equipment. I was able to find a video on how to configure Telephony Services which made it easy for intercampus calling, but I was unable to call external to other campuses. With my previous experience I knew a Dial Peer was needed, but was unsure of how to configure them in packet tracer.
        - **Solution**: I asked Chat GPT how to configure a Dial peer in cisco packet tracer. Chap GPT gave me an example syntax for the configurations, and I just had to modify them for my network.