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CONETSC - Computer Networks and Security Lecture
Final Project

Seamless Connectivity: Designing an Efficient Network Architecture for Computer Shops

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I. Introduction

In designing an effective network architecture for a computer shop it is important to have reliable and smooth connectivity for both the shop owners and their customers. Factors like fluctuating internet quality, varying customer demands, and the need to support many devices without compromising performance make this a complex challenge. There's also the balance between affordability and the need for robust networking gear to handle a commercial setting. It is challenging due to the potential for a varied network environment. This means different types of devices, technologies, and communication protocols may need to be connected and integrated. Navigating this heterogeneous network landscape requires careful planning and coordination to ensure seamless integration and functionality across all components.

II. Understanding Design Problems and Boundaries

Figure 1. Typical Internet Cafe Setup

To achieve optimal effectiveness and performance, a computer shop must build an efficient network architecture that addresses issues while clearly defining boundaries. The quality of internet access is a significant problem that can cause disruptions to operations and negatively impact consumer satisfaction. One way to lessen downtime from an outage at one provider is to have backup internet connections from multiple ISPs. To guarantee a seamless user experience, bandwidth management technologies like traffic shaping and prioritization processes are necessary for varying consumer needs, such as high-bandwidth activities like video streaming or online gaming.

Compatibility and integration of various devices and technologies inside the shop's network is another crucial design issue. For instance, utilizing protocols like Ethernet and Wi-Fi standards to seamlessly integrate wired and wireless connections guarantees communication amongst a variety of devices, including desktops, laptops, cellphones, and Internet of Things devices. These devices can automatically assign IP addresses by putting in a reliable DHCP (Dynamic Host Configuration Protocol) system, which will make network management easier.

Managing the network's logical, physical, security, performance, and scalability components requires well-defined boundaries. Determining the layout of network infrastructure components such as routers, switches, and access points inside the computer shop constitutes the physical boundaries. Virtual Local Area Networks (VLANs) within the network to manage traffic and improve security is one of the physical boundaries. Such as VLANs may be utilized to separate networks such as making a guest Wi-Fi network from the internal networks, preventing unauthorized access to private and sensitive information.

Setting up security boundaries to defend the network against cyber threats. Protecting data and preserving network integrity may be achieved by putting firewalls, intrusion detection systems (IDS), and encryption mechanisms into place. Performance boundaries ensure the network satisfies performance needs for both internal operations and consumer services. Examples of these boundaries include bandwidth requirements and Quality of Service (QoS) standards.

III. Approach Formulation

In order to design a complex system, it must first be broken down into manageable pieces. The first factor to consider would be handling the internet connectivity of the network. Such parameters could include the number of modems, routers, and switches needed for setting up the network. Since the setup aims to be as cost-effective as possible, the design will not include the 5505 device due to needing multiple amounts of the said device. The 5505 device can be included if there are no budget constraints to be considered since the device can be added as an additional security device, as it features a full-featured firewall system. In this network design, the group has considered utilizing switches and routers to enable the connection of the devices. The group considered another option such as utilizing VLANs in order to reduce the amount of switches used, but ended up with the setup that utilizes a switch to transfer data. Having one switch control all the connections could cause problems when the worst-case scenario happens, such as the switch malfunctioning which causes all the devices to lose connection.

IV. Attainment of Objectives

This paper attempts to achieve the following objectives:

1) To design an internet cafe network that supports computers, specifically desktop computers
2) To simulate a typical internet cafe network in packet tracer
3) To utilize subnetting techniques in distinguishing subnetworks within the internet cafe network
4) To monitor network latency in the simulated network

V. Network Design

The network architecture of a typical low-budget computer shops are just composed of the provided ISP router and network hubs to connect the computers. However, the problem with that type of setup is that hubs have the tendency to experience data collisions that would lead to an unpleasant network experience for its users and that the ISP-provided routers are usually not powerful or have many functionalities that can properly manage a network such as the one found in computer shops. The way that we propose the network architecture for this project is that it uses separate routers as well as switches such that there would be room for expansion as well as having profound stability in the network as the use case of computer shop users are usually time sensitive application and requires zero downtime in operation due to it online competitive game-centric nature. The proposed network design also applies and uses the concept of subnetting, of which different subnets are made to isolate the different classifications of users in the network, namely Admin, Regular, and VIP Groups of computers, that was done to enhance privacy and security in the network, and effectively manage the network. The classification of users is expected to have predefined access in the network, and the Admin, as its name suggests, administrates or manages the computers in the network and has complete control over the computers. The regular group consists of many computers sharing one network switch following the star topology, and that is the same for the VIP and admin groups. Star topology is used to connect computers because of its effectiveness, ease of deployment, and scalability. It is designed in such a way that the network is compartmentalized and adds reliability. The IP addresses of the computers are predefined, which means it is static instead of DHCP for effective management of the computers as every computer can be recorded and addressed easily when needed.

VI. Network Simulation

Typical computer shop setups are shown in Figure 2 and that it is a relatively simple, affordable, and easy to implement however, they come with downsides, its reliability because of its use of network hubs and heavy dependence on the usually underpowered ISP router. This project aims to provide an optimal network design backed with engineering principles such that one potential owner may rest easy knowing that their network is stable and reliable.

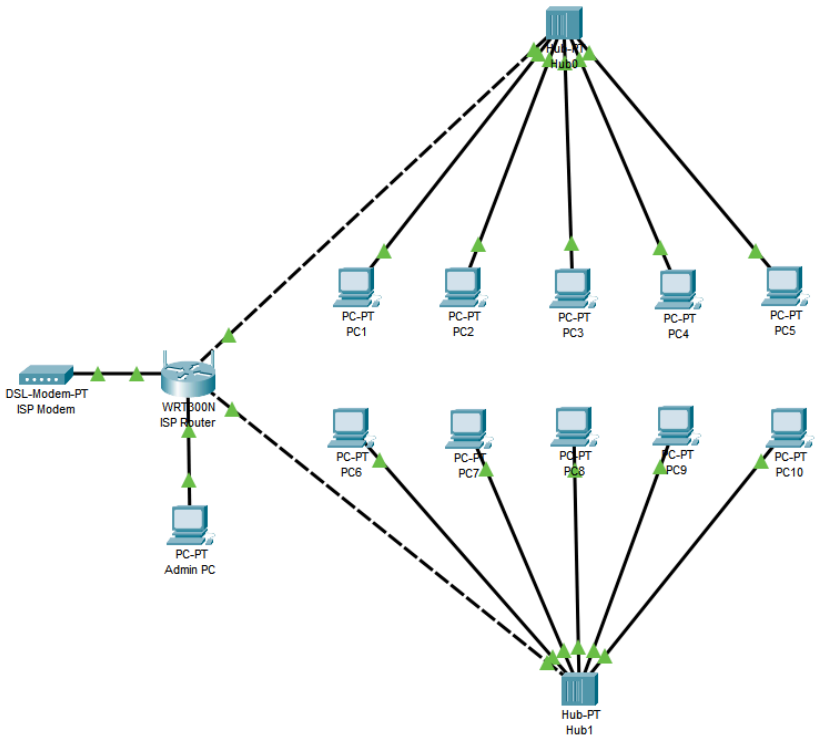

Figure 2. Typical Low Budget Compshop Network Design

In the following setup, we've configured all the PCs to be connected to a designated switch, which in turn connects to the Gateway Address. Meanwhile, there is only one other subnet that both Regular PCs and VIP PCs use, which is 192.169.2.x. Regular PCs use the IP address range of 192.169.2.1 - 192.169.2.63, while VIP PCs use an IP address range of 192.169.2.64 - 192.169.2.253. The three separate LANs are connected by 3 multiconnected routers, with the top router being connected to the Internet and Admin LAN. All the PCs are connected through the use of switches, which are then in turn connected to their designated routers. Sending message packets is implemented in order to test the interconnectivity of the network. Ping commands are used in order to test the latency of each node in the network. The results can be seen in the figures below.

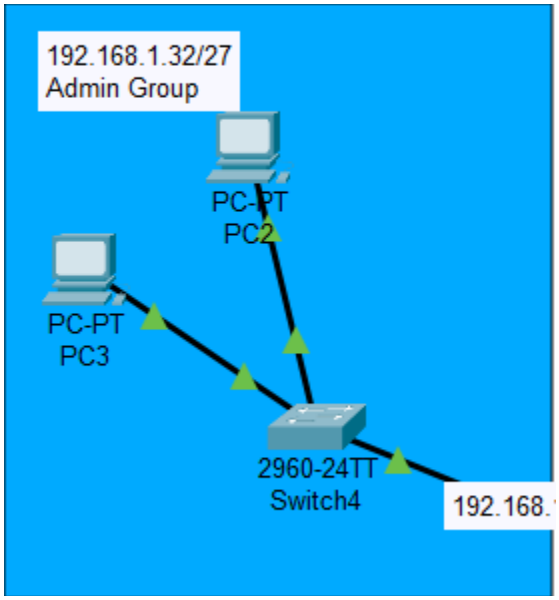

Figure 3. Admin Subnet

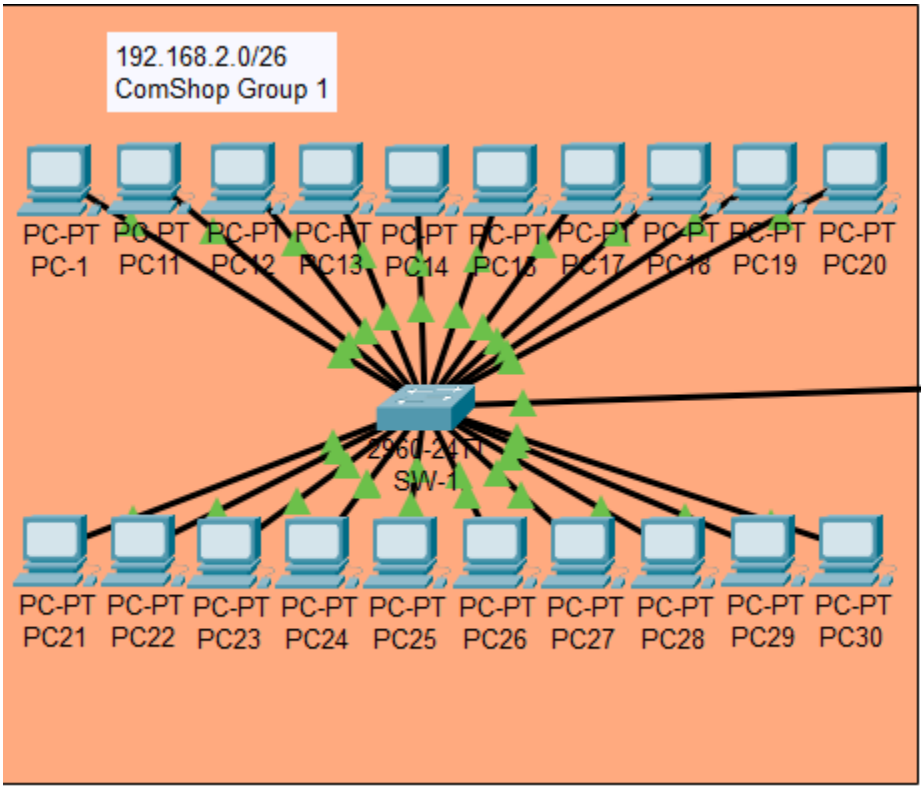

Figure 4. Regular Rate PCs

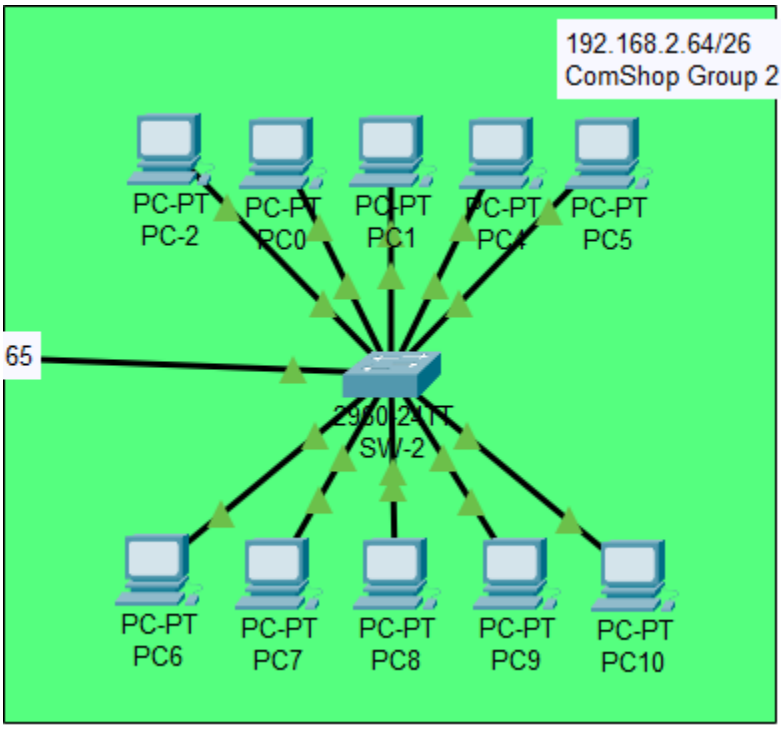

Figure 5. VIP PCs

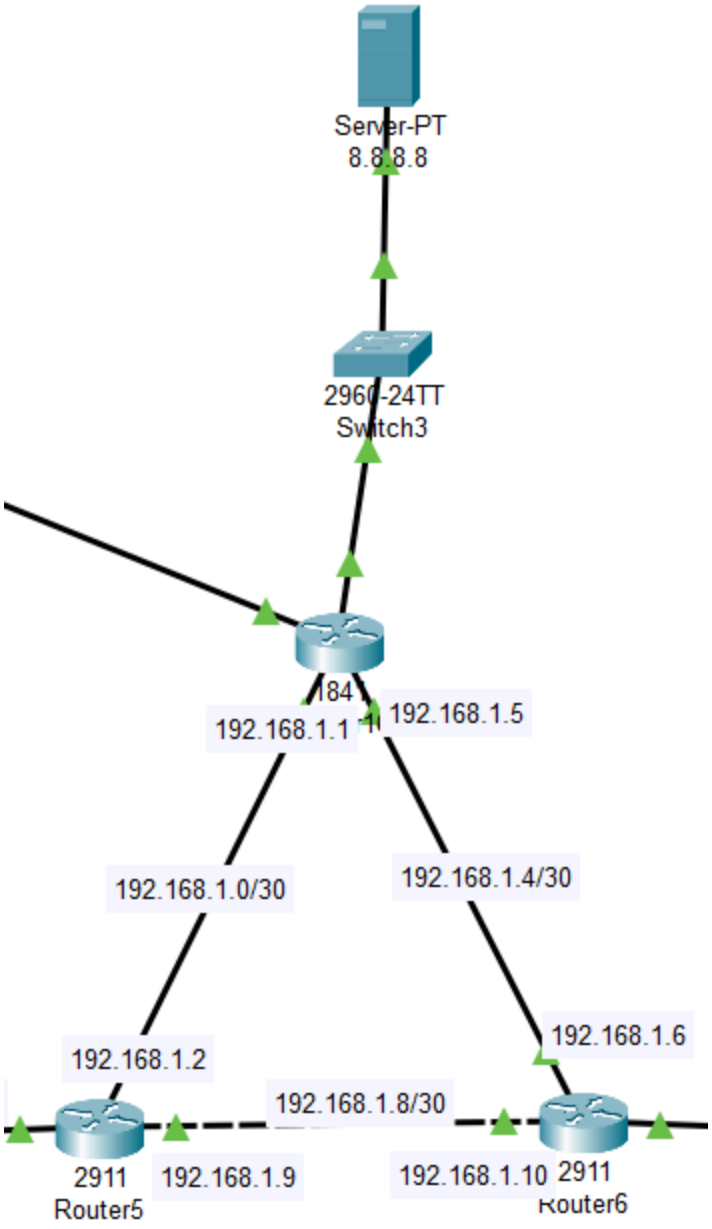

Figure 6. Routing System

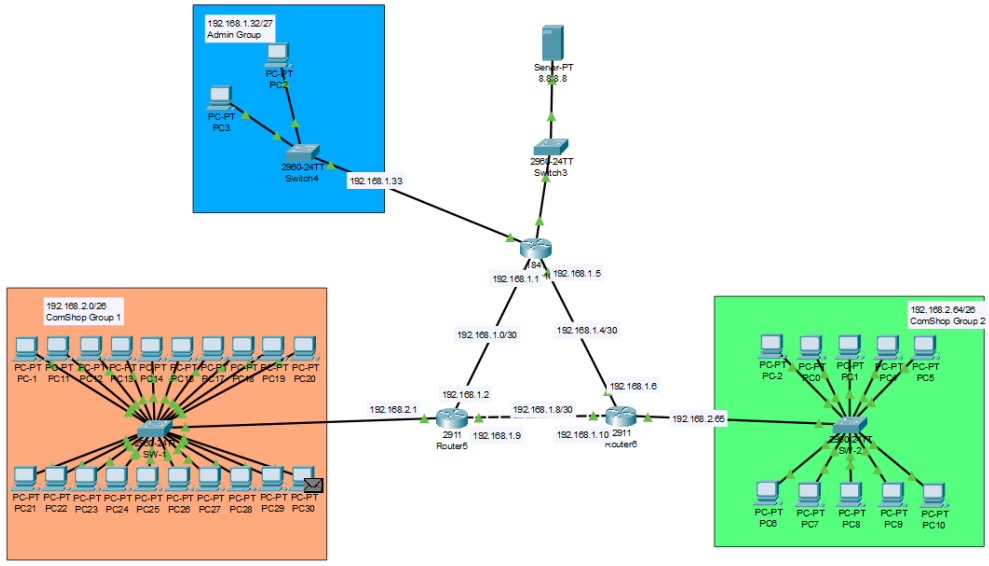

Figure 8. Computer Cafe Network in Packet Tracer

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC-1	8.8.8.8	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC5	8.8.8.8	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC3	8.8.8.8	ICMP		0.000	N	2	(edit)	(delete)

Figure 8. Sending Messages to the Internet Server from PCs of different LAN

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	8.8.8.8	PC-1	ICMP		0.000	N	0	(edit)	(delete)
	Successful	8.8.8.8	PC5	ICMP		0.000	N	1	(edit)	(delete)
	Successful	8.8.8.8	PC3	ICMP		0.000	N	2	(edit)	(delete)

Figure 9. Receiving Messages from the Internet Server to the PCs of different LAN

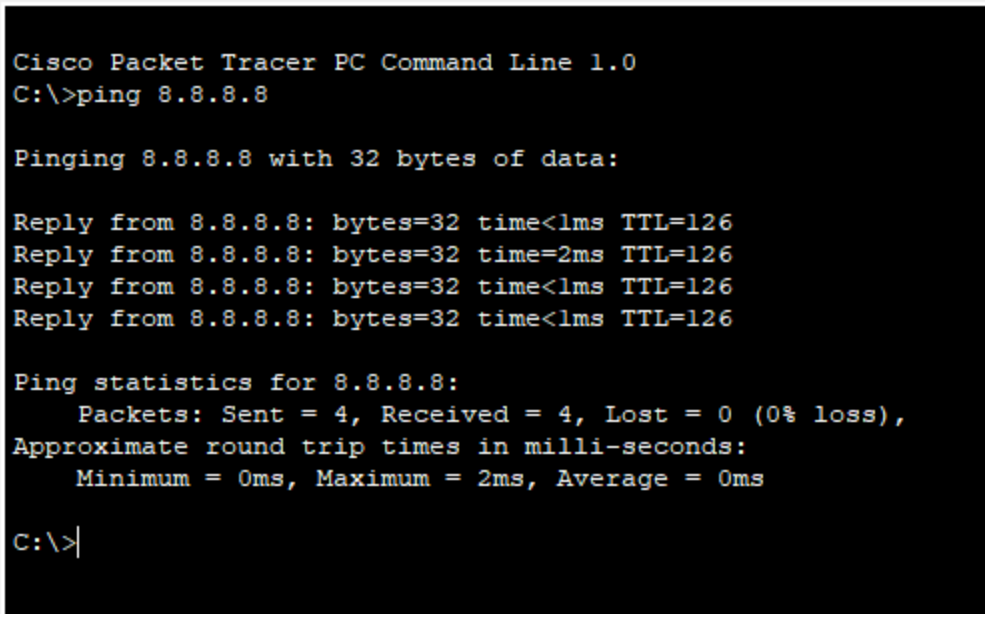

Figure 10. Ping from Regular PC (Computer Group 1)

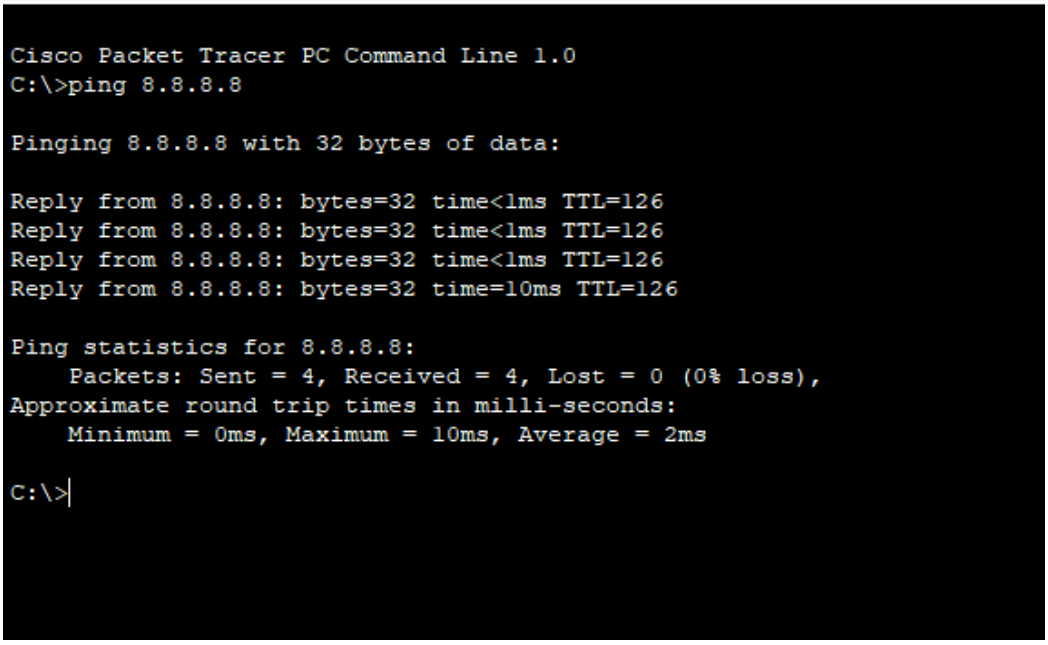

Figure 11. Ping from VIP PC (Computer Group 2)

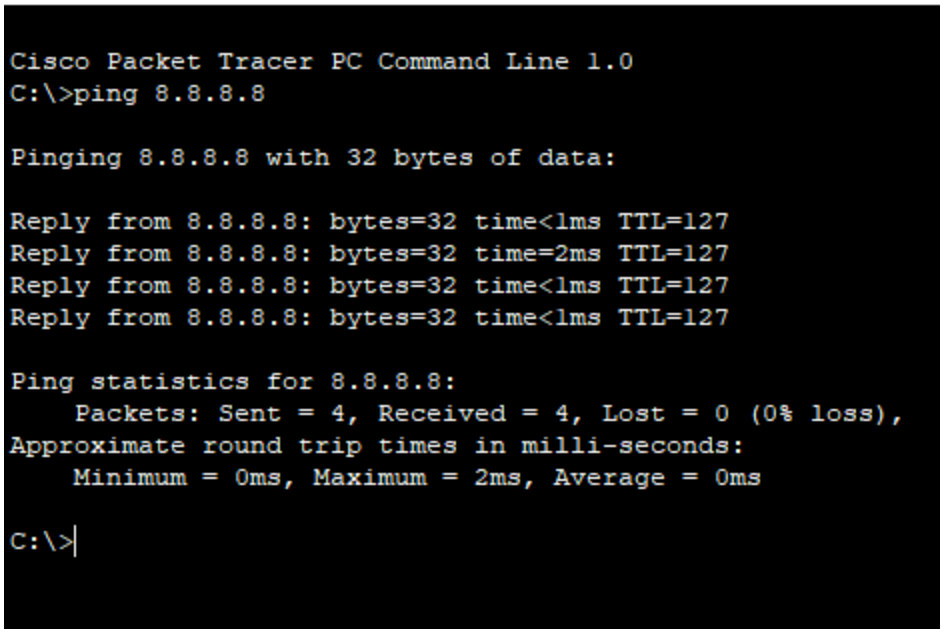

Figure 12. Ping from Admin PC (Admin Group)

Device Name	IPv4	Subnet Mask	Default Gateway
Main Server	8.8.8.8	255.0.0.0	8.8.8.1
PC2 (Admin)	192.168.1.40	255.255.255.224	192.168.1.33
PC3 (Admin)	192.168.1.41	255.255.255.225	192.168.1.33
PC-1 (Regular)	192.168.2.6	255.255.255.192	192.168.2.1
PC11 (Regular)	192.168.2.7	255.255.255.192	192.168.2.1
PC12 (Regular)	192.168.2.8	255.255.255.192	192.168.2.1
PC13 (Regular)	192.168.2.9	255.255.255.192	192.168.2.1
PC14 (Regular)	192.168.2.10	255.255.255.192	192.168.2.1
PC15 (Regular)	192.168.2.11	255.255.255.192	192.168.2.1
PC17 (Regular)	192.168.2.12	255.255.255.192	192.168.2.1
PC18 (Regular)	192.168.2.13	255.255.255.192	192.168.2.1
PC19 (Regular)	192.168.2.14	255.255.255.192	192.168.2.1
PC20 (Regular)	192.168.2.15	255.255.255.192	192.168.2.1
PC21 (Regular)	192.168.2.16	255.255.255.192	192.168.2.1
PC22 (Regular)	192.168.2.17	255.255.255.192	192.168.2.1
PC23 (Regular)	192.168.2.18	255.255.255.192	192.168.2.1

PC24 (Regular)	192.168.2.19	255.255.255.192	192.168.2.1
PC25 (Regular)	192.168.2.20	255.255.255.192	192.168.2.1
PC26 (Regular)	192.168.2.21	255.255.255.192	192.168.2.1
PC27 (Regular)	192.168.2.22	255.255.255.192	192.168.2.1
PC28 (Regular)	192.168.2.23	255.255.255.192	192.168.2.1
PC29 (Regular)	192.168.2.24	255.255.255.192	192.168.2.1
PC30 (Regular)	192.168.2.25	255.255.255.192	192.168.2.1
PC-2 (VIP)	192.168.2.70	255.255.255.192	192.168.2.65
PC0 (VIP)	192.168.2.71	255.255.255.192	192.168.2.65
PC1 (VIP)	192.168.2.72	255.255.255.192	192.168.2.65
PC4 (VIP)	192.168.2.73	255.255.255.192	192.168.2.65
PC5 (VIP)	192.168.2.74	255.255.255.192	192.168.2.65
PC6 (VIP)	192.168.2.75	255.255.255.192	192.168.2.65
PC7 (VIP)	192.168.2.76	255.255.255.192	192.168.2.65
PC8 (VIP)	192.168.2.77	255.255.255.192	192.168.2.65
PC9 (VIP)	192.168.2.78	255.255.255.192	192.168.2.65
PC10 (VIP)	192.168.2.79	255.255.255.192	192.168.2.65

Table 1. IP Configuration Table

VII. References

Dowd, P. W., & McHenry, J. T. (1998). Network security: it's time to take it seriously. Retrieved from https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=708446

SolarWinds. (n.d.). What Is VLAN? SolarWinds. Retrieved from https://www.solarwinds.com/resources/it-glossary/vlan

Zandbergen, P. (n.d.). Systems Security: Firewalls, Encryption, Passwords & Biometrics. Retrieved from https://study.com/academy/lesson/systems-security-firewalls-encryption-passwords-biometrics.html#:~:text=These%20include%20firewalls%2C%20data%20encryption,be%20viewed%20by%20authorized%20individuals.

Sequeira, A. J. (2021). Routing Technologies and Bandwidth Management. Pearson IT Certification. Retrieved from https://www.pearsonitcertification.com/articles/article.aspx?p=3129464&seqNum=6

Jones IT. (2020, March 15). Jones IT. Retrieved April 9, 2024, from Jones IT | Managed IT Services, IT Support, IT Consulting website: https://www.itjones.com/blogs/2020/3/15/how-to-build-a-computer-network-for-your-small-business-part-1-the-basics

Vandyne, J. J. (2023, June 28). Network Architecture in IT Solutions: A Comprehensive Guide to Networking. Retrieved April 9, 2024, from Inigo Tech website: https://inigo-tech.com/network-architecture/