



Rebuild the network infrastructure of Visual Architect and Web Development PVT LTD

**A dissertation submitted for the
Diploma in Network Engineering**

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Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge, it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this project is based on the work of under my supervision. The report has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: **Mr. Mohamed Ilham**

Signature

Date

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They taught me that life has its strengths and weaknesses, but how you learn from the weaknesses and live from the strengths is what makes life's journey enriching and rewarding. Also influential in the preparation and completion of this thesis are my distinguished colleagues, with whom I shared many ideas.

ABSTRACT

Visual Architect and Web Development PVT LTD is a web development and visual design services company. The company started three years ago and is growing rapidly and till date has 600 employees on three floors covering all operations. It Has Video Editing Department, Product Designing/Branding Department, Graphic Design Department, Web Design Department, and Architecture Department as the core departments of market focus. Other departments are for the main process. The company is presently confronted with multiple network challenges.

Its current infrastructure faces bottlenecks, fluctuating connectivity, and scaling issues. This makes the performance slow due to high usage of the network by employees, while clients face disruptions in accessing services because the network is incapable of sustaining 24x7 connectivity. The current network design accommodates all departments on one single shared structure, leading to network congestion and reducing overall performance. There are issues in the handling of the connection of devices, such as IP address conflicts and wireless access coverage gaps that really slow down productivity among employees and satisfaction for clients. This project addresses this issue with an overview of network infrastructure.

The network operating in this company is integrated with the latest network technologies for reliability, security and more efficient provision of various services. This will be achieved by increasing bandwidth, adding redundancy to power and internet sources, and extending wireless coverage by repositioning access points for better coverage. Further segregation of the departmental network will be done to alleviate network congestion, allowing better passage of data. This solution will leverage scalable technologies that will enable future growth; it will also support reliable, efficient, and secure network connectivity and boost productivity and service quality overall. This report delves into the problems of network infrastructure in Visual Architect and Web Development, highlighting its key role in shaping the future of technology development through its scalable and high-performance design.

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LIST OF ABBREVIATIONS

VLANs	- Virtual Local Area Network
VLSM	- Variable Length Subnet Mask
STP	- Spanning Tree Protocol
VTP	- VLAN Trucking Protocol
HSRP	- Hot Standby Router Protocol
ACL	- Access Control List
NAT	- Network Address Translation
SSH	- Secure Shell
DHCP	- Dynamic Host Configuration Protocol
DNS	- Domain Name System
EIGRP	- Enhanced Interior Gateway Routing Protocol
PAgP	- Port Aggregation Protocol
LAGP	- Link Aggregation Control Protocol
Ping	- Packet Internet / Inter-Network Groper
L3	- Layer 03
L2	- Layer 02
ISP	- Internet Service Provider
IP	- Internet Protocol
IPv4	- Internet Protocol Version 4
Mbps	- Megabits per second
Gbps	- Gigabits per second
Tbps	- Terabyte per second
LAN	- Local Area Network
Dept	- Department
PoE	- Power over Ethernet
QoS	- Quality of Service

MAC	- Media Access Control
LCs	- Line Cards
AP	- Access Point
Wi-Fi	- Wireless Fidelity
CCTV	- Closed circuit television
UPS	- Uninterrupted Power Supply

Chapter 01 - Introduction

1.1 Introduction of the Company

Visual Architect and Web Development PVT LTD is a leading provider of cutting-edge web development and visual design solutions. This company, which was established three years ago, has two floors and the number of employees at the time of starting the company is about 200 and currently around 600 employees are working. With a commitment to innovation and excellence, this company has established itself as a trusted partner for businesses seeking to enhance their digital presence and streamline their operations through advanced technological solutions.

In our latest endeavor, we propose the project to Regenerate the Network Infrastructure of this company. This initiative aims to restructure and modernize the network infrastructure, ensuring scalable, secured and efficient connectivity that supports their growing operational demands. Through this project, we seek to enhance the company ability to deliver top-tier services to the clients, maintain the company competitive edge, and foster a more efficient and productive work environment for their company.

- Three floors are available, along with a parking lot outside.
- About six hundred employees are currently employed. (About 200 Users per Floor)
- Moreover, Ten Departments are available as well.

GROUND FLOOR

- Video Editing Dept.
- Product Design/Branding Dept.
- Graphic Design Dept.

SECOND FLOOR

- IT Dept.
- Finance Dept.
- HR Dept.
- Marketing Dept.

FIRST FLOOR

- Web Design Dept.
- Architecture Dept.
- Legal Dept.

- Monitoring Room
- Repairing Room

1.2 Infrastructure

- Network devices implemented in the Network Control Area
- Each floor equipped with Switches, Servers and Routers, fixed to a rack
- Technology enabling visitors and users to connect to access internet Wirelessly
- Security and Communication
- Biometric scanners for secure access to private storerooms on each floor
- High-Bandwidth Access-points and CCTV cameras installed throughout

The company consists overall 600 number of employees at the beginning and then they are trying to expand the number of the employees by 200.

1.3 Problem Statements

Inability to Maintain 24/7 Connectivity with Customers

- The organization faces challenges in providing continuous, 24/7 connectivity to customers because the network infrastructure lacks sufficient bandwidth. The company is struggling to provide uninterrupted access to its services or support.

High Employee Access causes Low Network Performance (Bottleneck)

- The shared network experiences significant performance issues and slowdowns as all employees attempt to access it simultaneously. High employee access might reveal or exacerbate existing bottlenecks in the network infrastructure, such as inadequate bandwidth or insufficient server capacity.

All departments are in the same network

- With all departments sharing the same network, there is a significant risk of network congestion. High traffic from one department can impact the performance of other departments, leading to slower response times and reduced efficiency.

Scalability Issues with Employee Network Access

- This company is currently facing scalability issues with its employee network access. The primary problem is that the organization is unable to accommodate additional employees on the network.

Not have a proper DHCP Management

- There are usually problems as far as networks are concerned such as IP address collision where two or more devices will be assigned the same IP address because of the connectivity problem.

This can also cause devices to not connect, increased security risks because of access by unauthorized users, and ineffective network functioning. Lack of proper management of DHCP servers leads to the problems in scalability and increases configuration issues because of manual work, network performance and reliability is degraded.

Not enough coverage of WIFI (Poor installation of APs)

- When the APs are not installed properly, there are instances where some areas of any institution will receive poor signals or signals that change frequently, disrupting network connectivity.

This improper installment may be a result of poor assessment of the location of APs, underscoring of physical barriers, including walls and other furniture, or setting up of APs. Lack of proper APs coverage leads to network issues and poor user satisfaction as well.

1.4 Proposed Solutions

Implement Redundant ISPs and Power Supplies

- At Visual Architect and Web Development PVT LTD, we enhance network reliability and ensure uninterrupted service by implementing redundant ISPs and power supplies.

Increase Bandwidth and Adopt Advanced Technologies

- Boost network speed and avoid bottlenecks by increasing bandwidth and incorporating fiber optics and Ether Channel technology.
- Based on this Identification of the current bandwidth usage and identifying areas where bandwidth is being consumed excessively, upgrade the bandwidth capacity of the network.

This may involve negotiating with ISPs for higher bandwidth plans or incorporating additional lines to handle increased traffic. Implement tools to monitor and manage bandwidth usage to ensure optimal performance and prevent any single application or user from monopolizing resources.

- Implement link aggregation to combine multiple network connections into a single logical link. This approach will aggregate bandwidth, offer redundancy, and distribute the load across multiple links, effectively preventing bottlenecks and enhancing network reliability and performance.

Additional Considerations

- Ensure that all network equipment, such as routers and switches, is compatible with higher bandwidth and fiber optic connections. Upgrade or replace outdated equipment as necessary. Implement robust security measures to protect the enhanced network infrastructure, including encryption and firewalls, to safeguard data transmitted over fiber optics.

Design a Scalable, Secured and Reliable Network

- The goal of our company is to create scalable and dependable network solutions. High-performance switches should be enabled to create reliable connectivity and redundancy at the core layer and enable effective routing and load balancing at the distribution layer. End-user devices are supported by the access layer, which also offers fast, secure connectivity.

The network is modularly intended to accommodate future growth, enabling the easy installation of equipment as demand rises. To defend against potential attacks, security measures like as intrusion detection systems and firewalls are incorporated at every layer.

Optimize Network Architecture

- Our company offers a solution to optimize network architecture by strategically segregating network traffic based on departmental needs. This approach reduces congestion and enhances overall network efficiency by ensuring that each department's data traffic is isolated from others.

By implementing this solution, the company can tailor network resources to specific departmental requirements, preventing bottlenecks and improving performance. This segregation not only streamlines data flow but also enhances security and minimizes the risk of cross-departmental interference, leading to a more reliable and efficient network infrastructure.

Proper DHCP Management

- From handling DHCP management problems, it is recommended that organizations ensure the use of a central DHCP server and automatic assignment to avoid complications such as DHCP conflict and resultant connectivity complications.

The DHCP server should be regularly checked and modified because of expansion in the network. Therefore, DHCP management tools should be incorporated to aid in tracking, auditing, and troubleshooting to improve the efficiency of the networks.

Manage the coverage of Access Points

- First, we need to enhance the location procedures of access points regarding the building constructions, barriers and traffic load. Some of these tools include wireless heat maps, whereby an organization can easily see such things as the areas that are not covered by access points appropriately and then be able to move around the access points to come up with equal coverage areas.

Switch to APs with rotating antennas and those that support the most recent wireless standards (such as Wi-Fi 6 or similar). Periodically analyze the network's state and observe its high-risk areas and then respond by implementing the necessary adjustments. Also, modify the AP settings such as channel and power settings, to avoid interferences.

1.5 The Aim and Objectives

1.5.1 The Aim

The project aim is to rebuild the network infrastructure of Visual Architect and Web Development PVT LTD, ensuring high availability, enhanced performance, scalability, and credible security to support current and future business operations effectively.

1.5.2 Objectives

- Ensure 24/7 Connectivity
- Enhance the Network Performance and APs coverage
- Optimize Network Access for Employees
- Segregate Network for Different Departments
- Improve Network Scalability and Flexibility
- Implement Robust Security Measures
- Proper DHCP Management
- Proper Coverage Management of Access Points

1.6 What Technologies we used?

VLANs (Virtual Local Area Network)

- A physical network can be divided into logical segments using the network segmentation technique and that will improve the network structure, security, and traffic control.

VLSM (Variable Length Subnet Mask)

- This method is used for minimizing the IP addresses wastage.

STP (Spanning Tree Protocol)

- This is a network protocol that builds a loop-free Ethernet network. It helps to prevent loops and broadcast storms inside the network.

VTP (VLAN Trucking Protocol)

- This is a Cisco proprietary protocol used by Cisco switches to exchange VLAN information easily. You can synchronize VLAN information (such as VLAN ID or VLAN name) with using a VTP domain.

Ether-Channel

- EtherChannel, which is another name for link aggregation, is a method that combines several physical Ethernet links into one logical link, increasing redundancy and bandwidth.

HSRP (Hot Standby Router Protocol)

- This is a Cisco proprietary protocol. HSRP reduces the number of consumers impacted by router failures and provides redundancy by providing a single virtual IP address and MAC address for subnet devices.

ACL (Access Control List)

- Filters network traffic by handling which users or devices are allowed or denied access to specific network (Departments) and increase the security. Also, that will help to increase the network performance automatically.

NAT (Network Address Translation)

- This method is used for accessing the Internet. NAT will translate private IP addresses to a public IP address and, allowing multiple devices on a local network to share a single public IP address, conserving IP addresses and enhancing security.

DHCP (Dynamic Host Configuration Protocol)

- Automatically assigns IP addresses and other network configuration parameters to devices on a network, simplifying network administration and ensuring correct settings. (Make sure that to update the system generally)

SSH (Secure Shell)

- Provides secure, encrypted remote access to network devices, allowing administrators to manage and configure devices over a network securely. (Can use Telnet as well [Not recommended])

OSPF (Open Shortest Path First)

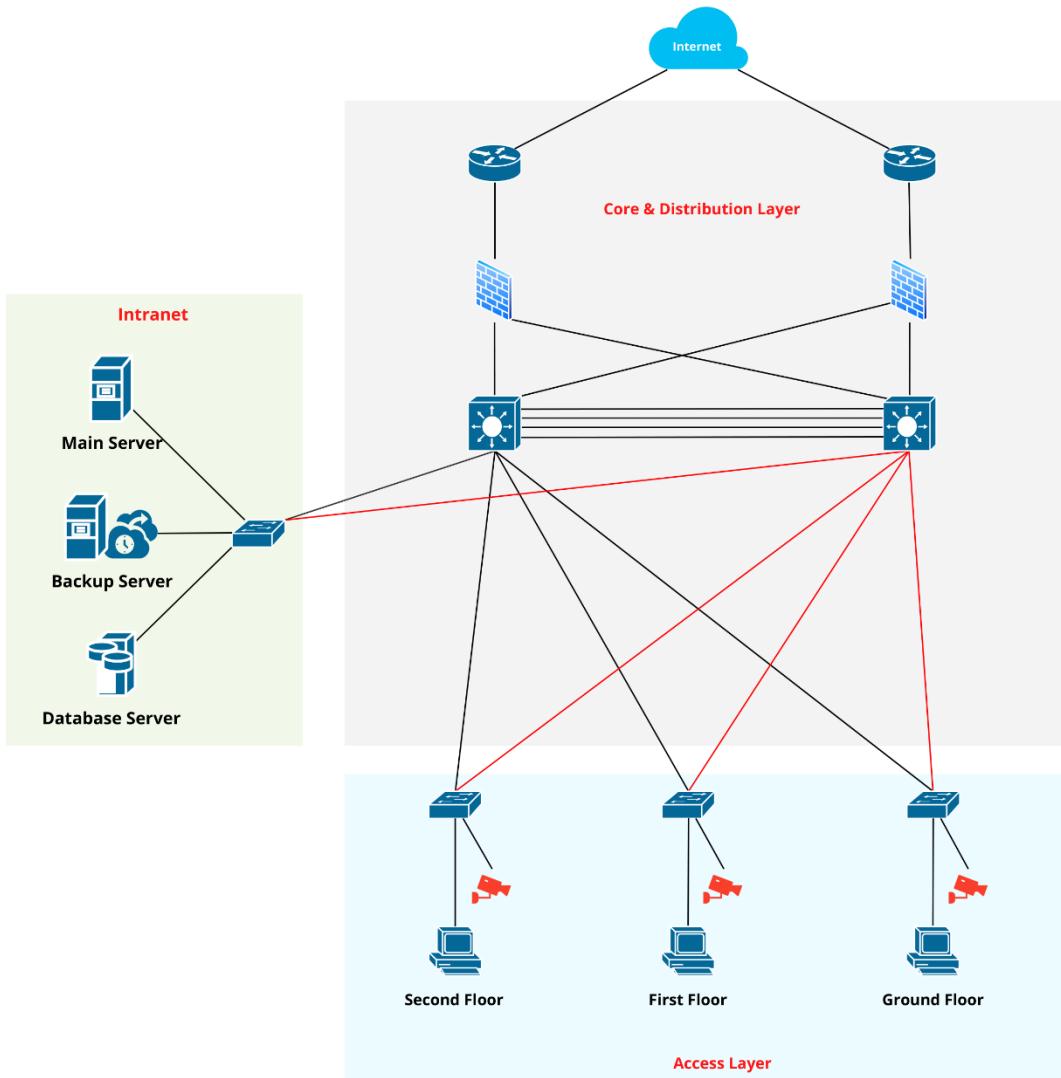
- A dynamic routing protocol that finds the best path for data between devices in a large, complex network, enabling efficient, reliable routing. In this case we must use OSPF, because this company have used many brands of devices. (Dell, Cisco)

Port Security

- This is used to restrict access on a switch port, and only can get access from authorized devices. Limited the number of MAC address that can be allowed on given ports, which provides more security as only the predefined MAC addresses can access the given ports.

Chapter 02 - Network Infrastructure & Design

2.1 Network Diagram



2.1.1 Figure

2.2 VLANs and IP Table

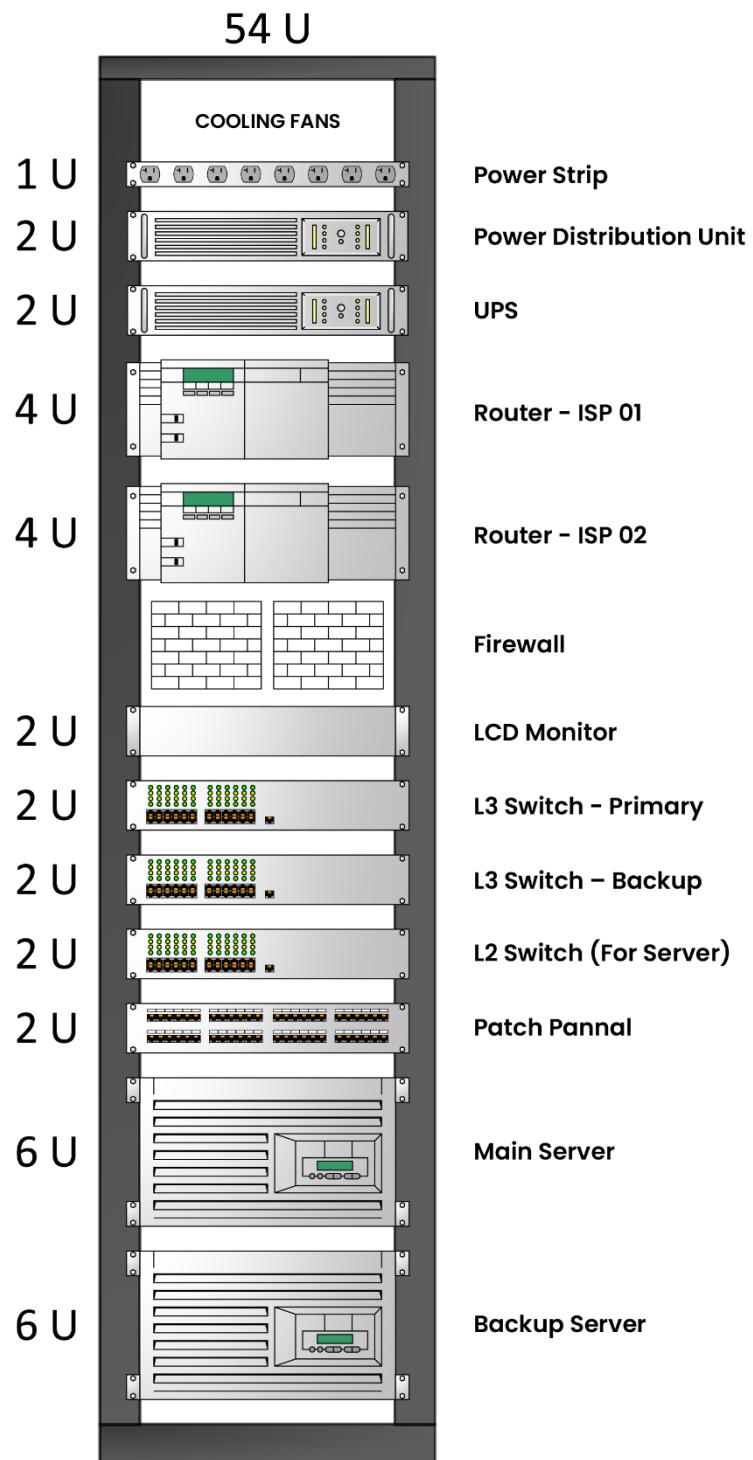
- 192.168.10.0/22 is Class C address. (For Users) The network 192.168.10.0/22 has 1024 hosts.
- 192.168.20.0/22 is Class C address. (For Wi-Fi) The network 192.168.20.0/22 has 1024 hosts.
- 10.10.10.0/29 is Class A address. (For Net. Devices) The network 10.10.10.0/29 has 8 hosts.
- 583 Users are available in the company.

Dept.	VLAN	Needed (Total Users)	Available (In Network)	Range	Prefix	Virtual IP (Gateway)	Subnet
Web Design	10	112	126	192.168.10.0	/25	192.168.10.125	255.255.255.128
				192.168.10.127			
Video Editing	20	102	126	192.168.10.128	/25	192.168.10.253	255.255.255.128
				192.168.10.255			
Architecture	30	102	126	192.168.11.0	/25	192.168.11.125	255.255.255.128
				192.168.11.127			
Product/ Branding	40	62	62	192.168.11.128	/26	192.168.11.189	255.255.255.192
				192.168.11.191			
Graphic	50	52	62	192.168.11.192	/26	192.168.11.253	255.255.255.192
				192.168.11.255			
HR	60	45	62	192.168.12.0	/26	192.168.12.61	255.255.255.192
				192.168.12.63			
IT	70	40	62	192.168.12.64	/26	192.168.12.125	255.255.255.192
				192.168.12.127			
Marketing	80	40	62	192.168.12.128	/26	192.168.12.189	255.255.255.192
				192.168.12.191			
Finance	90	30	30	192.168.12.192	/27	192.168.12.221	255.255.255.224
				192.168.12.223			
Reception	100	5	6	192.168.12.224	/29	192.168.12.229	255.255.255.248
				192.168.12.231			
Legal	110	3	6	192.168.12.232	/29	192.168.12.237	255.255.255.248
				192.168.12.239			
Servers	120	3	6	192.168.12.240	/29	192.168.12.245	255.255.255.248
				192.168.12.247			
Network Devices	-	6	8	10.10.10.0	/29	10.10.10.5	255.255.255.248
				10.10.10.7			
Access Points	200	593	1024	192.168.20.0	/22	192.168.23.253	255.255.252.0
				192.168.23.255			
CCTV	210	45	64	192.168.30.0	/26	192.168.30.61	255.255.255.192
				192.168.30.63			

2.2.1 Table

2.3 Server Rack and Floor Cabinets

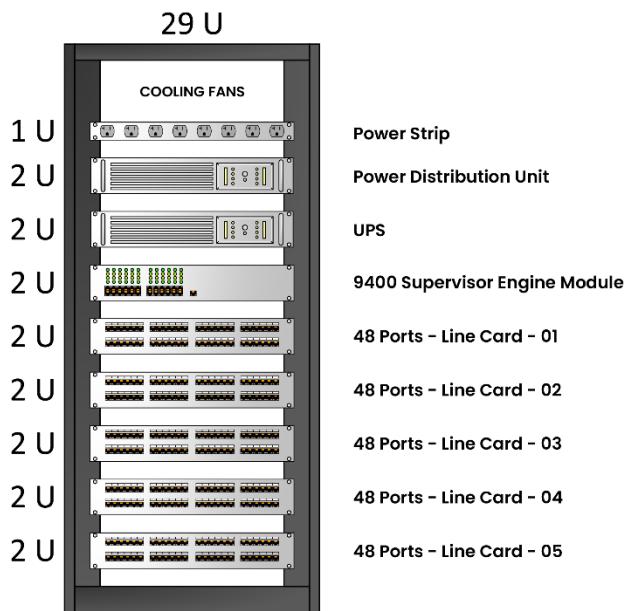
2.3.1 Main Server Rack



2.3.1 Figure

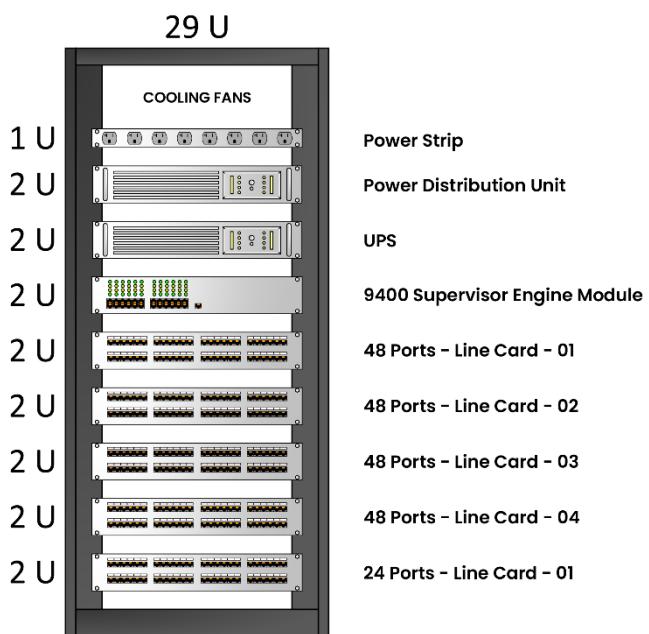
2.3.2 Mini Server Racks

Ground Floor



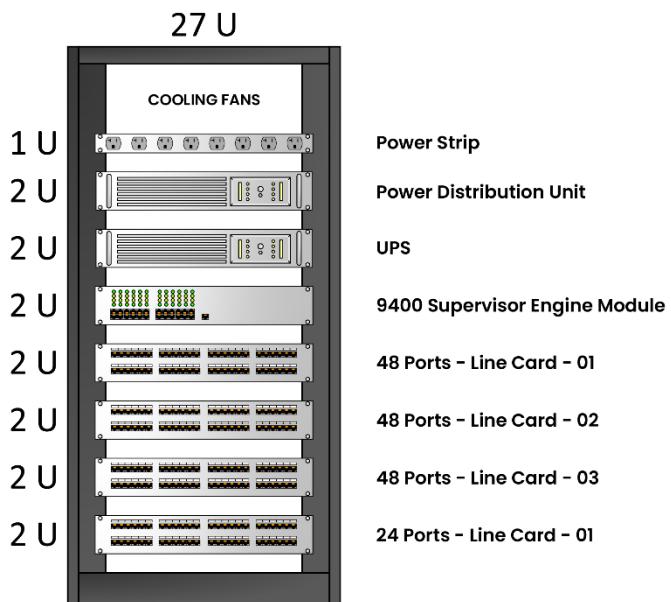
2.3.2.1 Figure

First Floor



2.3.2.2 Figure

Second Floor



2.3.2.3 Figure

2.4 Port Mapping Table

Edge Router (ISP) - Primary

Edge Router (ISP) - 01			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet 0/0	ISP-01	ISP's Link	-
GigabitEthernet 0/1	Firewall	Ethernet 1/1	Uplink
GigabitEthernet 0/2		Shutdown Port	

2.4.1 Table

Edge Router (ISP) – Backup

Edge Router (ISP) - 02			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet 0/0	ISP-02	ISP's Link	-
GigabitEthernet 0/1	Firewall	Ethernet 1/1	Uplink
GigabitEthernet 0/2		Shutdown Port	

2.4.2 Table

Firewall - 01

Firewall - 01			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet 1/1	ISP-01	GigabitEthernet 0/1	Uplink
GigabitEthernet 1/2	L3-Main	GigabitEthernet 1/1/1	EtherChannel - Trunk
GigabitEthernet 1/3	L3-Main	GigabitEthernet 1/1/2	EtherChannel - Trunk
GigabitEthernet 1/4			
GigabitEthernet 1/5			
GigabitEthernet 1/6			Shutdown Ports
GigabitEthernet 1/7			
GigabitEthernet 1/8			

2.4.3 Table

Firewall - 02

Firewall - 02			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet 1/1	ISP-02	GigabitEthernet 0/1	Uplink
GigabitEthernet 1/2	L3-Backup	GigabitEthernet 1/1/1	EtherChannel - Trunk
GigabitEthernet 1/3	L3-Backup	GigabitEthernet 1/1/2	EtherChannel - Trunk
GigabitEthernet 1/4			
GigabitEthernet 1/5			
GigabitEthernet 1/6			Shutdown Ports
GigabitEthernet 1/7			
GigabitEthernet 1/8			

2.4.4 Table

L3 Switch - Main

Multi Layer - Main			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet1/1/1	Firewall-01	GigabitEthernet 1/2	EtherChannel - Trunk
GigabitEthernet1/1/2	Firewall-01	GigabitEthernet 1/3	EtherChannel - Trunk
GigabitEthernet1/1/3	Shutdown Ports		
GigabitEthernet1/1/4			
GigabitEthernet1/0/1	L2-Switch (Ground)	GigabitEthernet0/1	EtherChannel - Trunk
GigabitEthernet1/0/2	L2-Switch (Ground)	GigabitEthernet0/2	EtherChannel - Trunk
GigabitEthernet1/0/3	L2-Switch (First)	GigabitEthernet0/1	EtherChannel - Trunk
GigabitEthernet1/0/4	L2-Switch (First)	GigabitEthernet0/2	EtherChannel - Trunk
GigabitEthernet1/0/5	L2-Switch (Second)	GigabitEthernet0/1	EtherChannel - Trunk
GigabitEthernet1/0/6	L2-Switch (Second)	GigabitEthernet0/2	EtherChannel - Trunk
GigabitEthernet1/0/7	L2-Switch-Server (Second)	GigabitEthernet0/1	EtherChannel - Trunk
GigabitEthernet1/0/8	L2-Switch-Server (Second)	GigabitEthernet0/2	EtherChannel - Trunk
GigabitEthernet1/0/9	Shutdown Ports		
GigabitEthernet1/0/10	L3-Backup	GigabitEthernet1/0/10	EtherChannel - Trunk
GigabitEthernet1/0/11	L3-Backup	GigabitEthernet1/0/11	EtherChannel - Trunk
GigabitEthernet1/0/12	L3-Backup	GigabitEthernet1/0/12	EtherChannel - Trunk
GigabitEthernet1/0/13	L3-Backup	GigabitEthernet1/0/13	EtherChannel - Trunk
GigabitEthernet1/0/14 - 24	Shutdown Ports		

2.4.5 Table

L3 Switch - Backup

Multi Layer - BKP			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet1/1/1	Firewall-02	GigabitEthernet 1/2	EtherChannel - Trunk
GigabitEthernet1/1/2	Firewall-02	GigabitEthernet 1/3	EtherChannel - Trunk
GigabitEthernet1/1/3	Shutdown Ports		
GigabitEthernet1/1/4			
GigabitEthernet1/0/1	L2-Switch (Ground)	GigabitEthernet0/3	EtherChannel - Trunk
GigabitEthernet1/0/2	L2-Switch (Ground)	GigabitEthernet0/4	EtherChannel - Trunk
GigabitEthernet1/0/3	L2-Switch (First)	GigabitEthernet0/3	EtherChannel - Trunk
GigabitEthernet1/0/4	L2-Switch (First)	GigabitEthernet0/4	EtherChannel - Trunk
GigabitEthernet1/0/5	L2-Switch (Second)	GigabitEthernet0/3	EtherChannel - Trunk
GigabitEthernet1/0/6	L2-Switch (Second)	GigabitEthernet0/4	EtherChannel - Trunk
GigabitEthernet1/0/7	L2-Switch-Server (Second)	GigabitEthernet0/3	EtherChannel - Trunk
GigabitEthernet1/0/8	L2-Switch-Server (Second)	GigabitEthernet0/4	EtherChannel - Trunk
GigabitEthernet1/0/9	Shutdown Ports		
GigabitEthernet1/0/10	L3-Main	GigabitEthernet1/0/10	EtherChannel - Trunk
GigabitEthernet1/0/11	L3-Main	GigabitEthernet1/0/11	EtherChannel - Trunk
GigabitEthernet1/0/12	L3-Main	GigabitEthernet1/0/12	EtherChannel - Trunk
GigabitEthernet1/0/13	L3-Main	GigabitEthernet1/0/13	EtherChannel - Trunk
GigabitEthernet1/0/14 - 24	Shutdown Ports		

2.4.6 Table

L2 Switch - (Intranet)

Intranet - L2 Switch			
Interface	Connect to	Connecting Ports	Port Mode
GigabitEthernet 0/1	L3-Main	GigabitEthernet1/0/7	EtherChannel - Trunk
GigabitEthernet 0/2	L3-Main	GigabitEthernet1/0/8	EtherChannel - Trunk
GigabitEthernet 0/3	L3-Backup	GigabitEthernet1/0/7	EtherChannel - Trunk
GigabitEthernet 0/4	L3-Backup	GigabitEthernet1/0/8	EtherChannel - Trunk
GigabitEthernet 0/5	Main Server	GigabitEthernet 0/1	Access Port
GigabitEthernet 0/6	Backup Server	GigabitEthernet 0/1	Access Port
GigabitEthernet 0/7 - 24	Shutdown Ports		

2.4.7 Table

L2 Switch - 01 (Ground Floor)

L2 Switch - 01 - Ground Floor				
LCs	Interface	Connect to	Connecting Ports	Port Mode
LC - 01	GigabitEthernet 0/1	L3-Main	GigabitEthernet1/0/1	EtherChannel - Trunk
	GigabitEthernet 0/2	L3-Main	GigabitEthernet1/0/2	EtherChannel - Trunk
	GigabitEthernet 0/3	L3-Backup	GigabitEthernet1/0/1	EtherChannel - Trunk
	GigabitEthernet 0/4	L3-Backup	GigabitEthernet1/0/2	EtherChannel - Trunk
	GigabitEthernet 0/5	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/6	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/7	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/8	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/9	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/10	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/11	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/12	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/13	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/14	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/15	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/16	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/17	PCs - Graphic	GigabitEthernet 0/1	Access Port
LC-02	GigabitEthernet 0/1 - 8	PCs - Graphic	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/9 - 48	PCs - Product & Branding	GigabitEthernet 0/1	Access Port
LC-03	GigabitEthernet 0/1 - 22	PCs - Product & Branding	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/23 - 48	PCs - Video	GigabitEthernet 0/1	Access Port
LC-04	GigabitEthernet 0/1 - 48	PCs - Video	GigabitEthernet 0/1	Access Port
LC-05	GigabitEthernet 0/1 - 28	PCs - Video	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/29 - 40	AccessPoints	FastEthernet	Access Port
	GigabitEthernet 0/41 - 48	CCTVs	FastEthernet	Access Port

2.4.8 Table

- LCs - Line Cards

L2 Switch - 02 (First Floor)

L2 Switch - 02 - First Floor				
LCs	Interface	Connect to	Connecting Ports	Port Mode
LC - 01	GigabitEthernet 0/1	L3-Main	GigabitEthernet1/0/3	EtherChannel - Trunk
	GigabitEthernet 0/2	L3-Main	GigabitEthernet1/0/4	EtherChannel - Trunk
	GigabitEthernet 0/3	L3-Backup	GigabitEthernet1/0/3	EtherChannel - Trunk
	GigabitEthernet 0/4	L3-Backup	GigabitEthernet1/0/4	EtherChannel - Trunk
	GigabitEthernet 0/5	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/6	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/7	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/8	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/9	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/10	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/11	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/12	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/13	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/14	PCs - Web	GigabitEthernet 0/1	Access Port
LC-02	GigabitEthernet 0/15	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/16	PCs - Web	GigabitEthernet 0/1	Access Port
LC-03	GigabitEthernet 0/17	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/18	PCs - Web	GigabitEthernet 0/1	Access Port
LC-04	GigabitEthernet 0/19	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/20	PCs - Web	GigabitEthernet 0/1	Access Port
LC-05	GigabitEthernet 0/21 - 48	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/1 - 48	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/1 - 16	PCs - Web	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/17 - 48	PCs - Architecture	GigabitEthernet 0/1	Access Port
LC-04				
LC-05	GigabitEthernet 0/1 - 10	PCs - Architecture	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/11 - 13	PCs - Legal	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/14 - 20	AccessPoints	FastEthernet	Access Port
	GigabitEthernet 0/21 - 24	CCTVs	FastEthernet	Access Port

2.4.9 Table

L2 Switch - 03 (Second Floor)

L2 Switch - 03 - Second Floor				
LCs	Interface	Connect to	Connecting Ports	Port Mode
LC - 01	GigabitEthernet 0/1	L3-Main	GigabitEthernet1/0/5	EtherChannel - Trunk
	GigabitEthernet 0/2	L3-Main	GigabitEthernet1/0/6	EtherChannel - Trunk
	GigabitEthernet 0/3	L3-Backup	GigabitEthernet1/0/5	EtherChannel - Trunk
	GigabitEthernet 0/4	L3-Backup	GigabitEthernet1/0/6	EtherChannel - Trunk
	GigabitEthernet 0/5	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/6	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/7	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/8	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/9	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/10	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/11	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/12	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/13	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/14	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/15	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/16	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/17	PCs - HR	GigabitEthernet 0/1	Access Port
LC-02	GigabitEthernet 0/18	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/19	PCs - HR	GigabitEthernet 0/1	Access Port
LC-03	GigabitEthernet 0/20	PCs - HR	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/21 - 40	PCs - HR	GigabitEthernet 0/1	Access Port
LC-04	GigabitEthernet 0/41 - 48	PCs - IT	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/1 - 25	PCs - IT	GigabitEthernet 0/1	Access Port
LC-03	GigabitEthernet 0/26 - 48	PCs - Marketing	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/1 - 18	PCs - Marketing	GigabitEthernet 0/1	Access Port
LC-04	GigabitEthernet 0/19 - 48	PCs - Finance	GigabitEthernet 0/1	Access Port
	GigabitEthernet 0/1 - 16	AccessPoints	FastEthernet	Access Port
	GigabitEthernet 0/17 - 24	CCTVs	FastEthernet	Access Port

2.4.10 Table

2.5 Bandwidth Calculation

Bandwidth Calculation Table

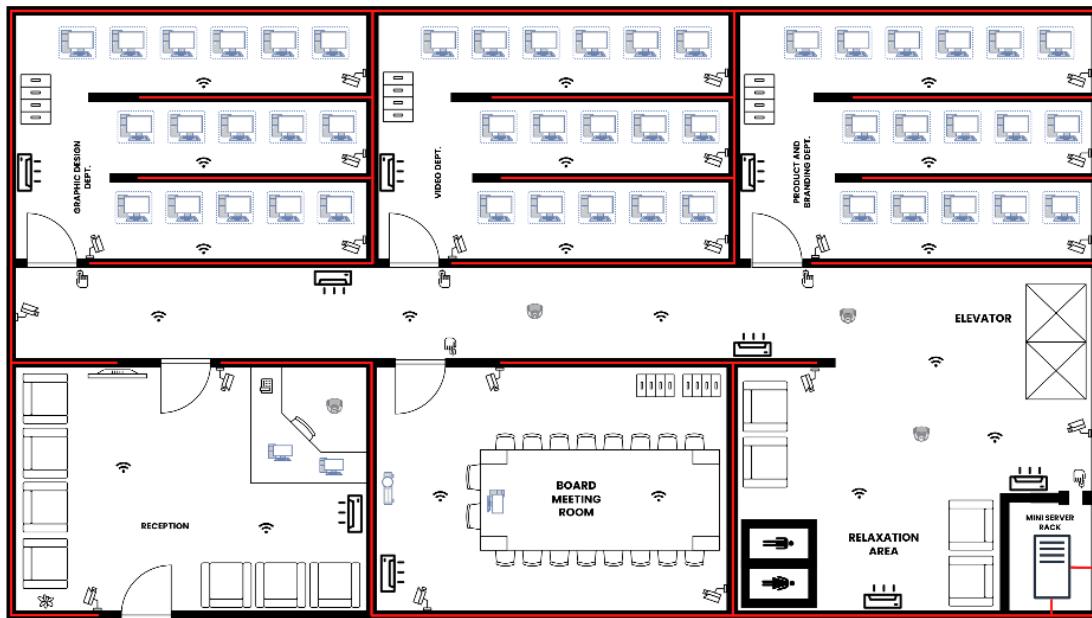
User Categories	No of User	Allocated Bandwidth for 1 User	Required Bandwidth
Web Dept	112	64 Mbps	7168 Mbps
Video Dept	102	64 Mbps	6528 Mbps
Architecture Dept	102	64 Mbps	6528 Mbps
Product & Branding Dept	62	64 Mbps	3968 Mbps
Graphic Dept	52	64 Mbps	3328 Mbps
HR Dept	45	32 Mbps	1440 Mbps
IT Dept	40	64 Mbps	2560 Mbps
Marketing Dept	40	32 Mbps	1280 Mbps
Finance Dept	30	32 Mbps	960 Mbps
Reception	5	32 Mbps	160 Mbps
Legal Dept	3	32 Mbps	96 Mbps
AccessPoints	600	1 Mbps	600 Mbps
CCTV	45	2 Mbps	90 Mbps
Required Total Bandwidth			34706 Mbps

2.5.1 Table

- This Company required Total Bandwidth is 34,706Mbps.
- That means the company needs 35GB (34.706 Gbps) per second.
- And the company needs approximately 30,240TB for one month with a daily working time of 8 hours.
 - $35 \text{ GB} * 60 = 2,100 \text{ GB}$ - Per Minute
 - $2,100 \text{ GB} * 60 = 126,000 \text{ GB}$ - Per Hour
 - $126,000 \text{ GB} * 8 = 1,008,000 \text{ GB}$ - Per Day
 - $1,008,000 \text{ GB} * 30 = 30,240,000 \text{ GB}$ - Per Month
 - $30,240\text{TB}$ - Per Month

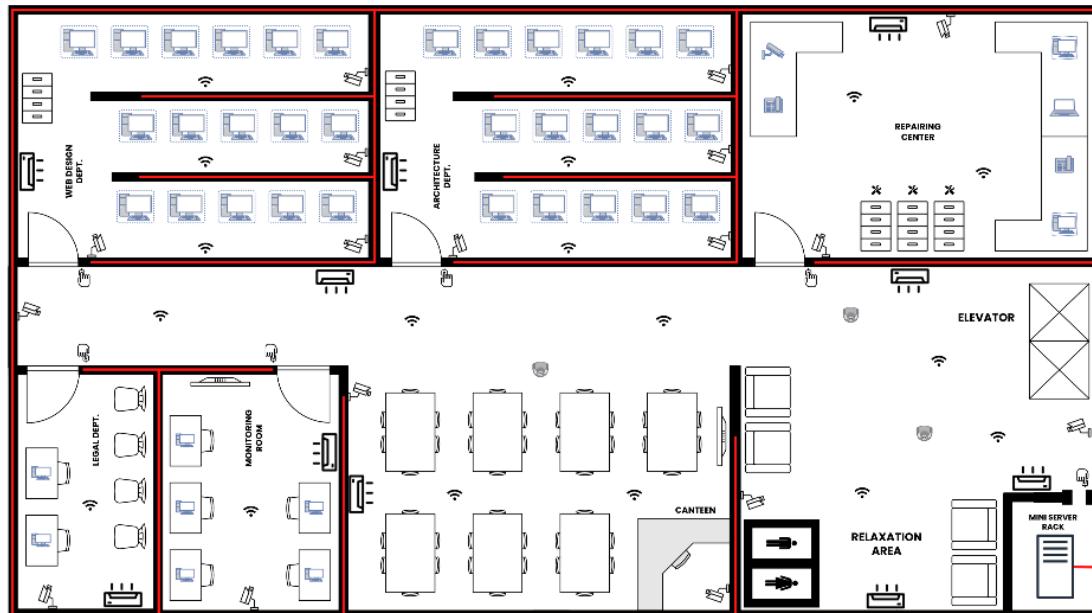
2.6 Floor Plan Designs

Ground Floor



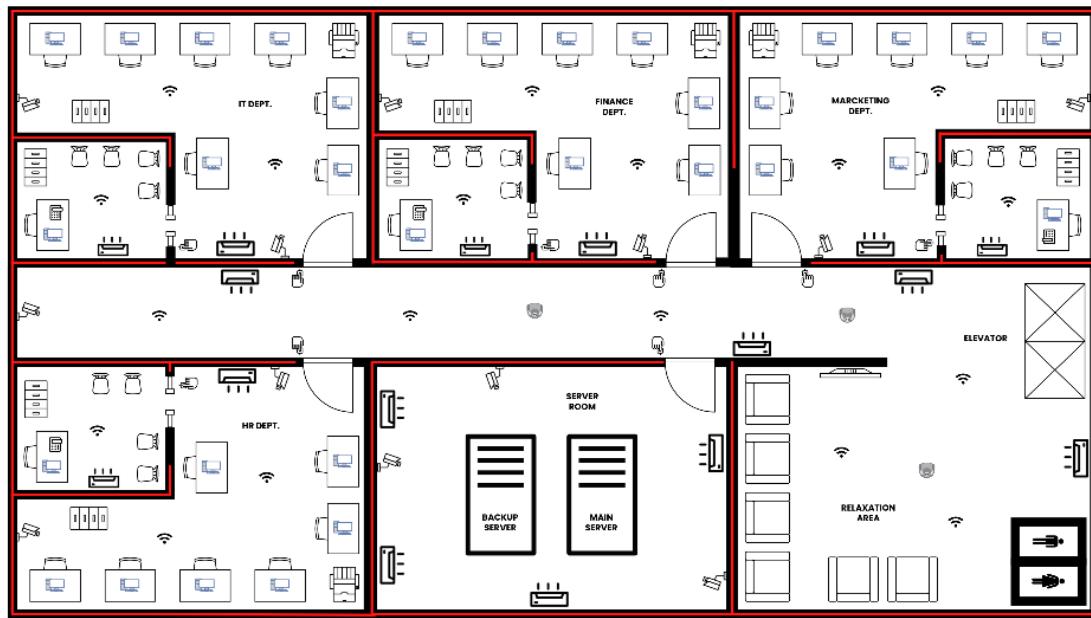
2.6.1 Figure

Frist Floor



2.6.2 Figure

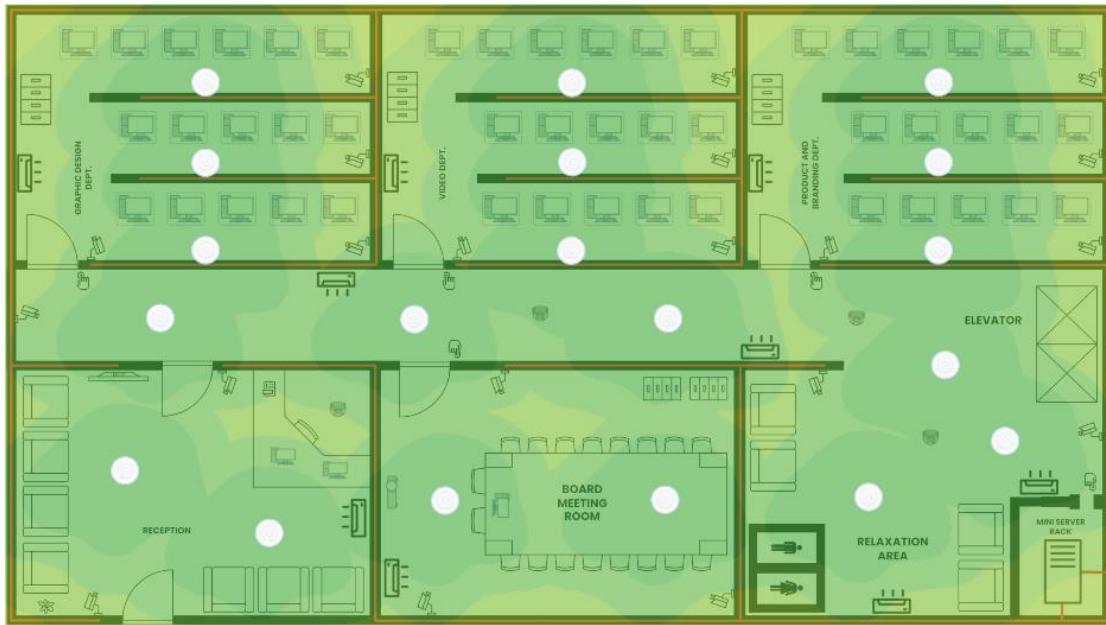
Second Floor



2.6.3 Figure

2.7 Wi-Fi Heat Maps

Ground Floor



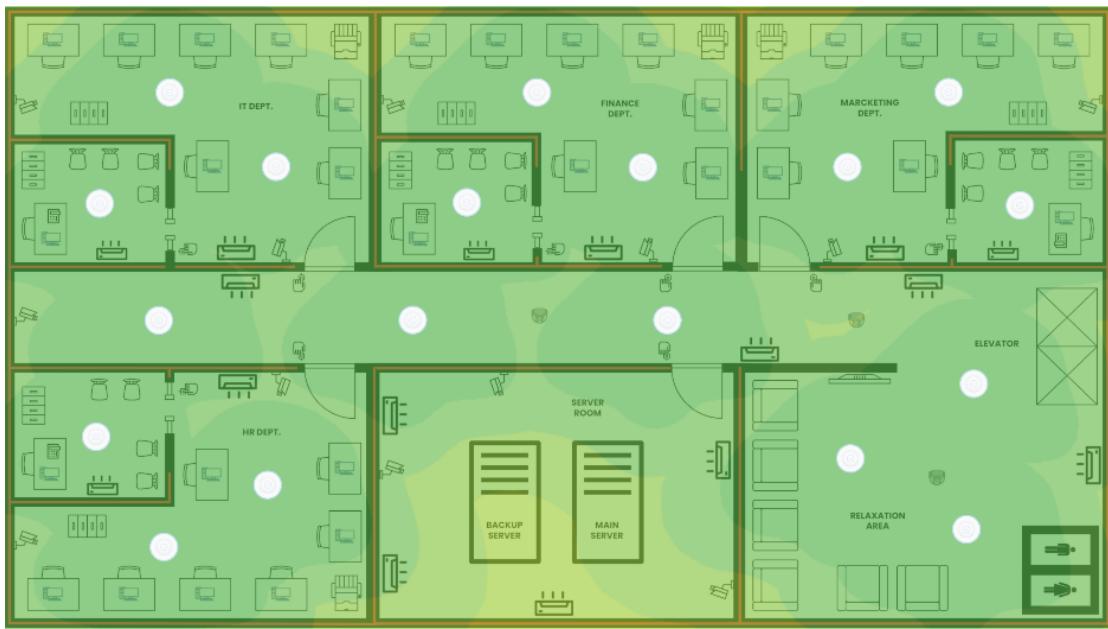
2.7.1 Figure

Frist Floor



2.7.2 Figure

Second Floor



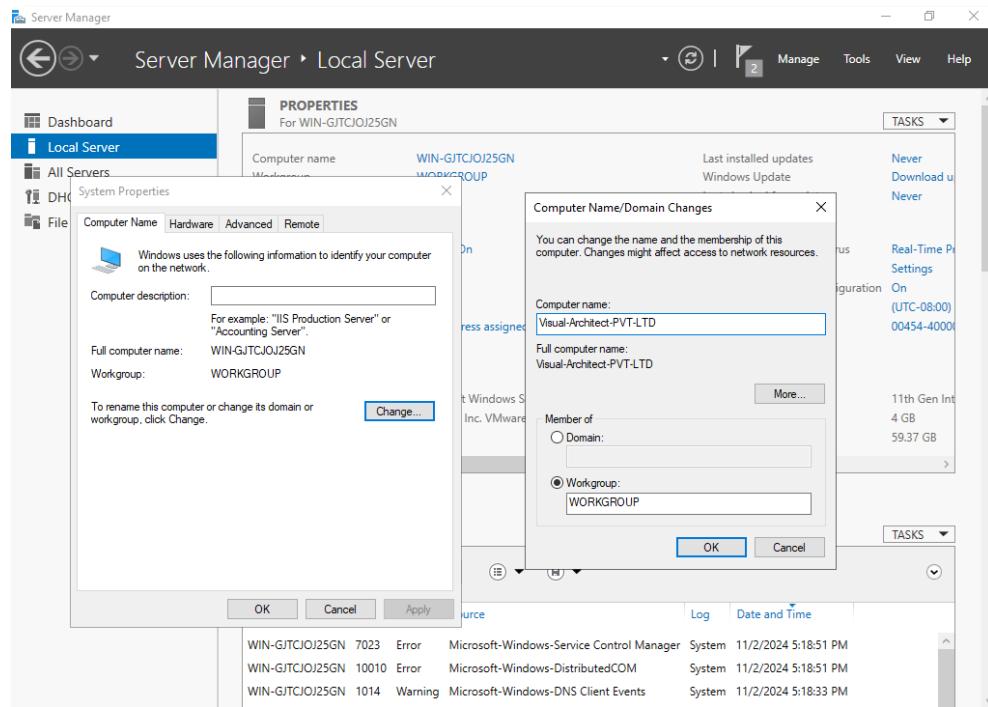
2.7.3 Figure

Chapter 03 - Implementation

3.1 Server Implementation

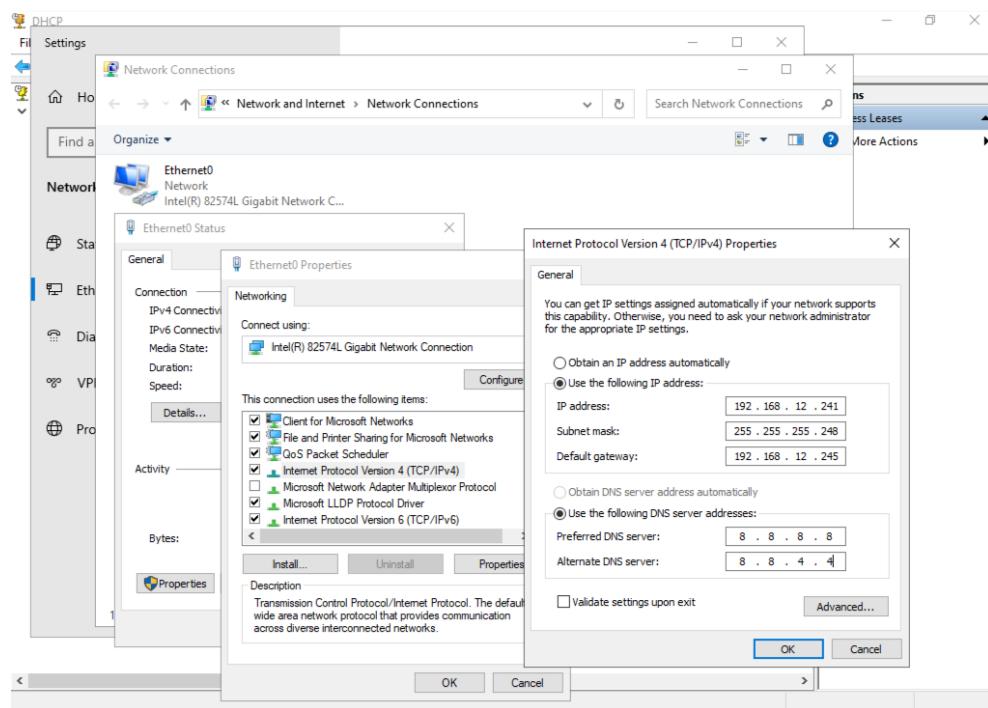
3.1.1 Initial Configuration

Renaming the Server



3.1.1.1 Figure

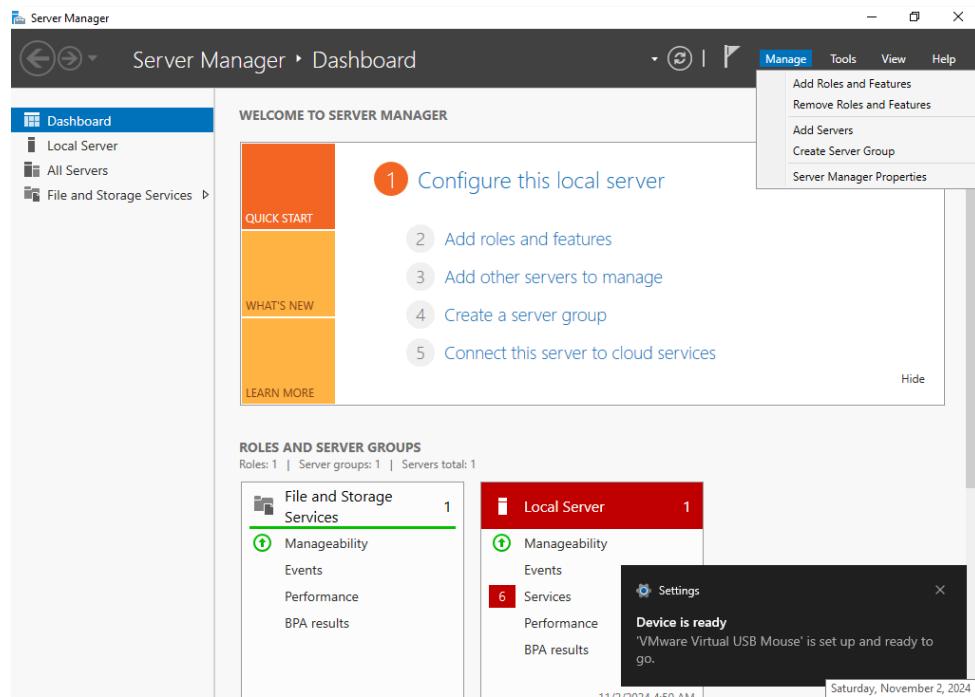
IPv4 Configure to the Server (IP Helper Address)



3.1.1.2 Figure

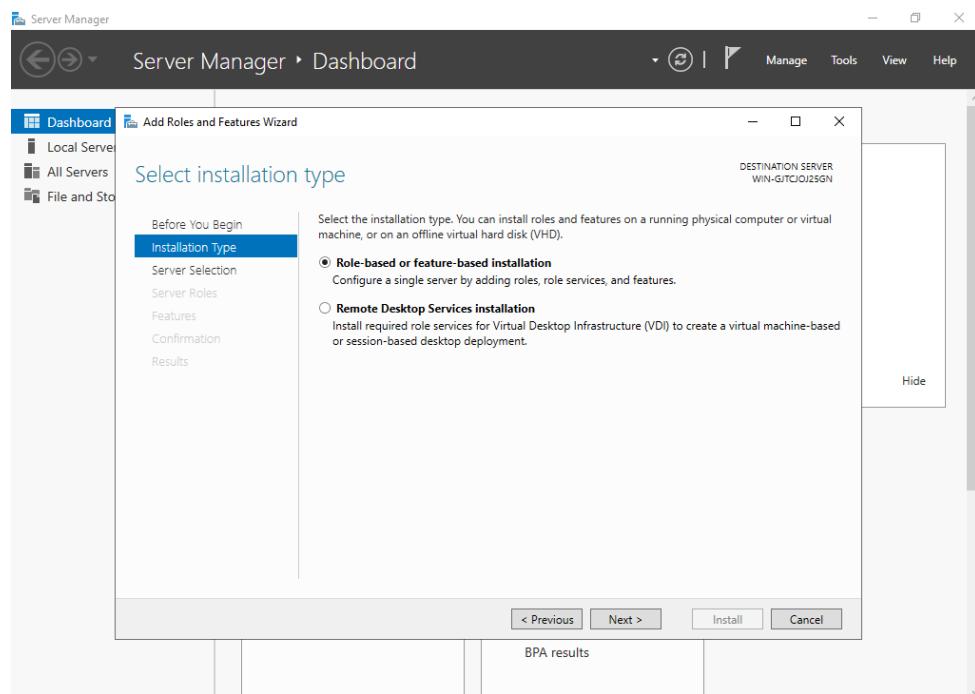
3.1.2 Add Role and Features

Add Role and Features



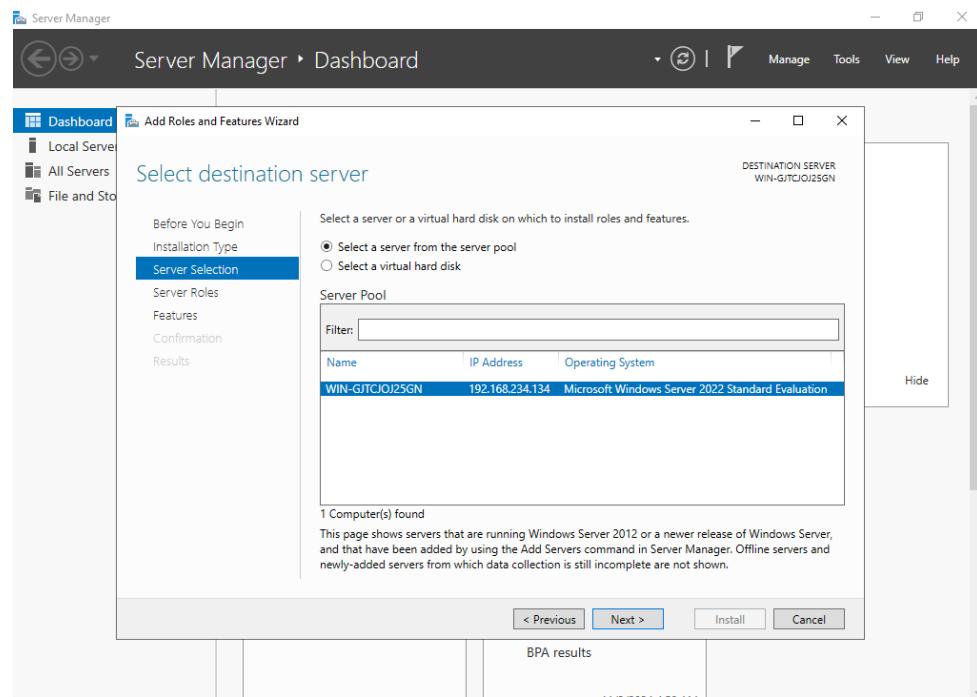
3.1.2.1 Figure

Select Installation Type



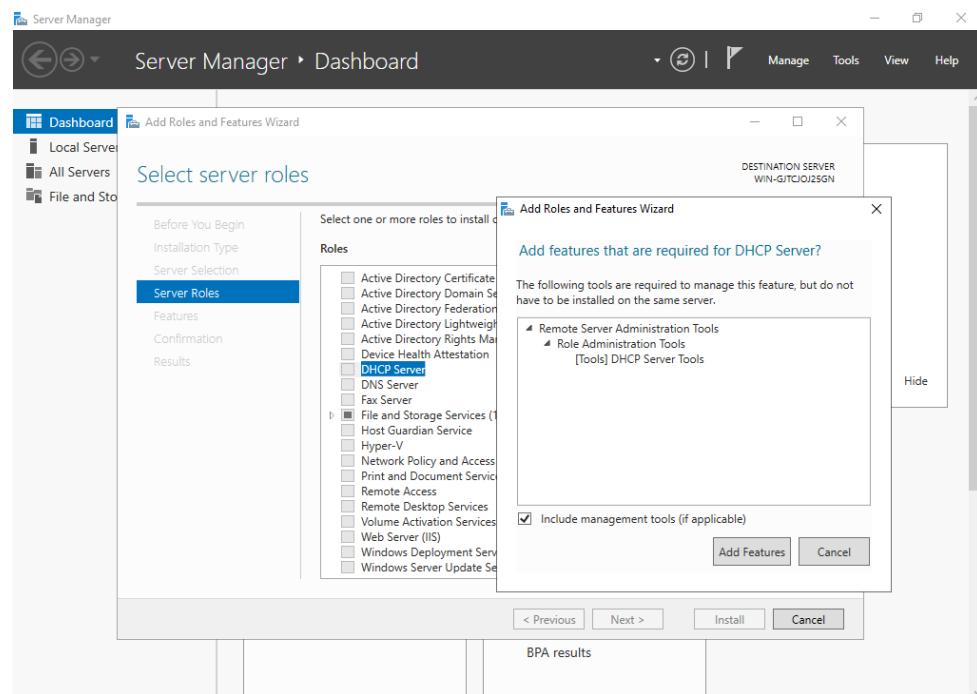
3.1.2.2 Figure

Select Destination Server



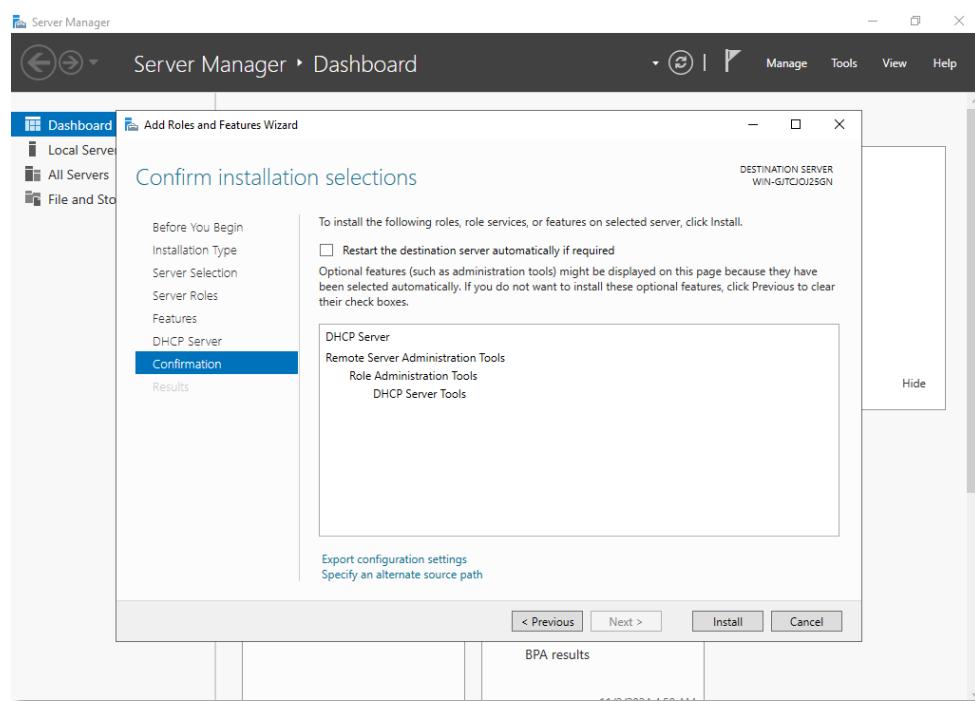
3.1.2.3 Figure

Select Server Roles (DHCP)



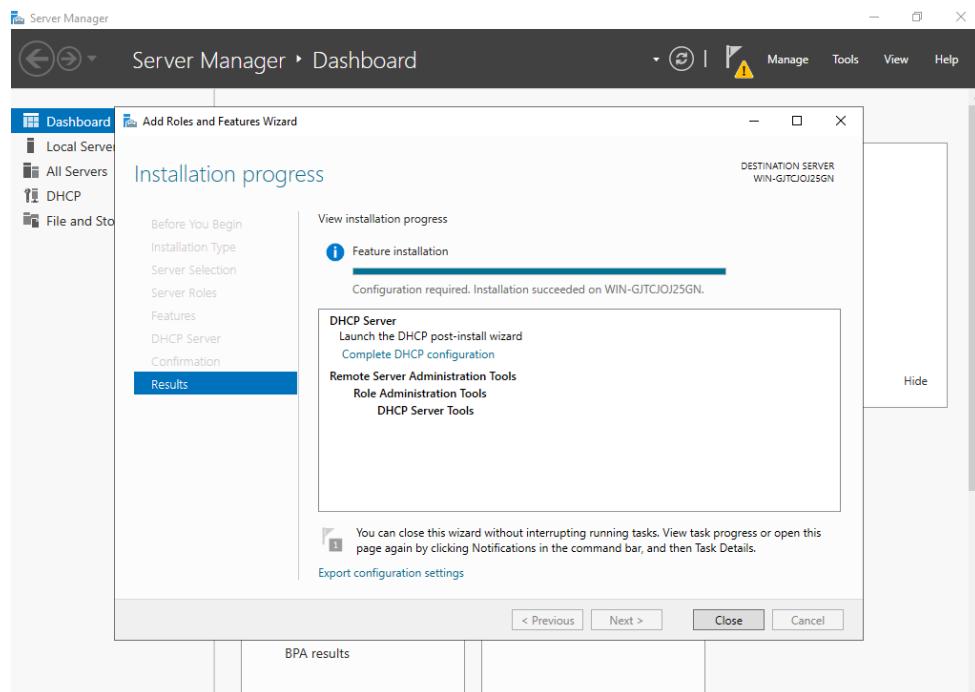
3.1.2.4 Figure

Confirm Installation Selections



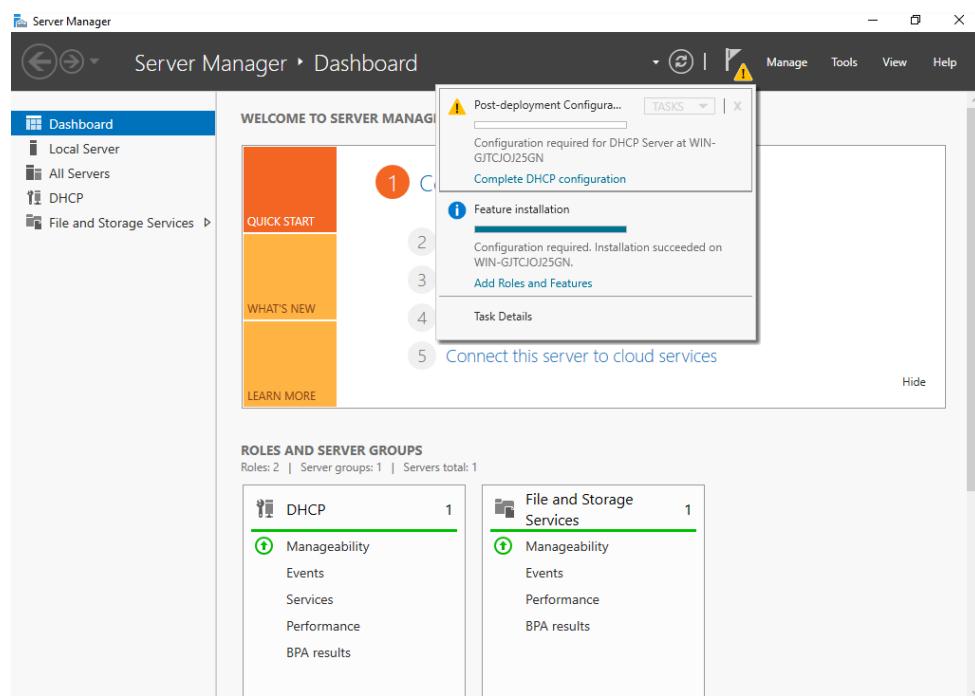
3.1.2.5 Figure

Installation Progress



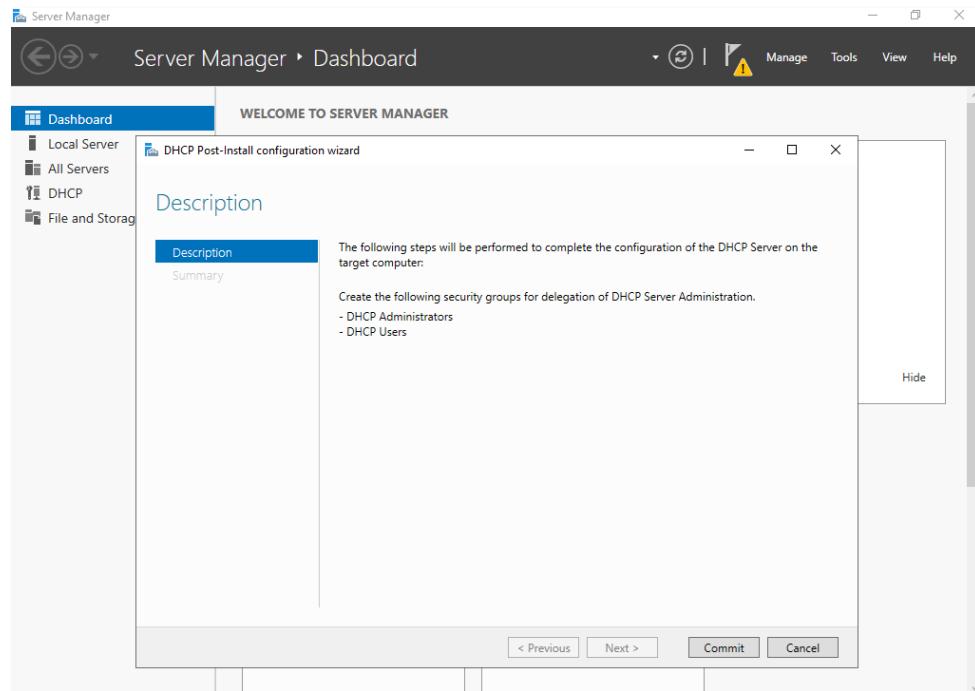
3.1.2.6 Figure

Complete DHCP Configuration



3.1.2.7 Figure

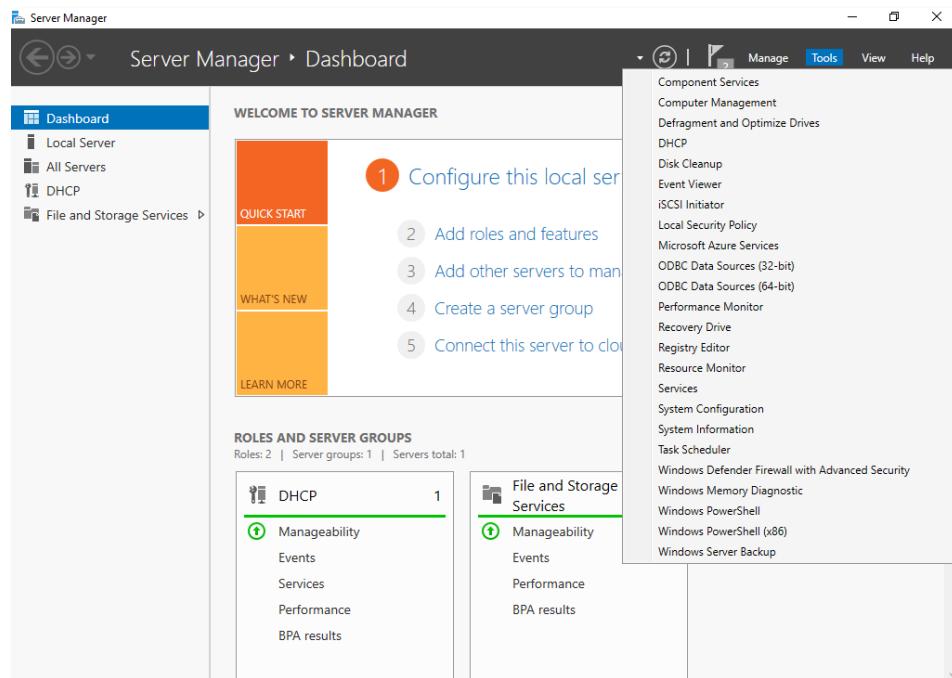
Complete DHCP Configuration by Committing



3.1.2.8 Figure

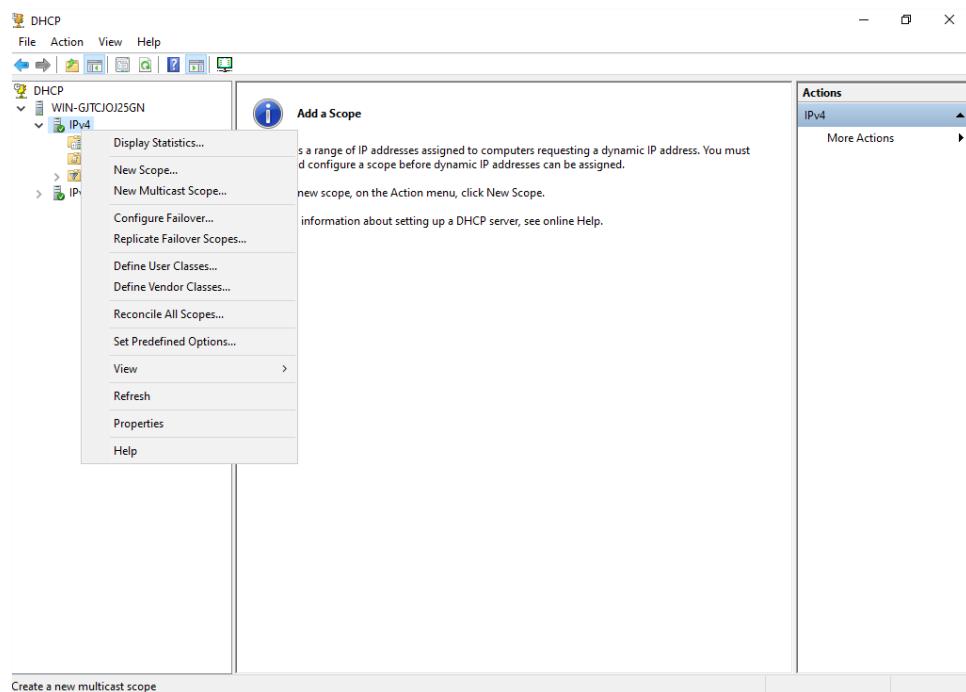
3.1.3 Activating DHCP Feature

Selecting DHCP Service



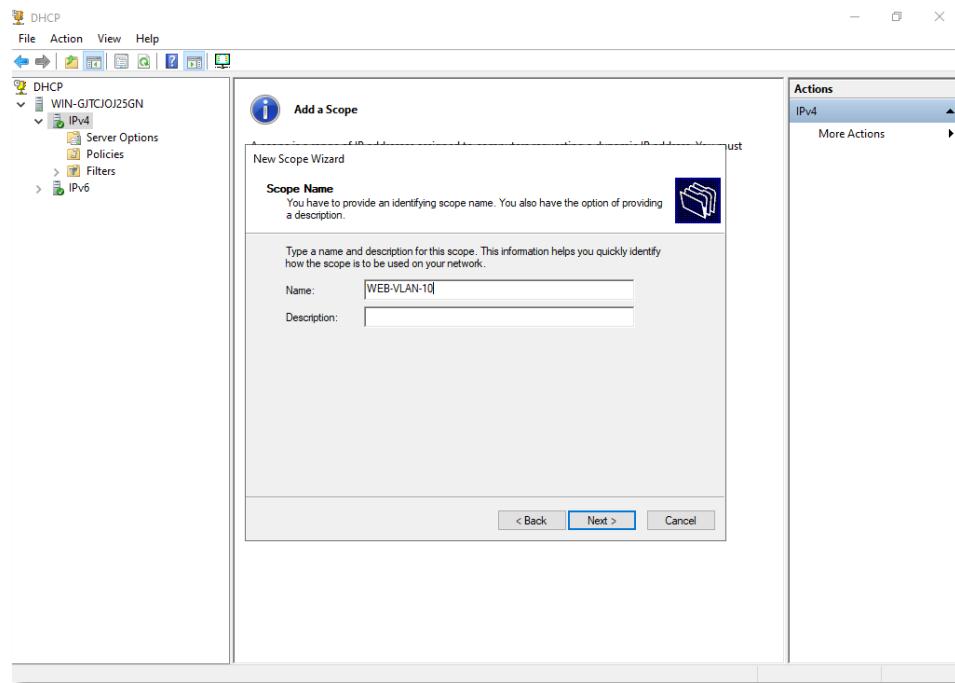
3.1.3.1 Figure

Adding a New Scope



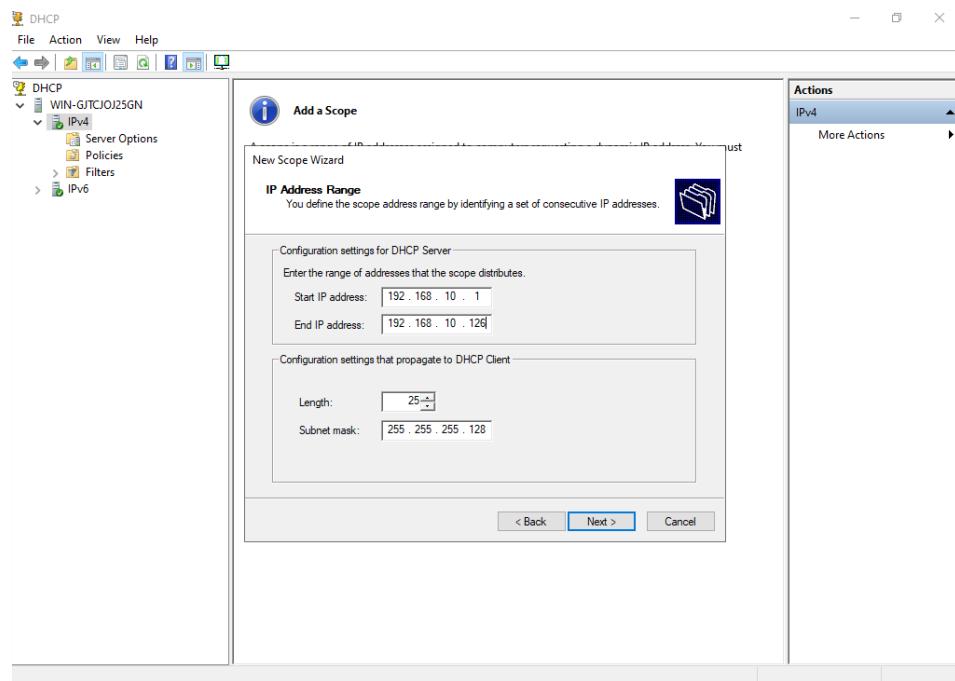
3.1.3.2 Figure

Adding a Scope Name



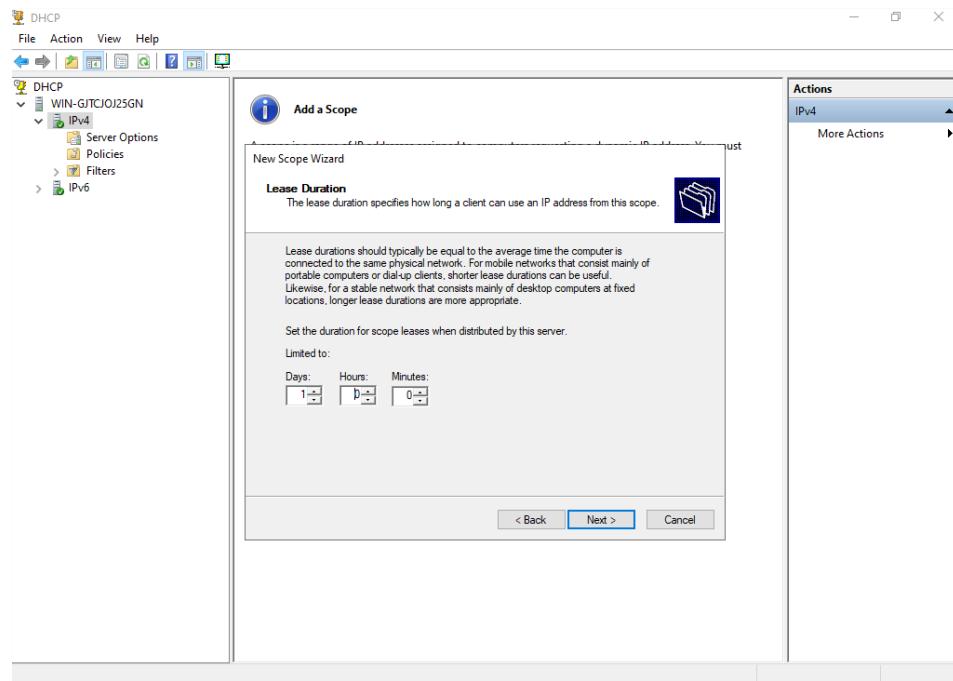
3.1.3.3 Figure

Assigning IP Address Range



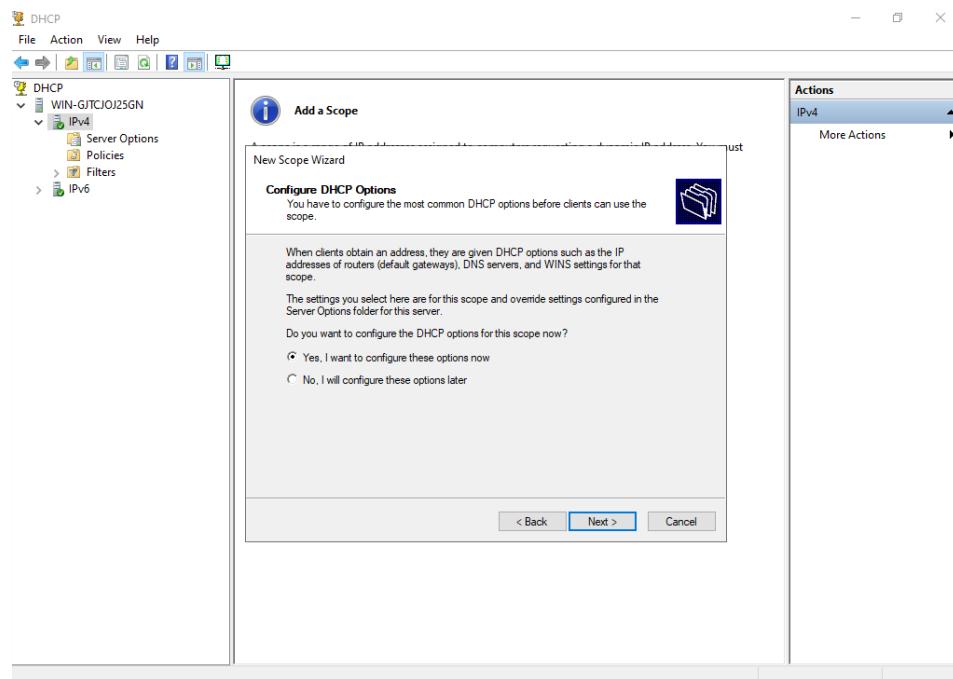
3.1.3.4 Figure

Assigning a Lease Duration



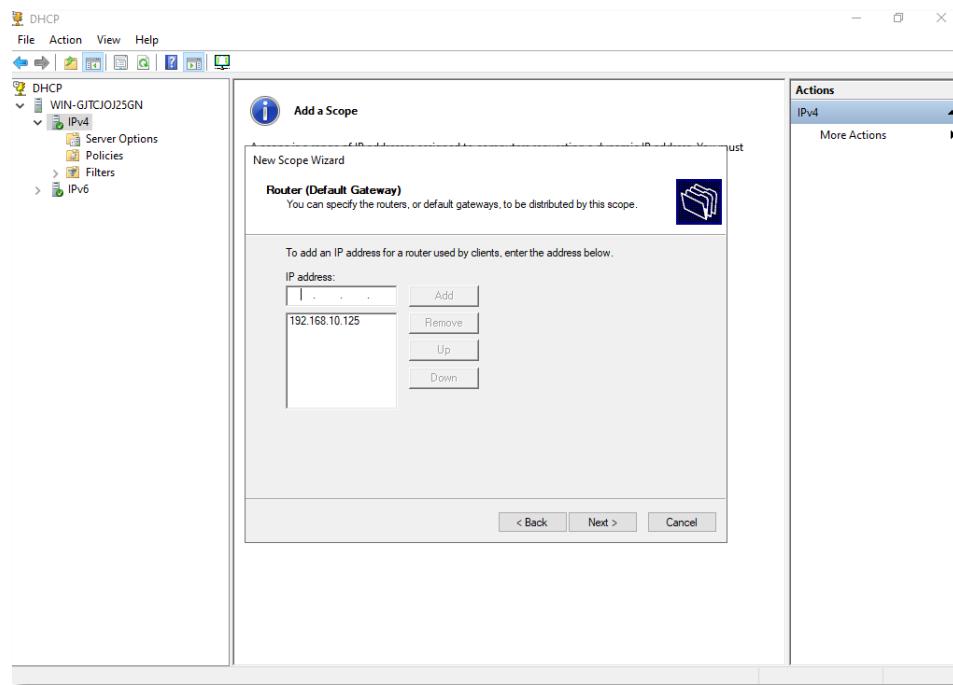
3.1.3.5 Figure

Configuring DHCP Options



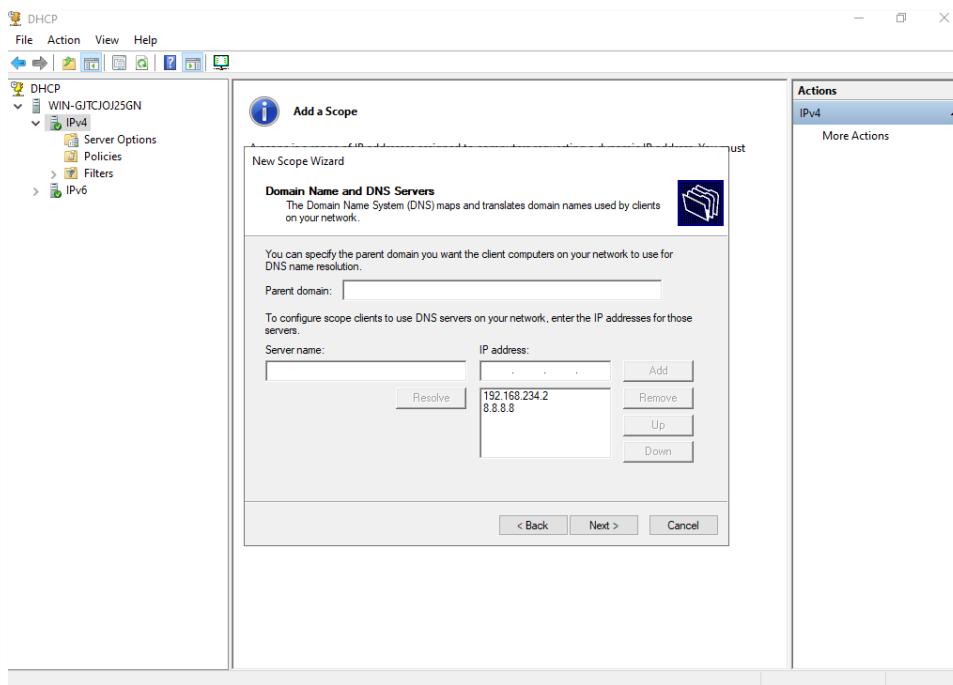
3.1.3.6 Figure

Assigning Default Gateway to the Scope



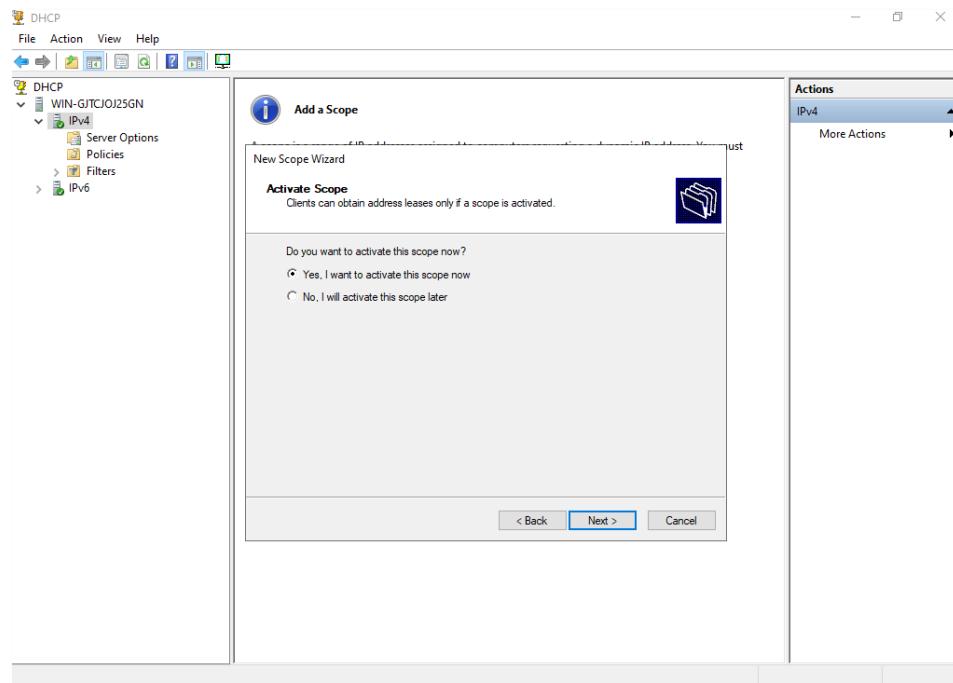
3.1.3.7 Figure

Assigning DNS IPs



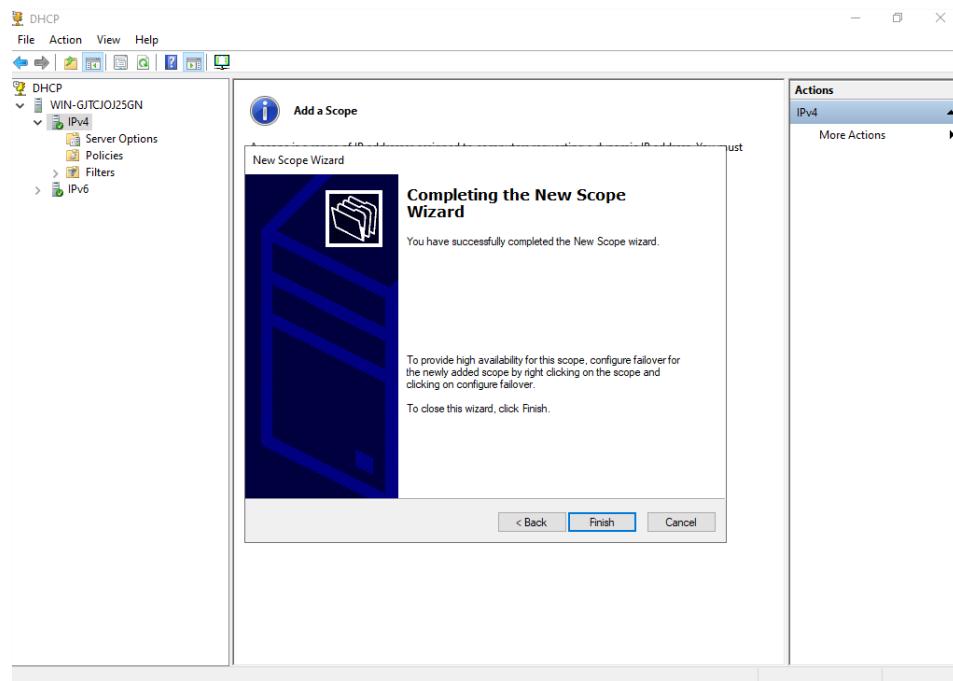
3.1.3.8 Figure

Activating the Scope



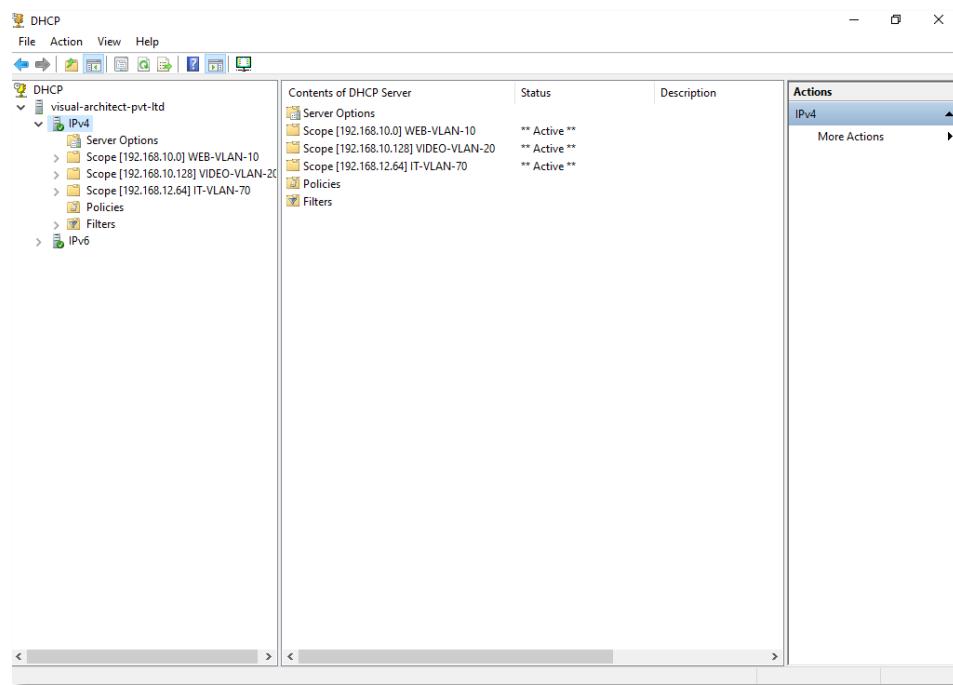
3.1.3.9 Figure

Completing the Scope Configuration



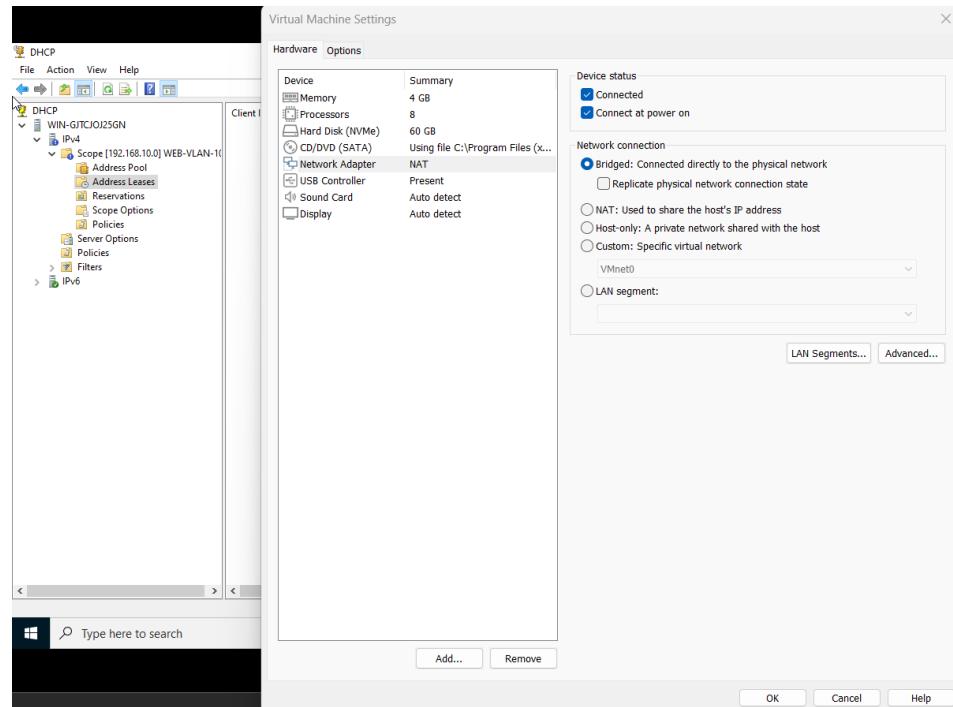
3.1.3.10 Figure

Configured DHCP Scopes



3.1.3.11 Figure

Changing Network Adapter



3.1.3.12 Figure

3.2 Network Devices Implementation

3.2.1 Edge Router Configurations

Initial Configurations (Edge Router)

```
G4-Router(config)#  
G4-Router(config)#  
G4-Router(config)#line console 0  
G4-Router(config-line)#password con123  
G4-Router(config-line)#login  
G4-Router(config-line)#exit  
G4-Router(config)#  
G4-Router(config)#enable secret en123  
G4-Router(config)#  
G4-Router(config)#line vty 0 4  
G4-Router(config-line)#password vty123  
G4-Router(config-line)#login  
G4-Router(config-line)#exit  
G4-Router(config)#  
G4-Router(config)#banner login #Unauthorized Access is Avoided#  
G4-Router(config)#  
G4-Router(config)#
```

3.2.1.1 Figure

Port Configurations (Edge Router)

```
G4-Router(config)#  
G4-Router(config)#  
G4-Router(config)#interface GigabitEthernet0/0  
G4-Router(config-if)#ip address 10.10.10.1 255.255.255.248  
G4-Router(config-if)#no shutdown  
G4-Router(config-if)#
```

3.2.1.2 Figure

```
G4-Router(config-if)#  
G4-Router(config-if)#interface GigabitEthernet0/1  
G4-Router(config-if)#ip add dhcp  
G4-Router(config-if)#no shutdown  
G4-Router(config-if)#  
G4-Router(config-if)#
```

3.2.1.3 Figure

NAT / ACL Configuration (Edge Router)

```
G4-Router(config)#  
G4-Router(config)#  
G4-Router(config)#access-list 1 permit 0.0.0.0 255.255.255.255  
G4-Router(config)#ip nat inside source list 1 interface GigabitEthernet0/1 overload  
G4-Router(config)#  
G4-Router(config)#
```

3.2.1.4 Figure

```
G4-Router(config)#  
G4-Router(config)#  
G4-Router(config)#interface GigabitEthernet0/0  
G4-Router(config-if)#ip nat inside  
G4-Router(config-if)#  
G4-Router(config-if)#
```

3.2.1.5 Figure

```
G4-Router(config)#  
G4-Router(config)#interface GigabitEthernet0/1  
G4-Router(config-if)#ip nat outside  
G4-Router(config-if)#  
G4-Router(config-if)#  
G4-Router(config-if)#
```

3.2.1.6 Figure

Routing Configurations - EIGRP (Edge Router)

```
G4-Router(config-if)#  
G4-Router(config-if)#  
G4-Router(config-if)#router eigrp 5  
G4-Router(config-router)#  
G4-Router(config-router)#network 10.10.10.0 0.0.0.7  
G4-Router(config-router)#  
G4-Router(config-router)#redistribute static  
G4-Router(config-router)#  
G4-Router(config-router)#  
G4-Router(config-router)#exit  
G4-Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.16.254  
G4-Router(config)#  
G4-Router(config)#
```

3.2.1.7 Figure

SSH Configuration (Edge Router)

```
G4-Router(config)#  
G4-Router(config)#username nibm password nibml23  
G4-Router(config)#username admin privilege 15 secret adminl23  
G4-Router(config)#service password-encryption  
G4-Router(config)#ip ssh version 2  
Please create RSA keys to enable SSH (and of atleast 768 bits for SSH v2).  
G4-Router(config)#ip domain-name mydomain.com  
G4-Router(config)#crypto key generate rsa  
The name for the keys will be: G4-Router.mydomain.com  
Choose the size of the key modulus in the range of 360 to 4096 for your  
General Purpose Keys. Choosing a key modulus greater than 512 may take  
a few minutes.  
  
How many bits in the modulus [512]: 1024  
% Generating 1024 bit RSA keys, keys will be non-exportable...  
[OK] (elapsed time was 3 seconds)  
  
G4-Router(config)#  
*Oct 25 22:48:06.903: %SSH-5-ENABLED: SSH 2.0 has been enabled  
G4-Router(config)#  
G4-Router(config)#line vty 0 15  
G4-Router(config-line)#exec-timeout 15  
G4-Router(config-line)#login local  
G4-Router(config-line)#transport input ssh  
G4-Router(config-line)#  
G4-Router(config-line)#[
```

3.2.1.8 Figure

Save the Configurations (Edge Router)

```
G4-Router#  
G4-Router#  
G4-Router#copy runn  
G4-Router#copy running-config st  
G4-Router#copy running-config startup-config  
Destination filename [startup-config]?  
Building configuration...  
[OK]  
G4-Router#  
G4-Router#
```

3.2.1.9 Figure

3.2.2 Multi-Layer Primary Switch Configurations

Initial Configurations (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#hostname G4-L3-Main
G4-L3-Main(config)#
G4-L3-Main(config)#line console 0
G4-L3-Main(config-line)#password con123
G4-L3-Main(config-line)#login
G4-L3-Main(config-line)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#enable secret en123
G4-L3-Main(config)#
G4-L3-Main(config)#line vty 0 4
G4-L3-Main(config-line)#password vty123
G4-L3-Main(config-line)#login
G4-L3-Main(config-line)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#banner login #Unauthorized Access is Avoided#
G4-L3-Main(config)#

```

3.2.2.1 Figure

VTP Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#vtp d
G4-L3-Main(config)#vtp domain visual
Changing VTP domain name from NULL to visual
G4-L3-Main(config)#
G4-L3-Main(config)#vtp mode ser
G4-L3-Main(config)#vtp mode server
Device mode already VTP SERVER.
G4-L3-Main(config)#
G4-L3-Main(config)#

```

3.2.2.2 Figure

Creating VLANs Configurations (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#vlan 10
G4-L3-Main(config-vlan)#name WEB_dept
G4-L3-Main(config-vlan)#vlan 20
G4-L3-Main(config-vlan)#name VIDEO_dept
G4-L3-Main(config-vlan)#vlan 30
G4-L3-Main(config-vlan)#name ARCHITECTURE_dept
G4-L3-Main(config-vlan)#vlan 40
G4-L3-Main(config-vlan)#name PRODUCT_dept
G4-L3-Main(config-vlan)#vlan 50
G4-L3-Main(config-vlan)#name GRAPHIC_dept
G4-L3-Main(config-vlan)#vlan 60
G4-L3-Main(config-vlan)#name HR_dept
G4-L3-Main(config-vlan)#vlan 120
G4-L3-Main(config-vlan)#name Servers
G4-L3-Main(config-vlan)#

```

3.2.2.3 Figure

Creating VLAN interfaces and HSRP Configurations (L3-Primary)

```

G4-L3-Main(config)# 
G4-L3-Main(config)#interface Vlan10
G4-L3-Main(config-if)#description ##Web##
G4-L3-Main(config-if)#ip address 192.168.10.124 255.255.255.128
G4-L3-Main(config-if)#standby 1 ip 192.168.10.125
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan20
G4-L3-Main(config-if)#description ##Video##
G4-L3-Main(config-if)#ip address 192.168.10.252 255.255.255.128
G4-L3-Main(config-if)#standby 1 ip 192.168.10.253
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan30
G4-L3-Main(config-if)#description ##Architecture##
G4-L3-Main(config-if)#ip address 192.168.11.124 255.255.255.128
G4-L3-Main(config-if)#standby 1 ip 192.168.11.125
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan40
G4-L3-Main(config-if)#description ##Product##
G4-L3-Main(config-if)#ip address 192.168.11.188 255.255.255.192
G4-L3-Main(config-if)#standby 1 ip 192.168.11.189
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan50
G4-L3-Main(config-if)#description ##Graphic##
G4-L3-Main(config-if)#ip address 192.168.11.252 255.255.255.192
G4-L3-Main(config-if)#standby 1 ip 192.168.11.253
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan60
G4-L3-Main(config-if)#description ##HR##
G4-L3-Main(config-if)#ip address 192.168.12.60 255.255.255.192
G4-L3-Main(config-if)#standby 1 ip 192.168.12.61
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface Vlan120
G4-L3-Main(config-if)#description ##Servers##
G4-L3-Main(config-if)#ip address 192.168.12.244 255.255.255.248
G4-L3-Main(config-if)#standby 1 ip 192.168.12.245
G4-L3-Main(config-if)#standby 1 priority 109
G4-L3-Main(config-if)#standby 1 preempt
G4-L3-Main(config-if)#ip helper-address 192.168.12.241
G4-L3-Main(config-if)#no shut
G4-L3-Main(config-if)#

```

3.2.2.4 Figure

STP Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#spanning-tree vlan 10 root primary
G4-L3-Main(config)#spanning-tree vlan 20 root primary
G4-L3-Main(config)#spanning-tree vlan 30 root primary
G4-L3-Main(config)#spanning-tree vlan 40 root primary
G4-L3-Main(config)#spanning-tree vlan 50 root primary
G4-L3-Main(config)#spanning-tree vlan 60 root primary
G4-L3-Main(config)#spanning-tree vlan 120 root primary
G4-L3-Main(config)#

```

3.2.2.5 Figure

Trunk Ports Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#interface GigabitEthernet1/0/1
G4-L3-Main(config-if)#switchport mode trunk

G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface GigabitEthernet1/0/5
G4-L3-Main(config-if)#switchport mode trunk

G4-L3-Main(config-if)#

```

3.2.2.6 Figure

Ether-Channel Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#int range gigabitEthernet 1/0/6-7
G4-L3-Main(config-if-range)#switchport mode trunk

G4-L3-Main(config-if-range)#channel-group 1 mode desirable
G4-L3-Main(config-if-range)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#port-channel load-balance dst-mac
G4-L3-Main(config)#

```

3.2.2.7 Figure

Interface Configuration for Access Layer (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#interface gigabitEthernet 1/0/24
G4-L3-Main(config-if)#no switchport
G4-L3-Main(config-if)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#interface gigabitEthernet 1/0/24
G4-L3-Main(config-if)#ip address 10.10.10.4 255.255.255.248
G4-L3-Main(config-if)#no shutdown
G4-L3-Main(config-if)#exit
G4-L3-Main(config)#

```

3.2.2.8 Figure

Routing Configuration - EIGRP (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#ip routing
G4-L3-Main(config)#
G4-L3-Main(config)#router eigrp 5
G4-L3-Main(config-router)#
G4-L3-Main(config-router)#network 192.168.10.0 0.0.0.127
G4-L3-Main(config-router)#network 192.168.10.128 0.0.0.127
G4-L3-Main(config-router)#network 192.168.11.0 0.0.0.127
G4-L3-Main(config-router)#network 192.168.11.128 0.0.0.63
G4-L3-Main(config-router)#network 192.168.11.192 0.0.0.63
G4-L3-Main(config-router)#network 192.168.12.0 0.0.0.63
G4-L3-Main(config-router)#network 192.168.12.240 0.0.0.7
G4-L3-Main(config-router)#network 10.10.10.0 0.0.0.7
G4-L3-Main(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 5: Neighbor 10.10.10.1 (GigabitEthernet1/0/24) is up: new adjacency

G4-L3-Main(config-router)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#ip route 0.0.0.0 0.0.0.0 10.10.10.1
G4-L3-Main(config)#
G4-L3-Main(config)#

```

3.2.2.9 Figure

ACL Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#access-list 150 remark can not access vlan30 to vlan40
G4-L3-Main(config)#access-list 150 deny tcp 192.168.11.0 0.0.0.127 192.168.11.128 0.0.0.63
G4-L3-Main(config)#access-list 150 permit tcp any any
G4-L3-Main(config)#
G4-L3-Main(config)#access-list 160 remark can not access vlan40 to vlan50
G4-L3-Main(config)#access-list 160 deny tcp 192.168.11.128 0.0.0.63 192.168.11.192 0.0.0.63
G4-L3-Main(config)#access-list 160 permit tcp any any
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#interface gigabitEthernet1/0/1
G4-L3-Main(config-if)#ip access-group 150 in
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#interface gigabitEthernet1/0/5
G4-L3-Main(config-if)#ip access-group 160 out
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#
G4-L3-Main(config-if)#exit
G4-L3-Main(config)#
G4-L3-Main(config)#

```

3.2.2.10 Figure

SSH Configuration (L3-Primary)

```
G4-L3-Main(config)#
G4-L3-Main(config)#
G4-L3-Main(config)#username admin privilege 15 secret admin123
G4-L3-Main(config)#service password-encryption
G4-L3-Main(config)#ip ssh version 2
Please create RSA keys (of at least 768 bits size) to enable SSH v2.
G4-L3-Main(config)#
G4-L3-Main(config)#ip domain-name visual.lk
G4-L3-Main(config)#crypto key generate rsa
The name for the keys will be: G4-L3-Main.visual.lk
Choose the size of the key modulus in the range of 360 to 4096 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

G4-L3-Main(config)#
*Mar 2 1:8:37.986: %SSH-5-ENABLED: SSH 2 has been enabled
G4-L3-Main(config)#line vty 0 15
G4-L3-Main(config-line)#exec-timeout 15
G4-L3-Main(config-line)#login local
G4-L3-Main(config-line)#transport input ssh
G4-L3-Main(config-line)#

```

3.2.2.11 Figure

Save the Configurations (L3-Primary)

```
G4-L3-Main#  
G4-L3-Main#  
G4-L3-Main#copy ru  
G4-L3-Main#copy running-config s  
G4-L3-Main#copy running-config st  
G4-L3-Main#copy running-config startup-config  
Destination filename [startup-config]?  
Building configuration...  
[OK]  
G4-L3-Main#  
G4-L3-Main#
```

3.2.2.12 Figure

3.2.3 Multi-Layer Backup Switch Configurations

Initial Configurations (L3-Backup)

```

Switch(config)#
Switch(config)#
Switch(config)#hostname G4-L3-BKP
G4-L3-BKP(config)#
G4-L3-BKP(config)#line console 0
G4-L3-BKP(config-line)#password con123
G4-L3-BKP(config-line)#login
G4-L3-BKP(config-line)#
G4-L3-BKP(config-line)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#enable secret en123
G4-L3-BKP(config)#
G4-L3-BKP(config)#line vty 0 4
G4-L3-BKP(config-line)#password vty123
G4-L3-BKP(config-line)#login
G4-L3-BKP(config-line)#
G4-L3-BKP(config-line)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#banner login #Unauthorized Access is Avoided#
G4-L3-BKP(config)#
G4-L3-BKP(config)#

```

3.2.3.1 Figure

VTP Configuration (L3-Backup)

```

G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#vtp domain visual
Domain name already set to visual.
G4-L3-BKP(config)#vtp mode client
Setting device to VTP CLIENT mode.
G4-L3-BKP(config)#

```

3.2.3.2 Figure

Creating VLANs Configurations (L3-Backup)

```

G4-L3-BKP(config)#
G4-L3-BKP(config)#vlan 10
G4-L3-BKP(config-vlan)#name WEB_dept
G4-L3-BKP(config-vlan)#vlan 20
G4-L3-BKP(config-vlan)#name VIDEO_dept
G4-L3-BKP(config-vlan)#vlan 30
G4-L3-BKP(config-vlan)#name ARCHITECTURE_dept
G4-L3-BKP(config-vlan)#vlan 40
G4-L3-BKP(config-vlan)#name PRODUCT_dept
G4-L3-BKP(config-vlan)#vlan 50
G4-L3-BKP(config-vlan)#name GRAPHIC_dept
G4-L3-BKP(config-vlan)#vlan 60
G4-L3-BKP(config-vlan)#name HR_dept
G4-L3-BKP(config-vlan)#vlan 120
G4-L3-BKP(config-vlan)#name Servers
G4-L3-BKP(config-vlan)#

```

3.2.3.3 Figure

Creating VLAN interfaces and HSRP Configurations (L3-Backup)

```

G4-L3-BKP(config)#
G4-L3-BKP(config)#interface Vlan10
G4-L3-BKP(config-if)#description ##Web##
G4-L3-BKP(config-if)#ip address 192.168.10.126 255.255.255.128
G4-L3-BKP(config-if)#standby 1 ip 192.168.10.125
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan20
G4-L3-BKP(config-if)#description ##Video##
G4-L3-BKP(config-if)#ip address 192.168.10.254 255.255.255.128
G4-L3-BKP(config-if)#standby 1 ip 192.168.10.253
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan30
G4-L3-BKP(config-if)#description ##Architecture##
G4-L3-BKP(config-if)#ip address 192.168.11.126 255.255.255.128
G4-L3-BKP(config-if)#standby 1 ip 192.168.11.125
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan40
G4-L3-BKP(config-if)#description ##Product##
G4-L3-BKP(config-if)#ip address 192.168.11.190 255.255.255.192
G4-L3-BKP(config-if)#standby 1 ip 192.168.11.189
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan50
G4-L3-BKP(config-if)#description ##Graphic##
G4-L3-BKP(config-if)#ip address 192.168.11.254 255.255.255.192
G4-L3-BKP(config-if)#standby 1 ip 192.168.11.253
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan60
G4-L3-BKP(config-if)#description ##HR##
G4-L3-BKP(config-if)#ip address 192.168.12.62 255.255.255.192
G4-L3-BKP(config-if)#standby 1 ip 192.168.12.61
G4-L3-BKP(config-if)#standby 1 priority 100
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface Vlan120
G4-L3-BKP(config-if)#description ##Servers##
G4-L3-BKP(config-if)#ip address 192.168.12.246 255.255.255.248
G4-L3-BKP(config-if)#standby 1 ip 192.168.12.245
G4-L3-BKP(config-if)#standby 1 preempt
G4-L3-BKP(config-if)#ip helper-address 192.168.12.241
G4-L3-BKP(config-if)#no shut
G4-L3-BKP(config-if)#

```

3.2.3.4 Figure

STP Configuration (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#spanning-tree vlan 10 root secondary
G4-L3-BKP(config)#spanning-tree vlan 20 root secondary
G4-L3-BKP(config)#spanning-tree vlan 30 root secondary
G4-L3-BKP(config)#spanning-tree vlan 40 root secondary
G4-L3-BKP(config)#spanning-tree vlan 50 root secondary
G4-L3-BKP(config)#spanning-tree vlan 60 root secondary
G4-L3-BKP(config)#spanning-tree vlan 120 root secondary
G4-L3-BKP(config)#
G4-L3-BKP(config)#
```

3.2.3.5 Figure

Trunk Ports Configuration (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#interface GigabitEthernet1/0/1
G4-L3-BKP(config-if)#switchport mode trunk

G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface GigabitEthernet1/0/5
G4-L3-BKP(config-if)#switchport mode trunk

G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#
```

3.2.3.6 Figure

Ether-Channel Configuration (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#int range gigabitEthernet 1/0/6-7
G4-L3-BKP(config-if-range)#switchport mode trunk
G4-L3-BKP(config-if-range)#channel-group 1 mode desirable
G4-L3-BKP(config-if-range)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#port-channel load-balance dst-mac
G4-L3-BKP(config)#
G4-L3-BKP(config)#
```

3.2.3.7 Figure

Interface Configuration for Access Layer (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#interface gigabitEthernet 1/0/24
G4-L3-BKP(config-if)#no switchport
G4-L3-BKP(config-if)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#interface gigabitEthernet 1/0/24
G4-L3-BKP(config-if)#ip address 10.10.10.6 255.255.255.248
G4-L3-BKP(config-if)#no shutdown
G4-L3-BKP(config-if)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#
```

3.2.3.8 Figure

Routing Configuration - EIGRP (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#ip routing
G4-L3-BKP(config)#
G4-L3-BKP(config)#router eigrp 5
G4-L3-BKP(config-router)#
G4-L3-BKP(config-router)#network 192.168.10.0 0.0.0.127
G4-L3-BKP(config-router)#network 192.168.10.128 0.0.0.127
G4-L3-BKP(config-router)#network 192.168.11.0 0.0.0.127
G4-L3-BKP(config-router)#network 192.168.11.128 0.0.0.63
G4-L3-BKP(config-router)#network 192.168.11.192 0.0.0.63
G4-L3-BKP(config-router)#network 192.168.12.0 0.0.0.63
G4-L3-BKP(config-router)#network 192.168.12.240 0.0.0.7
G4-L3-BKP(config-router)#network 10.10.10.0 0.0.0.7
G4-L3-BKP(config-router)#
G4-L3-BKP(config-router)#ip route 0.0.0.0 0.0.0.0 10.10.10.1
G4-L3-BKP(config)#
G4-L3-BKP(config)#
```

3.2.3.9 Figure

ACL Configuration (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#access-list 150 remark can not access vlan30 to vlan40
G4-L3-BKP(config)#access-list 150 deny tcp 192.168.11.0 0.0.0.127 192.168.11.128 0.0.0.63
G4-L3-BKP(config)#access-list 150 permit tcp any any
G4-L3-BKP(config)#
G4-L3-BKP(config)#access-list 160 remark can not access vlan40 to vlan50
G4-L3-BKP(config)#access-list 160 deny tcp 192.168.11.128 0.0.0.63 192.168.11.192 0.0.0.63
G4-L3-BKP(config)#access-list 160 permit tcp any any
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#interface gigabitEthernet1/0/1
G4-L3-BKP(config-if)#ip access-group 150 in
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#interface gigabitEthernet1/0/5
G4-L3-BKP(config-if)#ip access-group 160 out
G4-L3-BKP(config-if)#
G4-L3-BKP(config-if)#exit
G4-L3-BKP(config)#
G4-L3-BKP(config)#
```

3.2.3.10 Figure

SSH Configuration (L3-Backup)

```
G4-L3-BKP(config)#
G4-L3-BKP(config)#
G4-L3-BKP(config)#username admin privilege 15 secret admin123
G4-L3-BKP(config)#service password-encryption
G4-L3-BKP(config)#ip ssh version 2
Please create RSA keys (of at least 768 bits size) to enable SSH v2.
G4-L3-BKP(config)#
G4-L3-BKP(config)#ip domain-name visual.lk
G4-L3-BKP(config)#crypto key generate rsa
The name for the keys will be: G4-L3-BKP.visual.lk
Choose the size of the key modulus in the range of 360 to 4096 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

G4-L3-BKP(config)#
G4-L3-BKP(config)#line vty 0 15
G4-L3-BKP(config-line)#exec-timeout 15
G4-L3-BKP(config-line)#login local
G4-L3-BKP(config-line)#transport input ssh
G4-L3-BKP(config-line)#+
```

3.2.3.11 Figure

Save the Configurations (L3-Backup)

```
G4-L3-BKP#  
G4-L3-BKP#  
G4-L3-BKP#copy run  
G4-L3-BKP#copy running-config st  
G4-L3-BKP#copy running-config startup-config  
Destination filename [startup-config]?  
Building configuration...  
[OK]  
G4-L3-BKP#  
G4-L3-BKP#
```

3.2.3.12 Figure

3.2.4 Layer 2 Switch-01 Configurations

- Ground floor, First floor and Second floor switches configurations All are same.

Initial Configurations (L2-01)

```

switch(config)#
switch(config)#
switch(config)#hostname G4-L2-01
G4-L2-01(config)#
G4-L2-01(config)#line console 0
G4-L2-01(config-line)#password con123
G4-L2-01(config-line)#login
G4-L2-01(config-line)#
G4-L2-01(config-line)#exit
G4-L2-01(config)#
G4-L2-01(config)#enable secret en123
G4-L2-01(config)#
G4-L2-01(config)#line vty 0 4
G4-L2-01(config-line)#password vty123
G4-L2-01(config-line)#login
G4-L2-01(config-line)#
G4-L2-01(config-line)#exit
G4-L2-01(config)#
G4-L2-01(config)#banner motd #Unauthorized Access is Avoided#
G4-L2-01(config)#
G4-L2-01(config)#

```

3.2.4.1 Figure

Creating VLANs Configuration (L2-01)

```

G4-L2-01(config)#
G4-L2-01(config)#
G4-L2-01(config)#vlan 10
G4-L2-01(config-vlan)#name WEB_dept
G4-L2-01(config-vlan)#vlan 20
G4-L2-01(config-vlan)#name VIDEO_dept
G4-L2-01(config-vlan)#vlan 30
G4-L2-01(config-vlan)#name ARCHITECTURE_dept
G4-L2-01(config-vlan)#vlan 40
G4-L2-01(config-vlan)#name PRODUCT_dept
G4-L2-01(config-vlan)#vlan 50
G4-L2-01(config-vlan)#name GRAPHIC_dept
G4-L2-01(config-vlan)#vlan 60
G4-L2-01(config-vlan)#name HR_dept
G4-L2-01(config-vlan)#vlan 120
G4-L2-01(config-vlan)#name Servers
G4-L2-01(config-vlan)#
G4-L2-01(config-vlan)#

```

3.2.4.2 Figure

Ports Trunk Configuration (L2-01)

```

G4-L2-01(config)#
G4-L2-01(config)#
G4-L2-01(config)#interface GigabitEthernet0/1
G4-L2-01(config-if)#switchport mode trunk
G4-L2-01(config-if)#
G4-L2-01(config-if)#interface GigabitEthernet0/2
G4-L2-01(config-if)#switchport mode trunk
G4-L2-01(config-if)#
G4-L2-01(config-if)#

```

3.2.4.3 Figure

Dividing Access Ports Configuration (L2-01)

3.2.4.4 Figure

VTP Configuration (L2-01)

```
G4-L2-01(config)#  
G4-L2-01(config)#  
G4-L2-01(config)#vtp domain visual  
Domain name already set to visual.  
G4-L2-01(config)#vtp mode client  
Setting device to VTP CLIENT mode.  
G4-L2-01(config)#  
G4-L2-01(config)#
```

3.2.4.5 Figure

Save the Configurations (L2-01)

```
G4-L2-01#  
G4-L2-01#  
G4-L2-01#copy ru  
G4-L2-01#copy running-config st  
G4-L2-01#copy running-config startup-config  
Destination filename [startup-config]?  
Building configuration...  
[OK]  
G4-L2-01#  
G4-L2-01#
```

3.2.4.6 Figure

3.2.5 Layer 2 Switch-02 Configurations

Initial Configurations (L2-02)

```

Switch(config)#
Switch(config)#
Switch(config)#hostname G4-L2-02
G4-L2-02(config)#
G4-L2-02(config)#line console 0
G4-L2-02(config-line)#password con123
G4-L2-02(config-line)#login
G4-L2-02(config-line)#
G4-L2-02(config-line)#exit
G4-L2-02(config)#
G4-L2-02(config)#enable secret en123
G4-L2-02(config)#
G4-L2-02(config)#line vty 0 4
G4-L2-02(config-line)#password vty123
G4-L2-02(config-line)#login
G4-L2-02(config-line)#
G4-L2-02(config-line)#exit
G4-L2-02(config)#
G4-L2-02(config)#banner motd #Unauthorized Access is Avoided#
G4-L2-02(config)#
G4-L2-02(config)#

```

3.2.5.1 Figure

Creating VLANs Configuration (L2-02)

```

G4-L2-02(config)#
G4-L2-02(config)#
G4-L2-02(config)#vlan 10
G4-L2-02(config-vlan)#name WEB_dept
G4-L2-02(config-vlan)#vlan 20
G4-L2-02(config-vlan)#name VIDEO_dept
G4-L2-02(config-vlan)#vlan 30
G4-L2-02(config-vlan)#name ARCHITECTURE_dept
G4-L2-02(config-vlan)#vlan 40
G4-L2-02(config-vlan)#name PRODUCT_dept
G4-L2-02(config-vlan)#vlan 50
G4-L2-02(config-vlan)#name GRAPHIC_dept
G4-L2-02(config-vlan)#vlan 60
G4-L2-02(config-vlan)#name HR_dept
G4-L2-02(config-vlan)#vlan 120
G4-L2-02(config-vlan)#name Servers
G4-L2-02(config-vlan)#
G4-L2-02(config-vlan)#

```

3.2.5.2 Figure

Ports Trunk Configuration (L2-02)

```

G4-L2-02(config)#
G4-L2-02(config)#
G4-L2-02(config)#interface GigabitEthernet0/1
G4-L2-02(config-if)#switchport mode trunk
G4-L2-02(config-if)#
G4-L2-02(config-if)#interface GigabitEthernet0/2
G4-L2-02(config-if)#switchport mode trunk
G4-L2-02(config-if)#
G4-L2-02(config-if)#

```

3.2.5.3 Figure

Dividing Access Ports Configuration (L2-02)

```
G4-L2-02(config)#
G4-L2-02(config)#
G4-L2-02(config)#interface range FastEthernet0/1-4
G4-L2-02(config-if-range)#switchport access vlan 10
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/5-8
G4-L2-02(config-if-range)#switchport access vlan 20
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/9-12
G4-L2-02(config-if-range)#switchport access vlan 30
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/13-14
G4-L2-02(config-if-range)#switchport access vlan 40
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/15-16
G4-L2-02(config-if-range)#switchport access vlan 50
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/17-20
G4-L2-02(config-if-range)#switchport access vlan 60
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#interface range FastEthernet0/21-24
G4-L2-02(config-if-range)#switchport access vlan 120
G4-L2-02(config-if-range)#switchport mode access
G4-L2-02(config-if-range)#
G4-L2-02(config-if-range)#

```

3.2.5.4 Figure

VTP Configuration (L2-02)

```
G4-L2-02(config)#
G4-L2-02(config)#
G4-L2-02(config)#vtp domain visual
Domain name already set to visual.
G4-L2-02(config)#vtp mode client
Setting device to VTP CLIENT mode.
G4-L2-02(config)#
G4-L2-02(config)#

```

3.2.5.5 Figure

Save the Configurations (L2-02)

```
G4-L2-02#
G4-L2-02#
G4-L2-02#copy run
G4-L2-02#copy running-config st
G4-L2-02#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
G4-L2-02#
G4-L2-02#

```

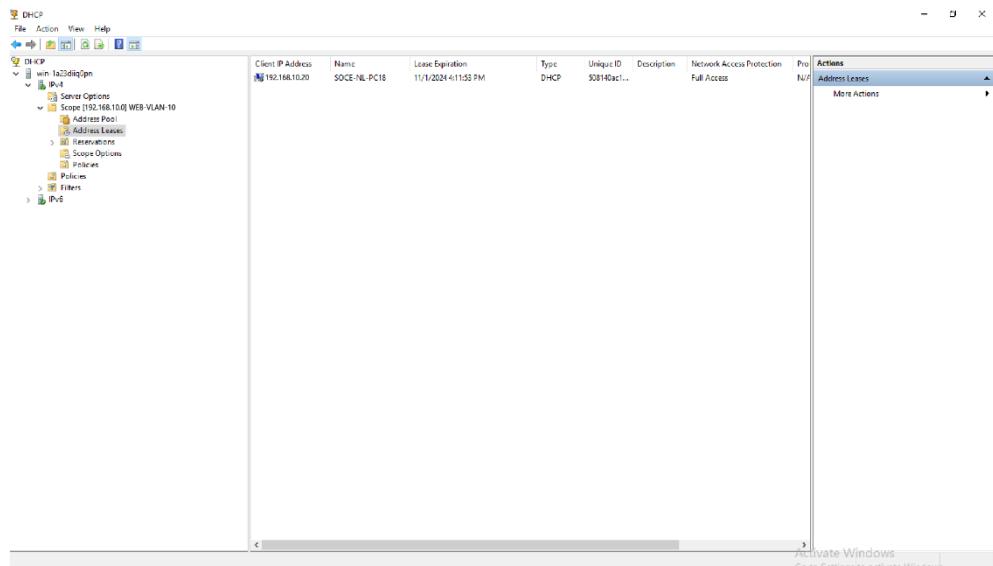
3.2.5.6 Figure

Chapter 04 - Implementation Verification

4.1 Implementation Verification

4.1.1 DHCP Server Verification

DHCP Server Verification – Leasing IPv4 Address



4.1.1.1 Figure

4.1.2 Edge Router Verification

IP Interface Configuration Verification (Edge Router)

```
G4-Router#sh ip interface br
G4-Router#sh ip interface brief
Interface          IP-Address      OK? Method Status           Protocol
GigabitEthernet0/0   10.10.10.1    YES manual up            up
GigabitEthernet0/1   unassigned     YES DHCP   up            down
GigabitEthernet0/2   unassigned     YES unset  administratively down down
Vlan1              unassigned     YES unset  administratively down down
G4-Router#
```

4.1.2.1 Figure

NAT Configuration Verification (Edge Router)

```
G4-Router#
G4-Router#sh ip nat st
G4-Router#sh ip nat statistics
Total translations: 0 (0 static, 0 dynamic, 0 extended)
Outside Interfaces: GigabitEthernet0/1
Inside Interfaces: GigabitEthernet0/0
Hits: 0 Misses: 0
Expired translations: 0
Dynamic mappings:
G4-Router#
```

4.1.2.2 Figure

IP Route Configuration Verification (Edge Router)

```
G4-Router#
G4-Router#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.10.10.0/29 is directly connected, GigabitEthernet0/0
L        10.10.10.1/32 is directly connected, GigabitEthernet0/0
D    192.168.10.0/24 [90/25628160] via 10.10.10.6, 05:26:12, GigabitEthernet0/0
      [90/25628160] via 10.10.10.4, 05:26:08, GigabitEthernet0/0
D    192.168.11.0/24 [90/25628160] via 10.10.10.6, 05:26:12, GigabitEthernet0/0
      [90/25628160] via 10.10.10.4, 05:26:08, GigabitEthernet0/0
D    192.168.12.0/24 [90/25628160] via 10.10.10.6, 05:26:12, GigabitEthernet0/0
      [90/25628160] via 10.10.10.4, 05:26:08, GigabitEthernet0/0
```

4.1.2.3 Figure

ACL Configuration Verification (Edge Router)

```
G4-Router#
G4-Router#sh acce
G4-Router#sh access-lists
Standard IP access list 1
  10 permit any

G4-Router#
```

4.1.2.4 Figure

4.1.3 Multi-Layer Primary Switch Verification

IP Interface Configuration Verification (L3-Main)

```
G4-L3-Main#sh ip interface bri
G4-L3-Main#sh ip interface brief
Interface          IP-Address      OK? Method Status           Protocol
Port-channel1     unassigned      YES unset up            up
GigabitEthernet1/0/1 unassigned      YES unset up            up
GigabitEthernet1/0/2 unassigned      YES unset down          down
GigabitEthernet1/0/3 unassigned      YES unset down          down
GigabitEthernet1/0/4 unassigned      YES unset down          down
GigabitEthernet1/0/5 unassigned      YES unset up            up
GigabitEthernet1/0/6 unassigned      YES unset up            up
GigabitEthernet1/0/7 unassigned      YES unset up            up
GigabitEthernet1/0/8 unassigned      YES unset down          down
GigabitEthernet1/0/9 unassigned      YES unset down          down
GigabitEthernet1/0/10 unassigned     YES unset down          down
GigabitEthernet1/0/11 unassigned     YES unset down          down
GigabitEthernet1/0/12 unassigned     YES unset down          down
GigabitEthernet1/0/13 unassigned     YES unset down          down
GigabitEthernet1/0/14 unassigned     YES unset down          down
GigabitEthernet1/0/15 unassigned     YES unset down          down
GigabitEthernet1/0/16 unassigned     YES unset down          down
GigabitEthernet1/0/17 unassigned     YES unset down          down
GigabitEthernet1/0/18 unassigned     YES unset down          down
GigabitEthernet1/0/19 unassigned     YES unset down          down
GigabitEthernet1/0/20 unassigned     YES unset down          down
GigabitEthernet1/0/21 unassigned     YES unset down          down
GigabitEthernet1/0/22 unassigned     YES unset down          down
GigabitEthernet1/0/23 unassigned     YES unset down          down
GigabitEthernet1/0/24 10.10.10.4    YES manual up           up
GigabitEthernet1/1/1 unassigned      YES unset down          down
GigabitEthernet1/1/2 unassigned      YES unset down          down
GigabitEthernet1/1/3 unassigned      YES unset down          down
GigabitEthernet1/1/4 unassigned      YES unset down          down
Vlan1             unassigned      YES unset administratively down down
Vlan10            192.168.10.124  YES manual up           up
Vlan20            192.168.10.252  YES manual up           up
Vlan30            192.168.11.124  YES manual up           up
Vlan40            192.168.11.188  YES manual up           up
Vlan50            192.168.11.252  YES manual up           up
Vlan60            192.168.12.60   YES manual up           up
Vlan120           192.168.12.244 YES manual up           up
G4-L3-Main#
```

4.1.3.1 Figure

VLAN Configuration Verification (L3-Main)

```
G4-L3-Main#sh vlan bri
G4-L3-Main#sh vlan brief
VLAN Name          Status    Ports
--- -----
1    default        active   Gig1/0/2, Gig1/0/3, Gig1/0/4, Gig1/0/8
                           Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
                           Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
                           Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
                           Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/1/1
                           Gig1/1/2, Gig1/1/3, Gig1/1/4
10   WEB_dept       active
20   VIDEO_dept     active
30   ARCHITECTURE_dept active
40   PRODUCT_dept   active
50   GRAPHIC_dept   active
60   HR_dept         active
120  Servers         active
1002 fddi-default  active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default  active
G4-L3-Main#
G4-L3-Main#
```

4.1.3.2 Figure

IP Route Configuration Verification (L3-Main)

```
G4-L3-Main#
G4-L3-Main#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is 10.10.10.1 to network 0.0.0.0

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D        10.0.0.0/8 is a summary, 04:44:27, Null0
C        10.10.10.0/29 is directly connected, GigabitEthernet1/0/24
      192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks
D        192.168.10.0/24 is a summary, 04:44:27, Null0
C        192.168.10.0/25 is directly connected, Vlan10
C        192.168.10.128/25 is directly connected, Vlan20
      192.168.11.0/24 is variably subnetted, 4 subnets, 3 masks
D        192.168.11.0/24 is a summary, 04:44:27, Null0
C        192.168.11.0/25 is directly connected, Vlan30
C        192.168.11.128/26 is directly connected, Vlan40
C        192.168.11.192/26 is directly connected, Vlan50
      192.168.12.0/24 is variably subnetted, 3 subnets, 3 masks
D        192.168.12.0/24 is a summary, 04:44:27, Null0
C        192.168.12.0/26 is directly connected, Vlan60
C        192.168.12.240/29 is directly connected, Vlan120
S*    0.0.0.0/0 [1/0] via 10.10.10.1

G4-L3-Main#
```

4.1.3.3 Figure

VTP Configuration Verification (L3-Main)

```
G4-L3-Main#
G4-L3-Main#sh vtp st
G4-L3-Main#sh vtp status
VTP Version capable          : 1 to 2
VTP version running          : 1
VTP Domain Name              : visual
VTP Pruning Mode             : Disabled
VTP Traps Generation         : Disabled
Device ID                    : 0001.6316.C080
Configuration last modified by 0.0.0.0 at 3-1-93 00:00:00
Local updater ID is 192.168.10.124 on interface Vl10 (lowest numbered VLAN interface found)

Feature VLAN :
-----
VTP Operating Mode           : Server
Maximum VLANs supported locally : 1005
Number of existing VLANs     : 12
Configuration Revision       : 63
MD5 digest                  : 0xAB 0x64 0x29 0xBF 0x21 0x95 0x38 0x65
                                0xEC 0x9B 0xD1 0x4C 0xD5 0x68 0x6F 0xD2
G4-L3-Main#
```

4.1.3.4 Figure

HSRP Configuration Verification (L3-Main)

```
G4-L3-Main#sh standby bri
G4-L3-Main#sh standby brief
                           P indicates configured to preempt.
                           |
Interface  Grp  Pri P State   Active      Standby          Virtual IP
Vl10       1    109 P Active  local       192.168.10.126  192.168.10.125
Vl20       1    109 P Active  local       192.168.10.254  192.168.10.253
Vl30       1    109 P Active  local       192.168.11.126  192.168.11.125
Vl40       1    109 P Active  local       192.168.11.190  192.168.11.189
Vl50       1    109 P Active  local       192.168.11.254  192.168.11.253
Vl60       1    109 P Active  local       192.168.12.62   192.168.12.61
Vl120      1    109 P Active  local       192.168.12.246  192.168.12.245
G4-L3-Main#
```

4.1.3.5 Figure

STP Configuration Verification (L3-Main)

```
G4-L3-Main#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
              Address     00E0.47E9.AE14
              Cost        4
              Port        5 (GigabitEthernet1/0/5)
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    32769 (priority 32768 sys-id-ext 1)
              Address     00E0.F9A2.341D
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

  Interface      Role Sts Cost      Prio.Nbr Type
  ----- -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Root FWD 4       128.5    P2p
  Po1            Altn BLK 3       128.29   Shr

VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    24586
              Address     00E0.F9A2.341D
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    24586 (priority 24576 sys-id-ext 10)
              Address     00E0.F9A2.341D
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

  Interface      Role Sts Cost      Prio.Nbr Type
  ----- -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1            Desg FWD 3       128.29   Shr

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    24596
              Address     00E0.F9A2.341D
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    24596 (priority 24576 sys-id-ext 20)
              Address     00E0.F9A2.341D
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

  Interface      Role Sts Cost      Prio.Nbr Type
  ----- -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1            Desg FWD 3       128.29   Shr

VLAN0030
  Spanning tree enabled protocol ieee
  Root ID    Priority    24606
              Address     00E0.F9A2.341D
              This bridge is the root
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    24606 (priority 24576 sys-id-ext 30)
              Address     00E0.F9A2.341D
              Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  20

  Interface      Role Sts Cost      Prio.Nbr Type
  ----- -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1            Desg FWD 3       128.29   Shr
```

4.1.3.6 Figure

```
VLAN0040
  Spanning tree enabled protocol ieee
  Root ID  Priority    24616
            Address 00E0.F9A2.341D
            This bridge is the root
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID Priority    24616 (priority 24576 sys-id-ext 40)
            Address 00E0.F9A2.341D
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
            Aging Time 20

  Interface Role Sts Cost      Prio.Nbr Type
----- -----
  Gi1/0/1   Desg FWD 4        128.1   P2p
  Gi1/0/5   Desg FWD 4        128.5   P2p
  Po1       Desg FWD 3        128.29  Shr

VLAN0050
  Spanning tree enabled protocol ieee
  Root ID  Priority    24626
            Address 00E0.F9A2.341D
            This bridge is the root
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID Priority    24626 (priority 24576 sys-id-ext 50)
            Address 00E0.F9A2.341D
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
            Aging Time 20

  Interface Role Sts Cost      Prio.Nbr Type
----- -----
  Gi1/0/1   Desg FWD 4        128.1   P2p
  Gi1/0/5   Desg FWD 4        128.5   P2p
  Po1       Desg FWD 3        128.29  Shr

VLAN0060
  Spanning tree enabled protocol ieee
  Root ID  Priority    24636
            Address 00E0.F9A2.341D
            This bridge is the root
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID Priority    24636 (priority 24576 sys-id-ext 60)
            Address 00E0.F9A2.341D
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
            Aging Time 20

  Interface Role Sts Cost      Prio.Nbr Type
----- -----
  Gi1/0/1   Desg FWD 4        128.1   P2p
  Gi1/0/5   Desg FWD 4        128.5   P2p
  Po1       Desg FWD 3        128.29  Shr

VLAN0120
  Spanning tree enabled protocol ieee
  Root ID  Priority    24696
            Address 00E0.F9A2.341D
            This bridge is the root
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID Priority    24696 (priority 24576 sys-id-ext 120)
            Address 00E0.F9A2.341D
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
            Aging Time 20

  Interface Role Sts Cost      Prio.Nbr Type
----- -----
  Gi1/0/1   Desg FWD 4        128.1   P2p
  Gi1/0/5   Desg FWD 4        128.5   P2p
  Po1       Desg FWD 3        128.29  Shr
```

4.1.3.7 Figure

Ether-Channel Configuration Verification (L3-Main)

```
G4-L3-Main#
G4-L3-Main#
G4-L3-Main#sh eth
G4-L3-Main#sh etherchannel su
G4-L3-Main#sh etherchannel summary
Flags: D - down      P - in port-channel
       I - stand-alone  S - suspended
       H - Hot-standby (LACP only)
       R - Layer3        S - Layer2
       U - in use        f - failed to allocate aggregator
       u - unsuitable for bundling
       w - waiting to be aggregated
       d - default port

Number of channel-groups in use: 1
Number of aggregators:          1

Group  Port-channel  Protocol    Ports
-----+-----+-----+
1      Po1(SU)       PAgP      Gig1/0/6(P) Gig1/0/7(P)
G4-L3-Main#
```

4.1.3.8 Figure

4.1.4 Multi-Layer Backup Switch Verification

IP Interface Configuration Verification (L3-Backup)

```
G4-L3-BKP#sh ip interface bri
G4-L3-BKP#sh ip interface brief
Interface          IP-Address      OK? Method Status           Protocol
Port-channel1     unassigned      YES unset up            up
GigabitEthernet1/0/1 unassigned      YES unset up            up
GigabitEthernet1/0/2 unassigned      YES unset down          down
GigabitEthernet1/0/3 unassigned      YES unset down          down
GigabitEthernet1/0/4 unassigned      YES unset down          down
GigabitEthernet1/0/5 unassigned      YES unset up            up
GigabitEthernet1/0/6 unassigned      YES unset up            up
GigabitEthernet1/0/7 unassigned      YES unset up            up
GigabitEthernet1/0/8 unassigned      YES unset down          down
GigabitEthernet1/0/9 unassigned      YES unset down          down
GigabitEthernet1/0/10 unassigned     YES unset down          down
GigabitEthernet1/0/11 unassigned     YES unset down          down
GigabitEthernet1/0/12 unassigned     YES unset down          down
GigabitEthernet1/0/13 unassigned     YES unset down          down
GigabitEthernet1/0/14 unassigned     YES unset down          down
GigabitEthernet1/0/15 unassigned     YES unset down          down
GigabitEthernet1/0/16 unassigned     YES unset down          down
GigabitEthernet1/0/17 unassigned     YES unset down          down
GigabitEthernet1/0/18 unassigned     YES unset down          down
GigabitEthernet1/0/19 unassigned     YES unset down          down
GigabitEthernet1/0/20 unassigned     YES unset down          down
GigabitEthernet1/0/21 unassigned     YES unset down          down
GigabitEthernet1/0/22 unassigned     YES unset down          down
GigabitEthernet1/0/23 unassigned     YES unset down          down
GigabitEthernet1/0/24 10.10.10.6    YES manual up           up
GigabitEthernet1/1/1 unassigned      YES unset down          down
GigabitEthernet1/1/2 unassigned      YES unset down          down
GigabitEthernet1/1/3 unassigned      YES unset down          down
GigabitEthernet1/1/4 unassigned      YES unset down          down
Vlan1             unassigned      YES unset administratively down down
Vlan10            192.168.10.126  YES manual up           up
Vlan20            192.168.10.254  YES manual up           up
Vlan30            192.168.11.126  YES manual up           up
Vlan40            192.168.11.190  YES manual up           up
Vlan50            192.168.11.254  YES manual up           up
Vlan60            192.168.12.62   YES manual up           up
Vlan120           192.168.12.246 YES manual up           up
G4-L3-BKP#
```

4.1.4.1 Figure

VLAN Configuration Verification (L3- Backup)

```
G4-L3-BKP#
G4-L3-BKP#sh vlan bri
G4-L3-BKP#sh vlan brief
VLAN Name                Status    Ports
---                      --
1  default                active    Gig1/0/2, Gig1/0/3, Gig1/0/4, Gig1/0/8
                                Gig1/0/9, Gig1/0/10, Gig1/0/11, Gig1/0/12
                                Gig1/0/13, Gig1/0/14, Gig1/0/15, Gig1/0/16
                                Gig1/0/17, Gig1/0/18, Gig1/0/19, Gig1/0/20
                                Gig1/0/21, Gig1/0/22, Gig1/0/23, Gig1/1/1
                                Gig1/1/2, Gig1/1/3, Gig1/1/4
10  WEB_dept              active
20  VIDEO_dept            active
30  ARCHITECTURE_dept     active
40  PRODUCT_dept          active
50  GRAPHIC_dept          active
60  HR_dept                active
120 Servers               active
1002 fddi-default          active
1003 token-ring-default   active
1004 fddinet-default       active
1005 trnet-default         active
G4-L3-BKP#
```

4.1.4.2 Figure

IP Route Configuration Verification (L3-Backup)

```
G4-L3-BKP#
G4-L3-BKP#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
      * - candidate default, U - per-user static route, o - ODR
      P - periodic downloaded static route

Gateway of last resort is 10.10.10.1 to network 0.0.0.0

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D        10.0.0.0/8 is a summary, 05:04:26, Null0
C        10.10.10.0/29 is directly connected, GigabitEthernet1/0/24
      192.168.10.0/24 is variably subnetted, 3 subnets, 2 masks
D        192.168.10.0/24 is a summary, 05:04:26, Null0
C        192.168.10.0/25 is directly connected, Vlan10
C        192.168.10.128/25 is directly connected, Vlan20
      192.168.11.0/24 is variably subnetted, 4 subnets, 3 masks
D        192.168.11.0/24 is a summary, 05:04:26, Null0
C        192.168.11.0/25 is directly connected, Vlan30
C        192.168.11.128/26 is directly connected, Vlan40
C        192.168.11.192/26 is directly connected, Vlan50
      192.168.12.0/24 is variably subnetted, 3 subnets, 3 masks
D        192.168.12.0/24 is a summary, 05:04:26, Null0
C        192.168.12.0/26 is directly connected, Vlan60
C        192.168.12.240/29 is directly connected, Vlan120
S*    0.0.0.0/0 [1/0] via 10.10.10.1

G4-L3-BKP#
```

4.1.4.3 Figure

VTP Configuration Verification (L3-Backup)

```
G4-L3-BKP#
G4-L3-BKP#sh vtp st
G4-L3-BKP#sh vtp status
VTP Version capable          : 1 to 2
VTP version running          : 1
VTP Domain Name              : visual
VTP Pruning Mode             : Disabled
VTP Traps Generation         : Disabled
Device ID                    : 0001.C975.3360
Configuration last modified by 0.0.0.0 at 3-1-93 00:00:00

Feature VLAN :
-----
VTP Operating Mode           : Client
Maximum VLANs supported locally : 1005
Number of existing VLANs     : 12
Configuration Revision       : 63
MD5 digest                  : 0xAB 0x64 0x29 0xBF 0x21 0x95 0x38 0x65
                                0xEC 0x9B 0xD1 0x4C 0xD5 0x68 0x6F 0xD2
G4-L3-BKP#
G4-L3-BKP#
```

4.1.4.4 Figure

HSRP Configuration Verification (L3-Backup)

```
G4-L3-BKP#sh standby bri
G4-L3-BKP#sh standby brief
      P indicates configured to preempt.
      |
Interface  Grp  Pri P State   Active      Standby      Virtual IP
Vl10       1    100 P Standby  192.168.10.124 local      192.168.10.125
Vl20       1    100 P Standby  192.168.10.252 local      192.168.10.253
Vl30       1    100 P Standby  192.168.11.124 local      192.168.11.125
Vl40       1    100 P Standby  192.168.11.188 local      192.168.11.189
Vl50       1    100 P Standby  192.168.11.252 local      192.168.11.253
Vl60       1    100 P Standby  192.168.12.60  local      192.168.12.61
Vl120      1    100 P Standby  192.168.12.244 local      192.168.12.245
G4-L3-BKP#
```

4.1.4.5 Figure

STP Configuration Verification (L3-Backup)

```

G4-L3-BKP#sh sp
G4-L3-BKP#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID  Priority    32769
            Address     0060.47E9.AE14
            Cost         4
            Port        1(GigabitEthernet1/0/1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    32769 (priority 32768 sys-id-ext 1)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Root FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4      128.5    P2p
  Po1           Desg FWD 3      128.29   Shr

VLAN0010
  Spanning tree enabled protocol ieee
  Root ID  Priority    24586
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28682 (priority 28672 sys-id-ext 10)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4      128.5    P2p
  Po1           Root FWD 3      128.29   Shr

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID  Priority    24596
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28692 (priority 28672 sys-id-ext 20)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4      128.5    P2p
  Po1           Root FWD 3      128.29   Shr

VLAN0030
  Spanning tree enabled protocol ieee
  Root ID  Priority    24606
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28702 (priority 28672 sys-id-ext 30)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4      128.5    P2p
  Po1           Root FWD 3      128.29   Shr

```

4.1.4.6 Figure

```
VLAN0040
  Spanning tree enabled protocol ieee
  Root ID  Priority    24616
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28712 (priority 28672 sys-id-ext 40)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1           Root FWD 3       128.29   Shr

VLAN0050
  Spanning tree enabled protocol ieee
  Root ID  Priority    24626
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28722 (priority 28672 sys-id-ext 50)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1           Root FWD 3       128.29   Shr

VLAN0060
  Spanning tree enabled protocol ieee
  Root ID  Priority    24636
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28732 (priority 28672 sys-id-ext 60)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1           Root FWD 3       128.29   Shr

VLAN0120
  Spanning tree enabled protocol ieee
  Root ID  Priority    24696
            Address     00E0.F9A2.341D
            Cost         3
            Port        29(Port-channel1)
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority    28792 (priority 28672 sys-id-ext 120)
            Address     00D0.58D9.5630
            Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time   20

  Interface      Role Sts Cost      Prio.Nbr Type
  -----  -----
  Gi1/0/1        Desg FWD 4       128.1    P2p
  Gi1/0/5        Desg FWD 4       128.5    P2p
  Po1           Root FWD 3       128.29   Shr
```

4.1.4.7 Figure

Ether-Channel Configuration Verification (L3-Backup)

```
G4-L3-BKP#sh eth
G4-L3-BKP#sh etherchannel sum
G4-L3-BKP#sh etherchannel summary
Flags: D - down P - in port-channel
      I - stand-alone S - suspended
      H - Hot-standby (LACP only)
      R - Layer3 S - Layer2
      U - in use f - failed to allocate aggregator
      u - unsuitable for bundling
      w - waiting to be aggregated
      d - default port

Number of channel-groups in use: 1
Number of aggregators: 1

Group Port-channel Protocol Ports
-----+-----+-----+
1      Po1(SU)       PAgP    Gig1/0/6(P) Gig1/0/7(P)
G4-L3-BKP#
```

4.1.4.8 Figure

4.1.5 Layer 2 Switch-01 Verification

IP Interface Configuration Verification (L2-01)

```
G4-L2-01#sh ip interface bri
G4-L2-01#sh ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet0/1    unassigned      YES manual up       up
FastEthernet0/2    unassigned      YES manual down    down
FastEthernet0/3    unassigned      YES manual down    down
FastEthernet0/4    unassigned      YES manual down    down
FastEthernet0/5    unassigned      YES manual down    down
FastEthernet0/6    unassigned      YES manual down    down
FastEthernet0/7    unassigned      YES manual down    down
FastEthernet0/8    unassigned      YES manual down    down
FastEthernet0/9    unassigned      YES manual down    down
FastEthernet0/10   unassigned      YES manual down    down
FastEthernet0/11   unassigned      YES manual down    down
FastEthernet0/12   unassigned      YES manual down    down
FastEthernet0/13   unassigned      YES manual down    down
FastEthernet0/14   unassigned      YES manual down    down
FastEthernet0/15   unassigned      YES manual down    down
FastEthernet0/16   unassigned      YES manual down    down
FastEthernet0/17   unassigned      YES manual down    down
FastEthernet0/18   unassigned      YES manual down    down
FastEthernet0/19   unassigned      YES manual down    down
FastEthernet0/20   unassigned      YES manual down    down
FastEthernet0/21   unassigned      YES manual down    down
FastEthernet0/22   unassigned      YES manual down    down
FastEthernet0/23   unassigned      YES manual up     up
GigabitEthernet0/1 unassigned      YES manual up     up
GigabitEthernet0/2 unassigned      YES manual up     up
Vlan1             unassigned      YES manual administratively down down
G4-L2-01#
```

4.1.5.1 Figure

VLAN Configuration Verification (L2-01)

```
G4-L2-01#sh vlan bri
G4-L2-01#sh vlan brief
VLAN Name           Status    Ports
--- -----
1     default        active
10    WEB_dept       active   Fa0/1, Fa0/2, Fa0/3, Fa0/4
20    VIDEO_dept     active   Fa0/5, Fa0/6, Fa0/7, Fa0/8
30    ARCHITECTURE_dept active   Fa0/9, Fa0/10, Fa0/11, Fa0/12
40    PRODUCT_dept   active   Fa0/13, Fa0/14
50    GRAPHIC_dept   active   Fa0/15, Fa0/16
60    HR_dept         active   Fa0/17, Fa0/18, Fa0/19, Fa0/20
120   Servers         active   Fa0/21, Fa0/22, Fa0/23, Fa0/24
1002  fddi-default   active
1003  token-ring-default active
1004  fddinet-default active
1005  trnet-default   active
G4-L2-01#
G4-L2-01#
```

4.1.5.2 Figure

VTP Configuration Verification (L2-01)

```
G4-L2-01#sh vtp st
G4-L2-01#sh vtp status
VTP Version capable      : 1 to 2
VTP version running      : 1
VTP Domain Name          : visual
VTP Pruning Mode         : Disabled
VTP Traps Generation     : Disabled
Device ID                : 00E0.B077.C800
Configuration last modified by 0.0.0.0 at 3-1-93 00:00:00

Feature VLAN :
-----
VTP Operating Mode       : Client
Maximum VLANs supported locally : 255
Number of existing VLANs  : 12
Configuration Revision    : 63
MD5 digest               : 0xAB 0x64 0x29 0xBF 0x21 0x95 0x38 0x65
                           0xEC 0x9B 0xD1 0x4C 0xD5 0x68 0x6F 0xD2
G4-L2-01#
```

4.1.5.3 Figure

4.1.6 Layer 2 Switch-02 Verification

IP Interface Configuration Verification (L2-02)

```
G4-L2-02#sh ip interface bri
G4-L2-02#sh ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet0/1    unassigned      YES manual down       down
FastEthernet0/2    unassigned      YES manual down       down
FastEthernet0/3    unassigned      YES manual down       down
FastEthernet0/4    unassigned      YES manual down       down
FastEthernet0/5    unassigned      YES manual down       down
FastEthernet0/6    unassigned      YES manual down       down
FastEthernet0/7    unassigned      YES manual down       down
FastEthernet0/8    unassigned      YES manual down       down
FastEthernet0/9    unassigned      YES manual down       down
FastEthernet0/10   unassigned      YES manual down       down
FastEthernet0/11   unassigned      YES manual down       down
FastEthernet0/12   unassigned      YES manual down       down
FastEthernet0/13   unassigned      YES manual down       down
FastEthernet0/14   unassigned      YES manual down       down
FastEthernet0/15   unassigned      YES manual down       down
FastEthernet0/16   unassigned      YES manual down       down
FastEthernet0/17   unassigned      YES manual down       down
FastEthernet0/18   unassigned      YES manual down       down
FastEthernet0/19   unassigned      YES manual down       down
FastEthernet0/20   unassigned      YES manual down       down
FastEthernet0/21   unassigned      YES manual down       down
FastEthernet0/22   unassigned      YES manual down       down
FastEthernet0/23   unassigned      YES manual down       down
FastEthernet0/24   unassigned      YES manual down       down
GigabitEthernet0/1 unassigned      YES manual up        up
GigabitEthernet0/2 unassigned      YES manual up        up
Vlan1             unassigned      YES manual administratively down down
G4-L2-02#
```

4.1.6.1 Figure

VLAN Configuration Verification (L2-02)

```
G4-L2-02#
G4-L2-02#sh vlan bri
G4-L2-02#sh vlan brief
VLAN Name           Status     Ports
---- -----
1     default        active
10    WEB_dept       active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
20    VIDEO_dept     active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
30    ARCHITECTURE_dept active    Fa0/9, Fa0/10, Fa0/11, Fa0/12
40    PRODUCT_dept   active    Fa0/13, Fa0/14
50    GRAPHIC_dept   active    Fa0/15, Fa0/16
60    HR_dept         active    Fa0/17, Fa0/18, Fa0/19, Fa0/20
120   Servers         active    Fa0/21, Fa0/22, Fa0/23, Fa0/24
1002  fddi-default   active
1003  token-ring-default active
1004  fddinet-default active
1005  trnet-default   active
G4-L2-02#
```

4.1.6.2 Figure

VTP Configuration Verification (L2-02)

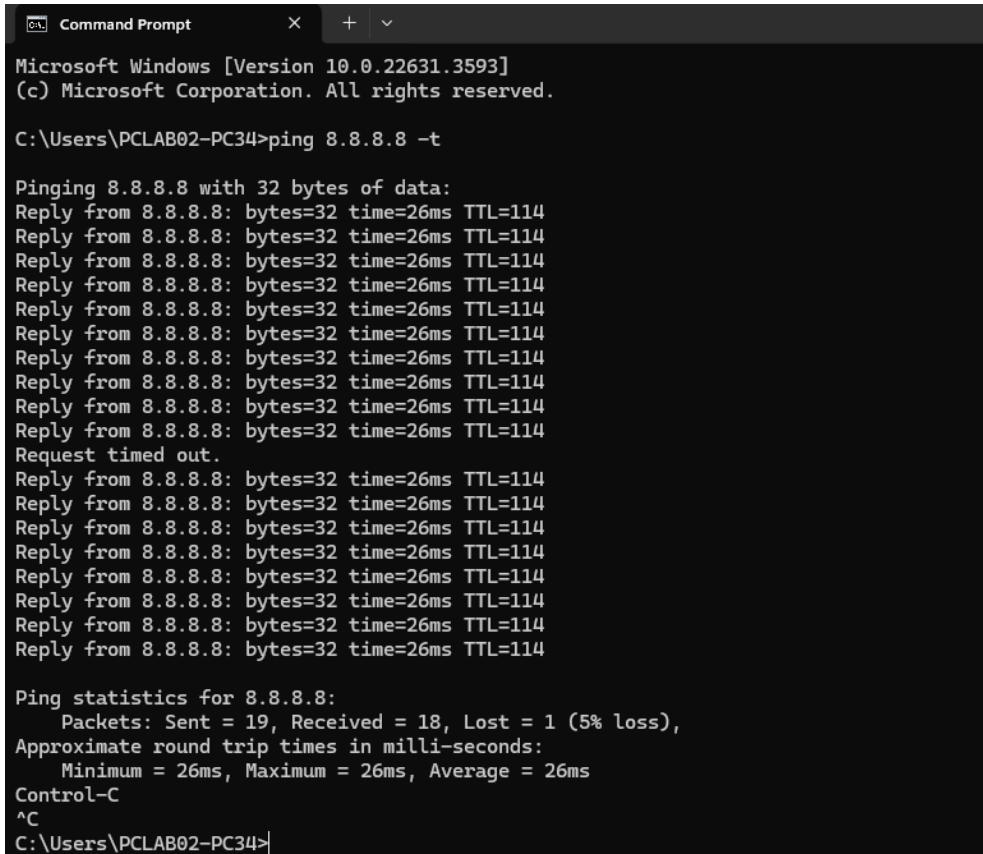
```
G4-L2-02#sh vtp st
G4-L2-02#sh vtp status
VTP Version capable      : 1 to 2
VTP version running      : 1
VTP Domain Name          : visual
VTP Pruning Mode         : Disabled
VTP Traps Generation     : Disabled
Device ID                : 0001.64E4.4000
Configuration last modified by 0.0.0.0 at 3-1-93 00:00:00

Feature VLAN :
-----
VTP Operating Mode       : Client
Maximum VLANs supported locally : 255
Number of existing VLANs   : 12
Configuration Revision     : 63
MD5 digest               : 0xAB 0x64 0x29 0xBF 0x21 0x95 0x38 0x65
                           0xEC 0x9B 0xD1 0x4C 0xD5 0x68 0x6F 0xD2
```

4.1.6.3 Figure

4.2 Connectivity Confirmation

Reach the Google DNS Server - Ping



```

C:\ Command Prompt      + | v
Microsoft Windows [Version 10.0.22631.3593]
(c) Microsoft Corporation. All rights reserved.

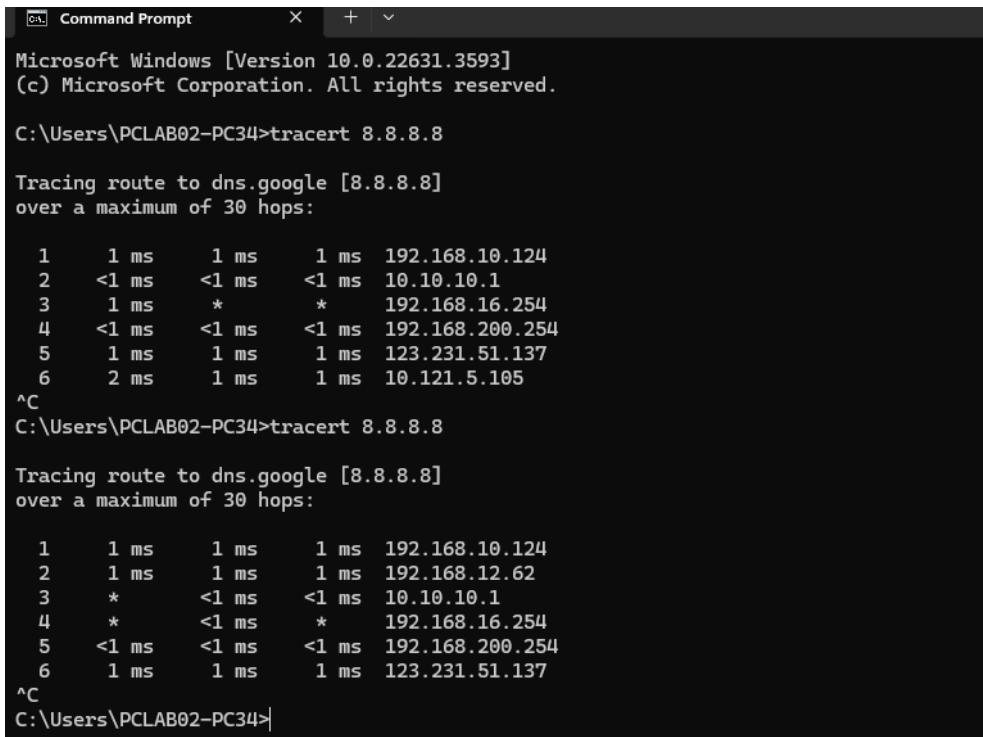
C:\Users\PCLAB02-PC34>ping 8.8.8.8 -t

Pinging 8.8.8.8 with 32 bytes of data:
Reply from 8.8.8.8: bytes=32 time=26ms TTL=114
Request timed out.
Reply from 8.8.8.8: bytes=32 time=26ms TTL=114
Ping statistics for 8.8.8.8:
    Packets: Sent = 19, Received = 18, Lost = 1 (5% loss),
Approximate round trip times in milli-seconds:
    Minimum = 26ms, Maximum = 26ms, Average = 26ms
Control-C
^C
C:\Users\PCLAB02-PC34>

```

4.2.1 Figure

Reach the Google DNS Server - Tracert



```

C:\ Command Prompt      + | v
Microsoft Windows [Version 10.0.22631.3593]
(c) Microsoft Corporation. All rights reserved.

C:\Users\PCLAB02-PC34>tracert 8.8.8.8

Tracing route to dns.google [8.8.8.8]
over a maximum of 30 hops:

 1   1 ms     1 ms     1 ms  192.168.10.124
 2   <1 ms    <1 ms    <1 ms  10.10.10.1
 3   1 ms     *         *   192.168.16.254
 4   <1 ms    <1 ms    <1 ms  192.168.200.254
 5   1 ms     1 ms     1 ms  123.231.51.137
 6   2 ms     1 ms     1 ms  10.121.5.105
^C
C:\Users\PCLAB02-PC34>tracert 8.8.8.8

Tracing route to dns.google [8.8.8.8]
over a maximum of 30 hops:

 1   1 ms     1 ms     1 ms  192.168.10.124
 2   1 ms     1 ms     1 ms  192.168.12.62
 3   *         <1 ms    <1 ms  10.10.10.1
 4   *         <1 ms    *       192.168.16.254
 5   <1 ms    <1 ms    <1 ms  192.168.200.254
 6   1 ms     1 ms     1 ms  123.231.51.137
^C
C:\Users\PCLAB02-PC34>

```

4.2.2 Figure

Chapter 05 - Conclusion

5.1 Conclusion

The network design presented in this report offers a comprehensive and efficient solution for enhancing the connectivity and communication infrastructure of the company. Through careful analysis and consideration of the company's requirements, we have developed a strong network architecture that supports the current needs and allows for future scalability. The design incorporates a hierarchical network model, utilizing core, distribution, and access layers to optimize performance, security, and manageability. By implementing redundant links, load balancing mechanisms, and backup systems, we have addressed potential points of failure 100 and ensured high availability for critical services. Additionally, the design incorporates provisions for wireless connectivity across the company, allowing seamless access to network resources for both staff and clients. Rich wireless coverage, coupled with access controls and quality of service mechanisms, ensures a reliable and optimized user experience. The deployment plan presented in this report outlines the necessary steps, timelines, and resource requirements for implementing the proposed network design.

Overall, the network design outlined in this report aspires to provide the company with a modern, scalable, and secure network infrastructure that fosters collaboration, innovation, and efficient communication among clients, departments, and staff. By embracing this design, the company can enhance its technological capabilities and support its mission of delivering high-quality service in the digital generation. The Floor Plans of the company consists of 3 floors which are, Ground floor, First floor and Second floor. There are WAPs, CCTVs, PCs, IP phones, and other technology on every floor. Since the budget is constrained, the customer has asked that Cat 6A cables be used for the wiring. The Red Lines on each floor represent the cable structure. All The servers are reachable at the second floor in the server room, along with other network management devices. Due to various departments, the number of host devices and speed of the internet connectivity may change.

Chapter 06

6.1 References

6.1.1 Network Design Implementation and Idea of All Theories

[CCNA: Introduction to Networks](#)

6.1.2 CCNA: Switching, Routing, and Wireless Essentials: Cisco Networking Academy.

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[CCNA: Switching, Routing, and Wireless Essentials](#)

6.1.3 CCNA: Enterprise Networking, Security, and Automation: Cisco Networking

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[Products, Solutions, and Services - Cisco](#)

Chapter 07 - Hardware Requirements

7.1 Hardware Requirements and Features

7.1.1 Access Points

Cisco Catalyst 9120AX Series



7.1.1 Figure

The Cisco Catalyst 9120AX Series Access Points are the next generation of enterprise access points. They are resilient, secure, and intelligent. Trust Anchor capabilities include:

- Image signing
- Secure Boot
- Cisco Trust Anchor module

Wi-Fi Standards	- 802.11ax (Wi-Fi 6)
Frequency Bands	- 2.4 GHz and 5 GHz
MIMO	- 4x4 MU-MIMO
Data Rates	- Up to 5.2 Gbps
Security	- WPA3, 802.1X, rogue detection
Management	- Cisco DNA Center, web interface

7.1.2 Server Racks

Cisco R42610 Rack



7.1.2.1 Figure

Cisco® R Series Racks are an ideal solution for mission-critical environments that require the highest levels of reliability, structural integrity, and security. The series' modern design delivers exceptional power, cooling, and cable management features as well as the strength and stability required in today's rack enclosures, offering peace of mind for the most important infrastructure elements.

The Cisco R Series Racks are certified for use with the Cisco Unified Computing System™ and selected Nexus products, allowing Cisco to offer a complete infrastructure solution, including computing, networking, rack, power, and services.

Height	- 42U
Width	- 600mm or 800mm
Depth	- 1200mm
Weight Capacity	- 3000 lbs (static)
Doors	- Perforated front and rear doors for airflow
Rails	- Adjustable mounting rails

Tedgetal 9U Wall Mount Cabinet



7.1.2.2 Figure

The Tedgetal 9U Wall Mount Cabinet is a compact, secure enclosure designed to store and organize network equipment like servers, switches, and routers. Built for space efficiency, it can be wall-mounted, saving valuable floor space. With a 9U capacity, it provides enough room for smaller setups, featuring ventilation for cooling, lockable doors, and easy cable management.

Brand	- Tedgetal
Color	- 9U
Product Dimensions	- 17.7"D x 22.4"W x 19.7"H
Compatible Devices	- Server
Mounting Type	- Wall Mount

7.1.3 Servers

Cisco UCS B200 M6 Blade Server



7.1.3.1 Figure

The Cisco UCS B200 M6 Blade Server delivers performance, flexibility, and optimization for deployments in data centers, in the cloud, and at remote sites.

Processors	- Up to 2x Intel Xeon Scalable Processors
Memory	- Up to 4 TB of DDR4
Storage	- NVMe, SAS, SATA options
Network	- Up to 25 Gb Ethernet
Management	- Cisco UCS Manager
Form Factor	- Half-width blade

Cisco UCS S3260 Storage Server



7.1.3.2 Figure

The Cisco UCS® S3260 Storage Server is a modular, high-density, high-availability, dual node storage-optimized server well suited for service providers, enterprises, and industry-specific environments.

- Form Factor - 4U
- Processors - Dual Intel Xeon Scalable Processors
- Memory - Up to 1.5 TB
- Storage - Up to 600 TB
- Network - 40 Gb Ethernet
- Management - Cisco UCS Manager

7.1.4 Edge Router

Cisco Catalyst C8200-1N-4T edge router



7.1.4 Figure

The Cisco Catalyst 8200 Series Edge Platforms are 5G-ready cloud edge platforms designed for Secure Access Service Edge (SASE), multilayer security, and cloud-native agility to accelerate your journey to cloud.

Performance	- 8 Gbps aggregate
Interfaces	- throughput
Routing Protocols	- 1x 10 GE, 4x 1 GE
Security	- BGP, OSPF, EIGRP
High Availability	- IPSec, firewall capabilities
Management	- Redundant power supplies Cisco DNA Center

7.1.5 Firewall Devices

Firepower 4145 Cisco



7.1.5 Figure

The Cisco Firepower 4100 Series is a family of seven threat-focused NGFW security platforms. Their throughput range addresses data center and internet edge use cases.

Throughput	- 45 Gbps
Firewall Connections	- Up to 50 million
Interfaces	- Multiple 1/10/40 GbE
Security Services	- IPS, URL filtering, AMP
Management	- Cisco Firepower Management Center
High Availability	- Active/Standby failover

7.1.6 Multi-Layer Switches

Catalyst 9500-48Y4C 25G high-performance Switches



7.1.6 Figure

The Catalyst 9500 Series, including the new Catalyst 9500X models, continues to shape the future with continued innovation that helps you reimagine connections, reinforce security and redefine the experience for your hybrid workforce big and small.

Ports	- 48x 25 GE, 4x 100 GE
Switching Capacity	- 6.4 Tbps
Routing Protocols	- BGP, OSPF, EIGRP
Stacking	- StackWise Virtual
Power	- Dual redundant power supplies
Management	- Cisco DNA Center

7.1.7 Layer 2 Switches

Cisco Catalyst 9300X-12Y-A Switch



7.1.7.1 Figure

Cisco Catalyst 9300 Series switches are Cisco's lead stackable enterprise access switching platform and as part of the Catalyst 9000 family, are built to transform your network to handle a hybrid world where the workplace is anywhere, endpoints could be anything, and applications are hosted all over the place. The Catalyst 9300 Series, including the new Catalyst 9300X models, continues to shape the future with continued innovation that helps you reimagine connections, reinforce security and redefine the experience for your hybrid workforce big and small.

Ports	- 12x 25 GE
Switching Capacity	- 480 Gbps
Stacking	- StackWise-480
PoE	- Up to 60W per port
Power	- Dual redundant power supplies
Management	- Cisco DNA Center

Cisco Catalyst 9400 Series Switch



7.1.7.2 Figure

Cisco® Catalyst® 9400 Series switches are Cisco's lead modular enterprise access switching platform and as part of the Catalyst 9000 family, are built to transform your network to handle a hybrid world where the workplace is anywhere, endpoints could be anything, and applications are hosted all over the place.

Slots	- 4 to 10 slots
Switching Capacity	- Up to 9 Tbps
Power	- Dual redundant power supplies
Stacking	- Cisco StackWise Virtual
PoE	- Up to 90W per port
Management	- Cisco DNA Center

7.1.8 Patch Panel



7.1.8 Figure

Prepare yourself for Copper Gigabit Ethernet with TRENDnet's Cat. 6 RJ-45 UTP Patch Panels. These patch panels are certified for 250Mhz Category 6, which are perfect for Copper Gigabit Ethernet connections

Ports	- 48 ports
Compatibility	- Cat6, Cat5e
Material	- 16-gauge steel
Mounting	- 19" rack mount
Color-coded labeling	- Yes
Shielding	- Unshielded

7.1.9 Power Supply

PDUMH30NET Power Supply



7.1.9 Figure

2.9kW switched PDU distributes, monitors and manages single-phase power in an IT environment. Built-in Java-free network interface helps you remotely monitor load levels to prevent overloads that cause downtime. The PDUMH30NET 2.9kW Single-Phase Switched PDU provides advanced network control and remote power monitoring with the ability to turn on, turn off, reboot or lock out power to each outlet. By reducing the frequency of on-site visits, these advanced remote capabilities can save you money and reduce downtime

Input Voltage	- 120V
Output Voltage	- 120V
Maximum Capacity	- 2.9 kW
Monitoring	- Remote monitoring via web/network
Form Factor	- 2U rack mount
Outlets	- 24 NEMA 5-15/20R outlets

7.1.10 UPS

OR1500LCDRTXL2U SMART APP LCD UPS



7.1.10.1 Figure

Cost-effective feature-rich power protection for networking, servers and telecommunications equipment. The CyberPower Smart App Intelligent LCD OR1500LCDRTXL2U uninterruptible power supply (UPS) is designed to protect office servers, corporate and departmental networks, and network-based appliances such as internetworking hardware, telecom equipment and high-end workstations. Its automatic voltage regulation (AVR) technology delivers a consistent and clean AC power, protecting connected equipment and preventing costly business interruptions. This UPS system is ENERGY STAR® qualified with patented Greenpower UPS™ Bypass circuitry to save on energy costs by reducing energy consumption and heat buildup.

Capacity	- 1500VA/1350W
Form Factor	- 2U rack mount
Runtime	- Up to 11 minutes at full load
Battery Type	- Sealed lead-acid
Monitoring	- LCD display, software management
Outlets	- 8 (6 battery/surge, 2 surge only)

OR500LCDRM1U SMART APP LCD UPS



7.1.10.2 Figure

A rackmount UPS with line interactive topology, the CyberPower Smart App LCD OR500LCDRM1U provides battery backup (using simulated sine wave output) and surge protection for department servers, workgroup servers, workstations, network devices, and telecom installations without active PFC power supplies. The OR500LCDRM1U uses Automatic Voltage Regulation (AVR) to correct minor power fluctuations without switching to battery power, which extends battery life. AVR is essential in areas where power fluctuations occur frequently.

Capacity	- 500VA/300W
Form Factor	- 1U rack mount
Runtime	- Up to 7 minutes at full load
Battery Type	- Sealed lead-acid
Monitoring	- LCD display, software management
Outlets	- 6 (4 battery/surge, 2 surge only)

7.1.11 IP Phones

Cisco IP Phone 8861



7.1.11 Figure

The Cisco® IP Phone 8861 is a business-class collaboration endpoint that combines high-fidelity, reliable, secure, and scalable voice over IP communications with Cisco Intelligent Proximity for telephony integration for personal mobile devices to support small to large enterprise businesses.

Display	- 5" color display
Lines	- Up to 10 lines
Network	- Dual Gigabit Ethernet ports
PoE	- Yes
Audio	- Wideband audio
Security	- Encrypted voice communications

7.1.12 IP Cameras

Cisco Video Surveillance 8400 IP Camera



7.1.12 Figure

The Cisco® Video Surveillance 8400 IP Camera is an outdoor, high-definition, full-functioned video endpoint with an integrated infrared illuminator and industry-leading image quality and processing power.

Resolution	- Up to 4K
Lens	- Varifocal lens
Power	- PoE
Storage	- MicroSD card slot
Connectivity	- RJ45 Ethernet
Environment	- Indoor/outdoor

7.1.13 Fingerprint Machine

ZKTeco K40 Pro Fingerprint Machine



7.1.13 Figure

The ZKTeco K40 Pro Fingerprint Machine is a sleek, compact biometric time attendance device. It features a 2.8-inch color display and supports fingerprint, RFID card, and password recognition, allowing for quick and secure access. With TCP/IP and USB communication options, it's easy to integrate into existing systems. Ideal for small to medium-sized businesses seeking efficient access control.

Fingerprint Capacity - 3,000

ID Card Capacity - 10, 000

Record Capacity - 100, 000

Display - 2.4-inch TFT Screen

Communication - TCP/IP, RS232/485, USB
(host & client) ADMS

Final Result of the Project

