RIPHAH
INTERNATIONAL UNIVERSITY

CNLP CORPORATION
MULTI-SITE NETWORK DESIGN

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INTRODUCTION

This project focuses on designing and implementing a complete multi-site network infrastructure for **CNLP Corporation**. The corporation has two geographically separated offices a **Head Office** and a **Branch Office** each consisting of three functional departments: **HR, IT,** & **Finance**.
The aim of this project is to create a **fully scalable, secure, and efficiently structured network** using advanced networking concepts such as VLAN segmentation, DHCP automation, hierarchical design, and WAN interconnectivity.

The network is simulated using Cisco Packet Tracer, a widely used educational tool for demonstrating real-world network behavior. The team followed industry-standard practices, including modular design, subnetting, multi-layer architecture, and structured documentation.

This report presents the **complete technical documentation** from the initial requirement-gathering phase to the final implementation and verification.

STEP 1: PROJECT SCOPE AND REQUIREMENTS

1.1 STAKEHOLDERS

- **Technical Team Members:** Each member was assigned a specialized role (Topology design, VLAN setup, Routing configuration, DHCP/Server setup, Documentation).
- **Simulated CNLP Corporation:** Represented the client's requirements.

1.2 OBJECTIVES

The primary goal of this project is to build a **secure, reliable, and scalable network** that meets the following requirements:

Functional Objectives:

- Establish two interconnected sites using a **WAN link**.
- Provide departmental **VLANs**.
- Enable inter-VLAN communication using **router-on-a-stick**.
- Automate IP assignment using **DHCP**.
- Configure a **DNS server** for name resolution.
- Ensure full connectivity between respective departments across sites.

Non-Functional Objectives:

- Maintain scalability for future growth.
- Apply security principles via VLAN segmentation.
- Follow Cisco hierarchical network model.
- Provide detailed and professional documentation.

1.3 TECHNICAL REQUIREMENTS

Requirement	Description
VLAN Segmentation	Each department must operate inside its own VLAN.
WAN Connectivity	Both sites must be linked via a router-to-router WAN link.
Dynamic Routing	OSPF must be implemented to allow route sharing.
DHCP Integration	Automatic IPv4 addressing for client PCs.
DNS	Central server for name resolution.
Packet Tracer Simulation	Project must be fully functional in simulation.
Testing Documentation	Screenshots for connectivity, routing, DHCP, VLANs.

STEP 2: LOGICAL REQUIREMENTS

2.1 NETWORK USERS AND DEPARTMENTS

Each site contains:

- HR Department
- IT Department
- FINANCE Department

Each department includes 5 PCs and 1 switch, totaling:

- 15 PCs per site
- 30 PCs company-wide

2.2 COMMUNICATION REQUIREMENTS

Internal Site Communication:

- All PCs must communicate within their VLAN.
- Access to shared servers limited to authorized VLANs.

Inter-Department Communication:

- Not all departments communicate directly.
- IT department may monitor or assist other departments.
- Finance and HR remain isolated unless required.

Inter-Site Communication:

- Department-to-department communication across sites
  (HR <> HR, IT <> IT, Finance <> Finance)
- WAN link must remain stable, with OSPF ensuring redundancy in routing updates.

STEP 3: LOGICAL TOPOLOGY DESIGN

The network follows a modular structured design:

- Access Layer: PCs and departmental switches
- Distribution Layer: Router-on-a-stick for inter-VLAN routing
- Core Layer: OSPF-based routed backbone between sites

3.1 DEVICE INVENTORY

Each site contains:

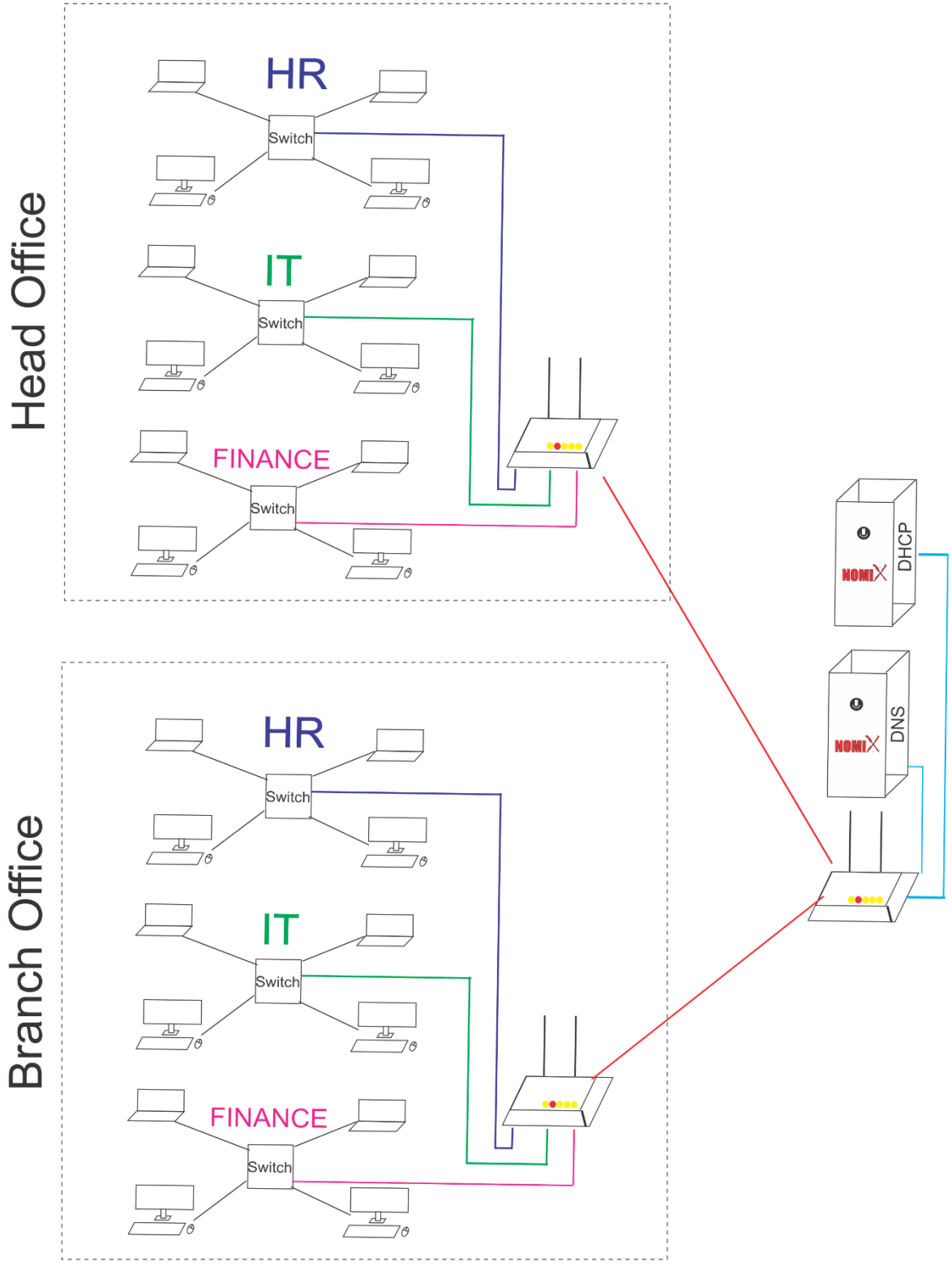
- 3 Access Switches (for HR, IT, Finance)
- 1 Router
- 5 PCs per department
- DHCP & DNS Servers (Head Office only)
- WAN connection between routers

3.2 TOPOLOGY DIAGRAM EXPLANATION

The diagram includes:

- Color-coded VLAN cables
- Router sub-interfaces for each VLAN
- Trunk links connecting switches to routers
- Serial link/ethernet WAN between Head and Branch routers
- DHCP and DNS servers connected to Head Office router

CNLP Corporation



STEP 4: VLAN DESIGN & CONFIGURATION

4.1 PURPOSE OF VLANS

VLANs provide:

- **Security**: prevents HR from accessing IT data
- **Performance**: reduces broadcast domain sizes
- **Scalability**: allows departments to expand without redesigning physical layout
- **Better Management**: simplifies troubleshooting

4.2 VLAN TABLE

Department	HO VLAN	BO VLAN
HR	2	3
IT	2	3
Finance	2	3

4.3 VLAN CREATION, ACCESS PORTS & TRUNKS

After VLANs were created, all PCs were mapped to their respective VLANs using access ports.
A dedicated trunk port was configured on each switch to carry VLAN traffic to the router.

STEP 5: IP ADDRESSING & SUBNETTING

5.1 ADDRESSING STRATEGY

A /24 subnet per department ensures:

- 254 usable IPs
- Easy expansion
- Clean addressing structure

5.2 FINAL IP ALLOCATION

VLAN	Network	Gateway
2	192.168.2.0/24	192.168. 2.33
2	192.168.2.0/24	192.168.2.65
2	192.168.2.0/24	192.168. 2.161
3	192.168.3.0/24	192.168.3.33
3	192.168.3.0/24	192.168.3.65
3	192.168.3.0/24	192.168.3.97

5.3 ROUTER SUB-INTERFACE CONFIGURATION EXPLANATION

Router-on-a-stick allows:

- Multiple VLANs over one physical interface
- Sub-interface per VLAN
- Encapsulation using 802.1Q

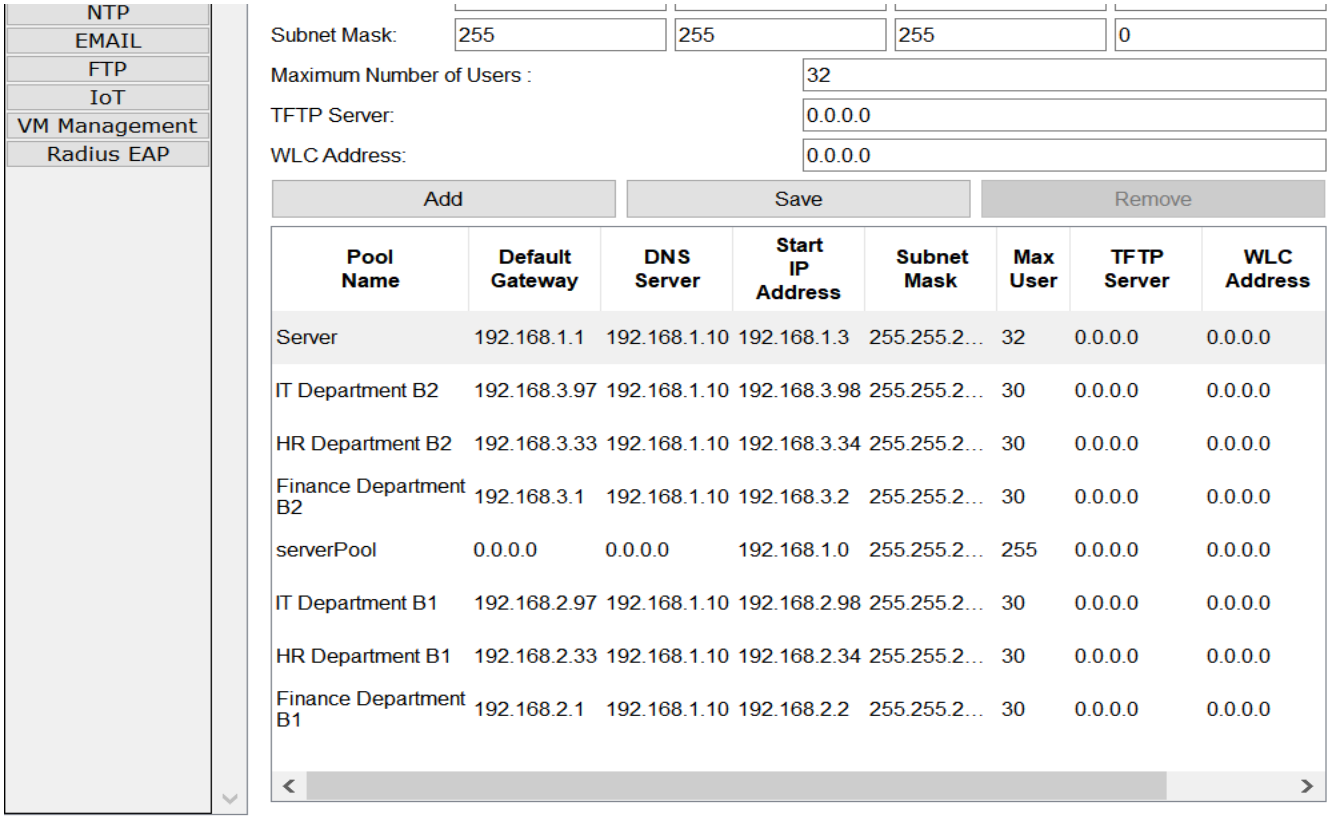
STEP 6: DHCP SERVER CONFIGURATION

The DHCP server handles:

- Automatic IP assignment
- Subnet mask
- Gateway
- DNS address

Centralized DHCP ensures simplified management and eliminates manual IP assignment.

Each VLAN has a separate DHCP pool.



Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Server	192.168.1.1	192.168.1.10	192.168.1.3	255.255.2...	32	0.0.0.0	0.0.0.0
IT Department B2	192.168.3.97	192.168.1.10	192.168.3.98	255.255.2...	30	0.0.0.0	0.0.0.0
HR Department B2	192.168.3.33	192.168.1.10	192.168.3.34	255.255.2...	30	0.0.0.0	0.0.0.0
Finance Department B2	192.168.3.1	192.168.1.10	192.168.3.2	255.255.2...	30	0.0.0.0	0.0.0.0
serverPool	0.0.0.0	0.0.0.0	192.168.1.0	255.255.2...	255	0.0.0.0	0.0.0.0
IT Department B1	192.168.2.97	192.168.1.10	192.168.2.98	255.255.2...	30	0.0.0.0	0.0.0.0
HR Department B1	192.168.2.33	192.168.1.10	192.168.2.34	255.255.2...	30	0.0.0.0	0.0.0.0
Finance Department B1	192.168.2.1	192.168.1.10	192.168.2.2	255.255.2...	30	0.0.0.0	0.0.0.0

STEP 7: TESTING & VERIFICATION

7.1 CONNECTIVITY TESTS

PC-to-PC Ping:

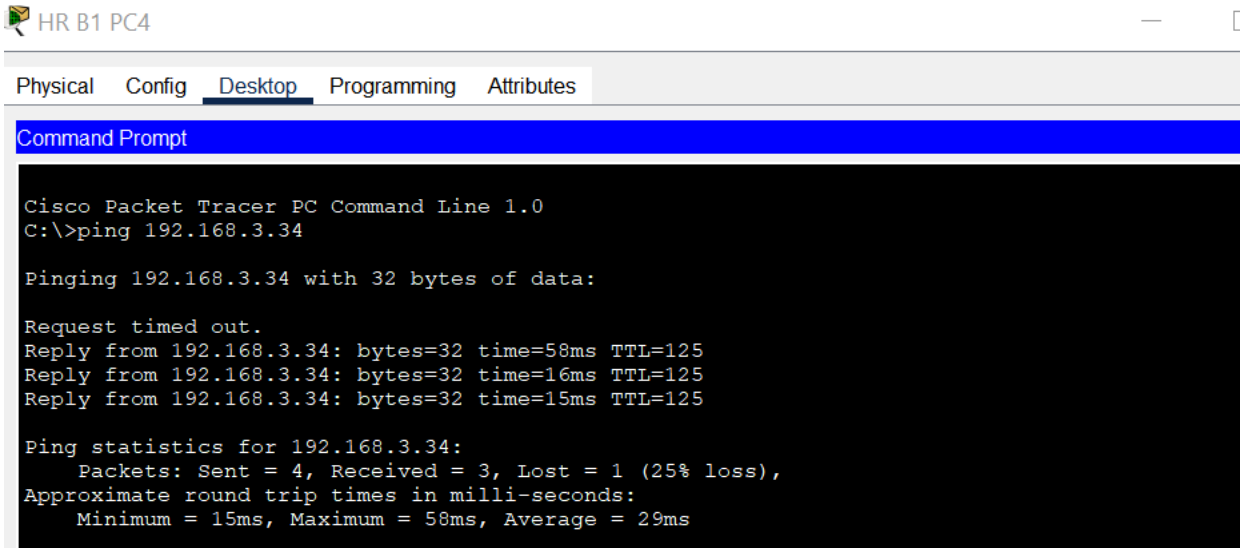
- Each PC tested connectivity within its VLAN.

Inter-VLAN Tests:

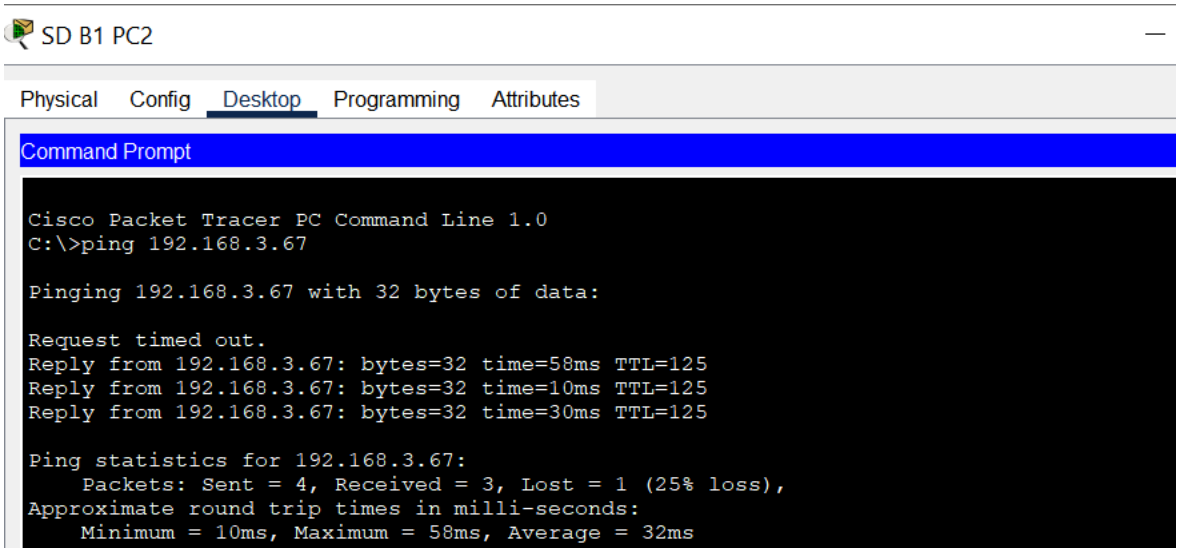
- Router successfully routed packets between VLANs.

Inter-Site Connectivity Tests:

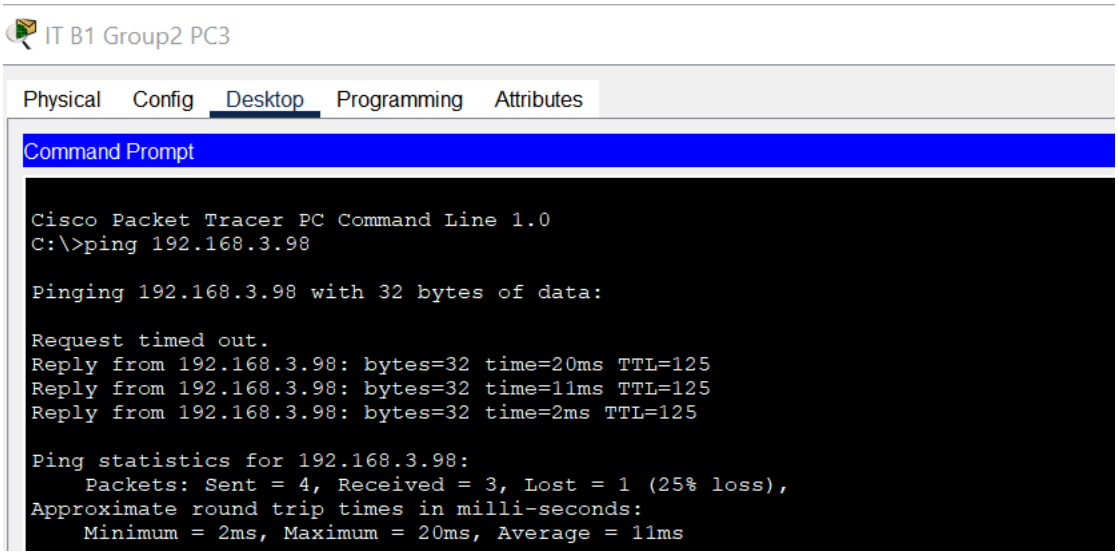
- HR(HO) > HR(BO)



- IT(HO) > IT(BO)



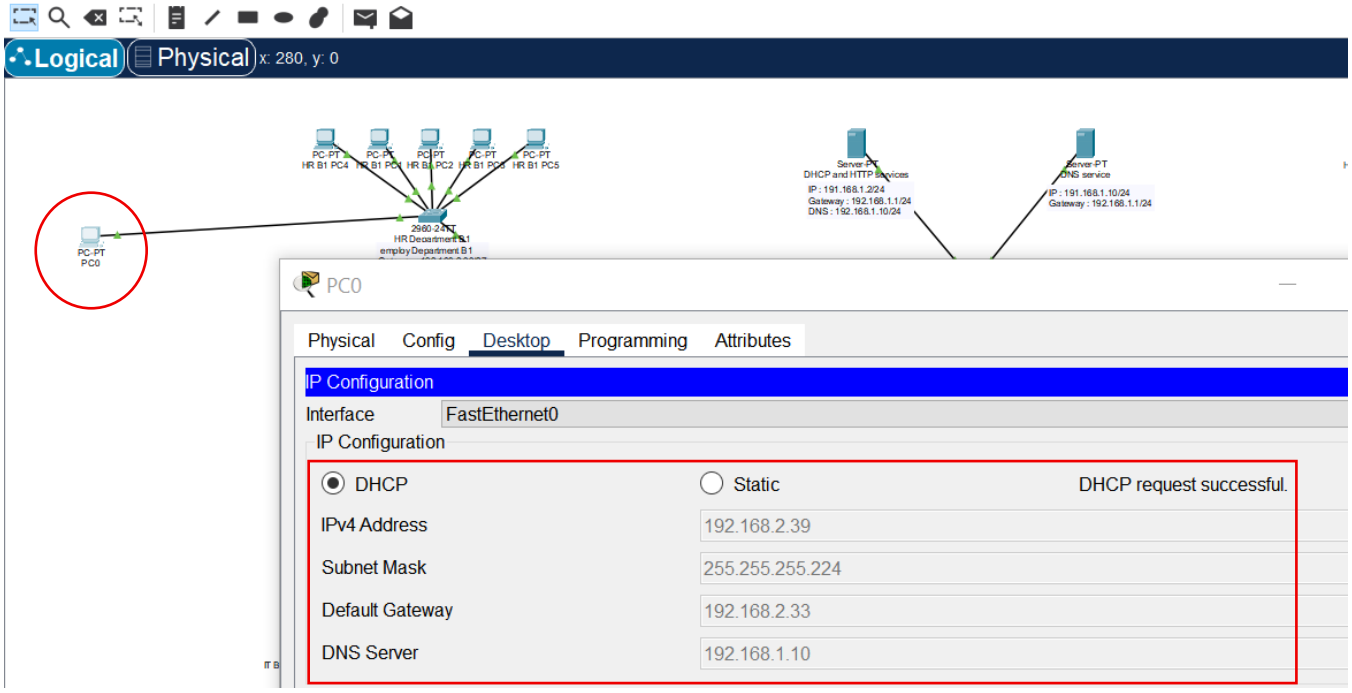
- Finance(HO) > Finance(BO)



7.2 DHCP TESTS

Each PC received:

- Correct IP
- Correct Gateway
- Correct DNS



STEP 8: LIMITATIONS & FUTURE IMPROVEMENTS

Limitations

- Only one WAN link (no redundancy).
- No ACLs applied (possible future security addition).
- No firewall configured.
- Basic DNS usage.

Future Enhancements

- Add multi-area OSPF for large-scale expansion.
- Add ACLs for department-level security.
- Implement backup WAN link for redundancy.
- Add IPv6 addressing.
- Add wireless networks.

STEP 9: CONCLUSION

This project successfully demonstrated the design and implementation of a **complete enterprise-level multi-site network**.
Using VLANs, DHCP, DNS, and hierarchical topology design, the CNLP Corporation network is now scalable, efficient, and secure.

Each team member contributed significantly according to the proposal. All project objectives were fully achieved.

STEP 10: GITHUB REPOSITORY

https://github.com/nomi2k4/cnlp-corporation-network