

CS215 – Data Communications and Management

Semester II, 2024

Mode: Face to Face

Assignment 2 – Network Design

Total Marks:

Weight: 20%

Case Scenario: – Network Analysis

Assignments Objectives:

This assignment tests the following course learning outcomes and the associated CBOK Attributes: CLO 2, 4 & 5

- Plan access control for a network.
- Build a secure LAN and WAN topology.
- Apply basic professional practices and ethics to Network Security and Management.

Note:

Generally, the Network analysis provides the capacity to estimate complex patterns of relationships and the network structure that can be analyzed to reveal core features of the network. When it comes to troubleshooting network configurations, a network architecture diagram removes the guesswork from the equation. It saves resources such as money and time when it comes to restarting a network. With an organized outline of how the components work together harmoniously, it is easier to pinpoint the specific areas where errors or problems may occur. This is very important for businesses that rely on these networks for their output. Time is of the essence and industries cannot afford any prolonged stoppage or interruption. With a network diagram, the hope is that any downtime can be sorted quickly with reliability as a guide. And so, for this assignment [A2], we will be commencing with XYZ Corporation's network layout to respond to the assignment requirements.

Introduction:

XYZ Corporation, a mid-sized company, is expanding its operations and upgrading its network infrastructure to support better security and efficient IP management. The IT department has been tasked with implementing VLANs for different departments, DHCP to dynamically allocate IP addresses, and Access Control Lists (ACLs) to restrict access between departments based on security policies. The company also requires separate VLANs for servers, along with access restrictions for the print server and printers.

You will need to subnet the network using VLSM (Variable Length Subnet Masking) to efficiently allocate IP addresses for each VLAN. Your task is to design, configure, and simulate this network using Cisco Packet Tracer.

The departments in XYZ Corporation include:

- Sales
- HR
- Finance
- IT
- Management

Additionally, the servers, printers, and print server will have their own dedicated VLANs for improved security and performance.

You have XYZ Corporation, and the management have mentioned few problems faced and require immediate assistance with minimal costs. The following key problems faced by XYZ Corporation can be addressed and resolved using Access Control Lists (ACLs) to manage traffic between different VLANs and enforce security policies:

- HR staff should not have access to Finance data. Implement an ACL to deny HR access to Finance VLAN.
- Sales staff should not have access to IT resources. Implement an ACL to deny Sales VLAN access to the IT VLAN.
- Management will have full access to all departments. Create an ACL that permits traffic from the Management VLAN to all other VLANs.

- Implement an ACL that denies IT VLAN access to Finance VLAN while allowing access to Sales and HR.
- Sales, HR, and Finance can access servers, which they should not. i.e. Only the Management and IT VLANs should be allowed to access the Servers VLAN. Deny access to all other VLANs.

These ACL configurations will address all the outlined problems and ensure that only authorized traffic flows between VLANs, thus improving security and network management in XYZ Corporation.

Task 1: Subnet Calculation using VSLM

Subnet the network 172.16.0.0/16 so that Sales, HR, Finance, IT, Management, Servers, Printers and Print Server are in their respective subnets.

Use VLSM – Variable Length Subnet Mask.

Instructions for Subnet Calculation:

- Calculate the required subnets and their corresponding subnet masks using VLSM.
- Ensure efficient IP address usage by assigning the smallest possible subnet for each department and device group.
- Provide the following details for each department:
 1. Subnet Address
 2. Subnet Mask
 3. Usable IP Range
 4. Broadcast Address

Fill in the following table after calculating the subnets:

Table 1 - Subnet Allocation Using VLSM

Department	Network	Subnet Mask	Usable IP Range	Broadcast Address
Sales				

HR				
Finance				
IT				
Management				
Servers				
Printers				
Printer Server				

Task 2: VLAN Configuration

The Director of XYZ Corporation does not have the funds to purchase separate switches for each of the networks or even upgrade the router. Therefore, you are required to re-configure the network. (Hint – each of the Departments needs to be allocated VLAN).

Fill in the table below:

Table 2 – VLANs for each department.

Department	VLAN ID	Switch Ports
Sales		Port 1 to Port 3
HR		Port 4 to Port 7
Finance		Port 8 to Port 10
IT		Port 11 to Port 14
Management		Port 15 to Port 17
Servers		Port 18 to Port 20

Printers		Port 21 to Port 22
Printer Server		Port 23 to Port 24

Task 3: DHCP Configuration Using VLSM Subnets

You are required to configure the router to act as the DHCP server for each VLAN. The DHCP pool for each VLAN should be based on the VLSM subnets you calculated in Task 1.

Instructions for DHCP Configuration:

- Create a DHCP pool for each VLAN using the appropriate subnet address and subnet mask.
- Ensure the correct default gateway for each pool.
- Assign DNS server IP as 8.8.8.8.

Fill in the table with the DHCP pools for each department:

Table 3: DHCP Pool Configuration

Department	DHCP Pool Range	Subnet Mask	Default Gateway
Sales			
HR			
Finance			
IT			
Management			
Servers			
Printers			

Printer Server			
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Task 4: Router on a Stick Configuration

You will configure inter-VLAN routing using a single physical interface on the router (Router on a Stick). Each VLAN will be assigned a subinterface on the router.

Instructions for Router Configuration:

- Create subinterfaces for each VLAN.
- Configure encapsulation (dot1Q) for each subinterface with the corresponding VLAN ID.
- Assign the gateway IP address for each VLAN using the first usable IP in the range calculated in Task 1.

Task 5: ACL Configuration

You will configure Access Control Lists (ACLs) to enforce security policies and restrict access between the VLANs.

Problems to Solve Using ACLs:

1. HR staff should not have access to Finance data. Implement an ACL to deny HR access to Finance VLAN.
2. Sales staff should not have access to IT resources. Implement an ACL to deny Sales VLAN access to the IT VLAN.
3. Management will have full access to all departments. Create an ACL that permits traffic from the Management VLAN to all other VLANs.
4. Implement an ACL that denies IT VLAN access to Finance VLAN while allowing access to Sales and HR.
5. Sales, HR, and Finance can access servers, which they should not. i.e. Only the Management and IT VLANs should be allowed to access the Servers VLAN. Deny access to all other VLANs.

Instructions for ACL Configuration:

- Create ACL rules to implement the specified security policies.

- Apply the ACLs to the appropriate router interfaces.

Task 6: Network Simulation in Cisco Packet Tracer

- Create the network topology in **Cisco Packet Tracer** based on your VLSM calculations and VLAN assignments.
- Configure the switch for VLANs and the router for **inter-VLAN routing** and DHCP.
- Test the network by verifying that each department can communicate as per the **ACL rules** and that clients are receiving IP addresses dynamically from the **DHCP server**.
- Ensure that the **Print Server** can only communicate with **Printers**.

Task 7: Documentation and Submission

You are required to submit the following:

- A **completed report** with the filled tables for the subnet calculation, VLAN configuration, and DHCP pool.
- A **Packet Tracer file** showing the configured network.
- A **list of all the commands** used for VLAN, DHCP, router, and ACL configurations with test connectivity results.
- A brief explanation of how the **ACLs** are used to secure the network and how **VLSM** optimizes the IP address allocation.

Submission Details

Submit the Packet Tracer Files on Moodle using the Project Leaders account. The filename should be read by the student IDs only. Ensure not to zip the file.

Incorrect submissions will result in a loss of marks or simply a mark of zero.

LATE SUBMISSION = ZERO (0) Plagiarism

No two teams should submit the same or similar assignment.

Queries

- Maintain contact through Moodle discussion forum named *Assignment Discussion Forum*.

- Feel free to consult the Lecturer/Course Coordinator during the online consultation hour or tutorial hours for queries.

Team Work

You are required to form a team of at least (max) 3-4 members for this assignment. Any additional remarks can be discussed with the Course coordinator/Lecturer only.

Assignment Mark Distribution

The total marks for this assignment are **80 marks**, distributed across various tasks as follows:

Task	Marks
Task 1: Subnet Calculation (VLSM)	10
Task 2: VLAN Configuration	10
Task 3: DHCP Configuration	10
Task 4: Router on a Stick Configuration	10
Task 5: ACL Configuration	15
Task 6: Network Simulation in Packet Tracer	10
Task 7: Documentation	15
Total	80

Assignment 2 Mark Allocation Sheet

After having discussed it as a group, we recommend the following mark allocation to each group member based on contribution or lack of it throughout the assignment.

Group number - [Accepted max of 3-4 members]

Project manager _____

Member ID	Percentage contribution	Responsibilities

Signed

Member Name

ID

Signature

The End!

Appendix

