

VxLEARN Networks

Networking & Cybersecurity Track
Simulated Employment Program

Lab Report: **Observe Traffic Flow in a Routed Network**

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Date: 11 November 2025

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1. Introduction

This report demonstrates how network segmentation and routing improve efficiency in a growing business environment.

Using Cisco Packet Tracer, we observed how broadcast traffic behaves in a single flat network, then reconfigured the network into separate routed subnets, and compared the traffic patterns before and after routing.

2. Background and Scenario

XYZ LLC is expanding rapidly and is currently using a single flat network for all departments. With approximately 150 connected devices, this design has led to performance issues due to excessive broadcast traffic.

To address this, a routed network design will be implemented. Routing separates departments into independent subnetworks, improving traffic handling, segmentation, and scalability.

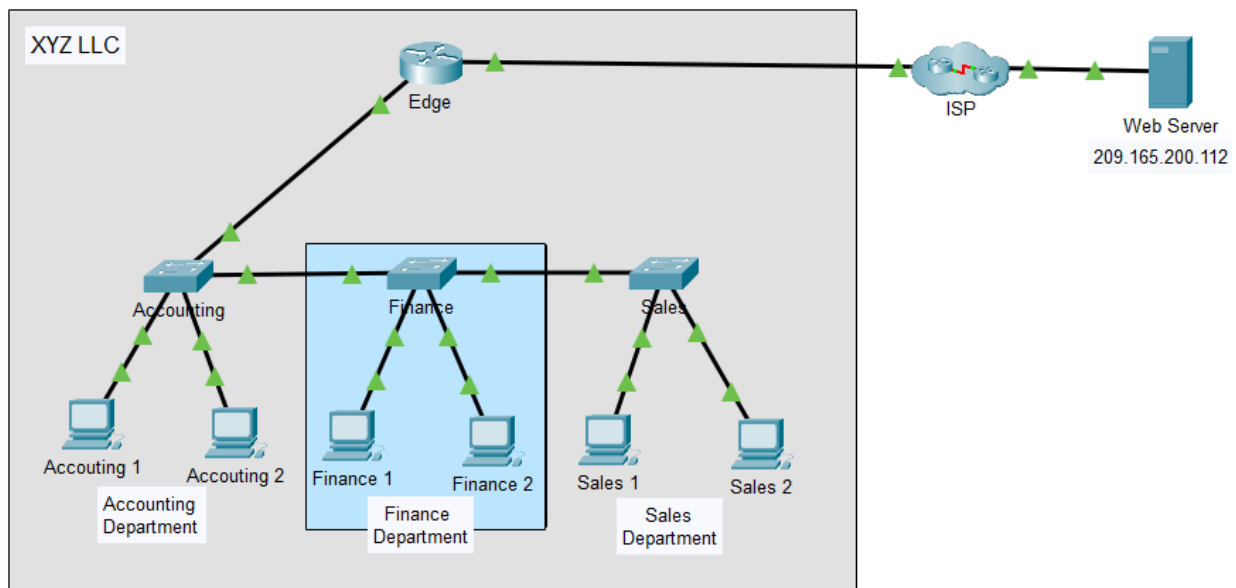
3. Objectives

- Observe communication in a single broadcast domain.
- Reconfigure the network to support multiple routed networks.
- Compare network behavior before and after routing is applied.

4. Network Topology Overview

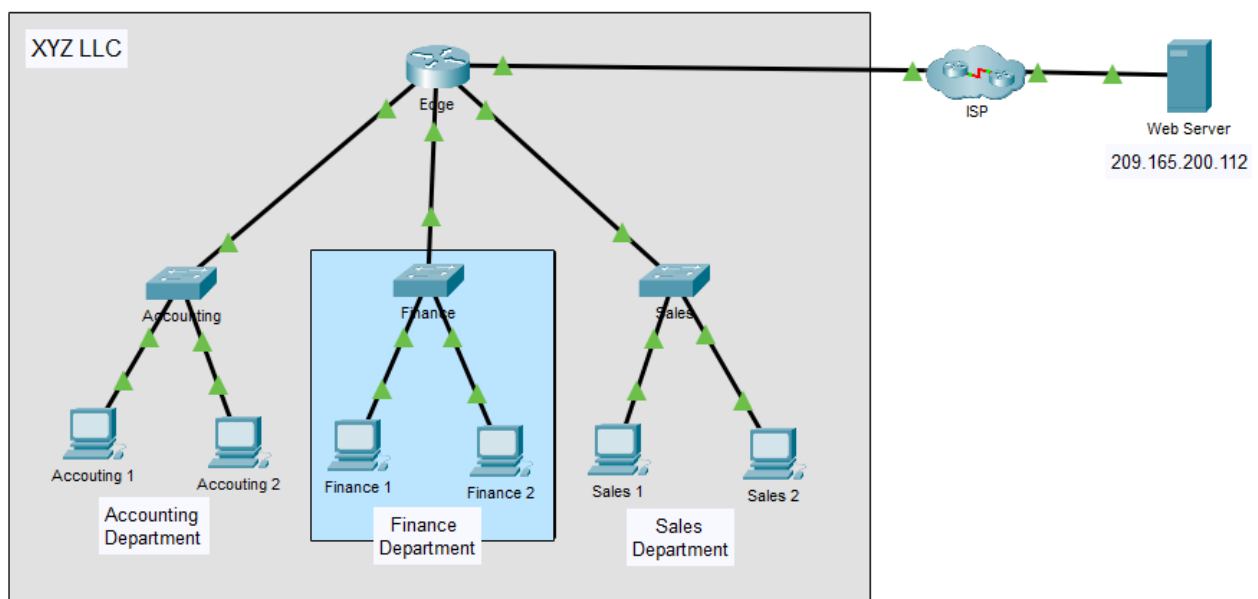
Initially:

- All hosts are in one LAN.
- The router only provides connectivity to the ISP.
- Department switches: one switch per department (Sales, Finance, Accounting).
- Host devices: multiple PCs connected to each department switch (e.g., Sales1, Sales2, etc.).
- Switch interconnections: the department switches are connected to each other using Ethernet links so they form one big switched fabric.
- Edge Router: one router connected to the switch fabric; it provides Internet/ISP access via its WAN interface (to the cloud). The router's LAN interface is also connected into the same switch fabric.



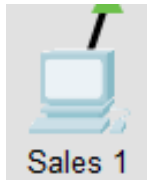
After reconfiguration:

- Each department switch now connects directly to its own Edge router interface.
- The old switch-to-switch links were removed, so the single large broadcast domain is gone.
- Accounting, Finance, and Sales each run on their own IPv4 subnet provided by the router's DHCP service.
- All interdepartment traffic now flows through the router instead of flooding the LAN.
- Broadcasts stay inside each department network, improving efficiency and reducing congestion.



5. Part 1 – Observe Traffic Flow in an Unrouted LAN

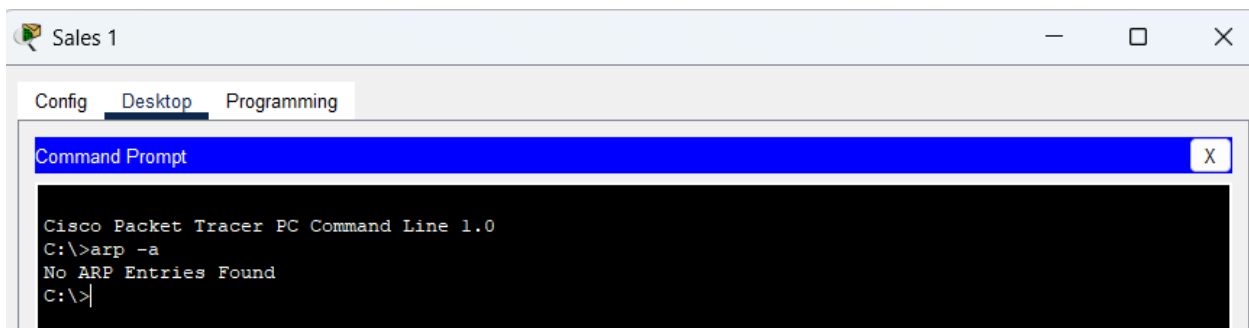
Step 1: Clear the ARP cache on host Sales 1.



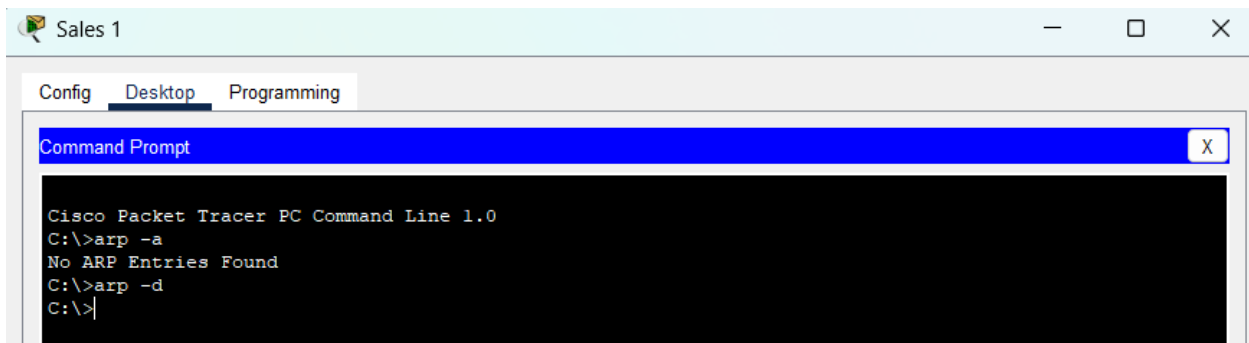
Open Sales 1 > Desktop > Command Prompt

Run: `arp -a` (displays the current ARP table)

If entries exist: `arp -d` (clears all ARP entries)



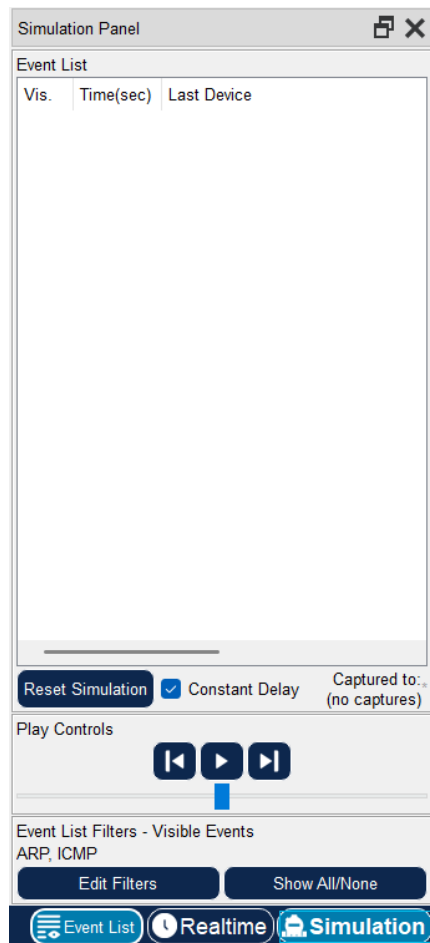
Sales1 ARP before



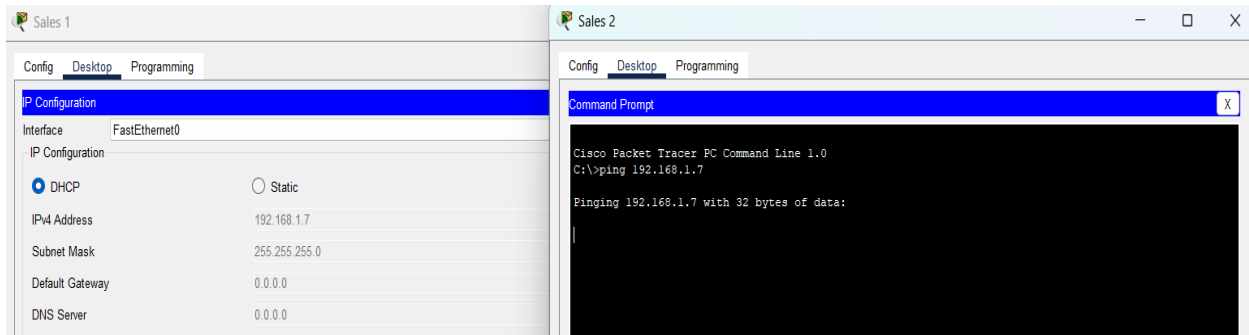
Sales1 ARP after

Step 2: Observe Traffic Flow in Simulation Mode

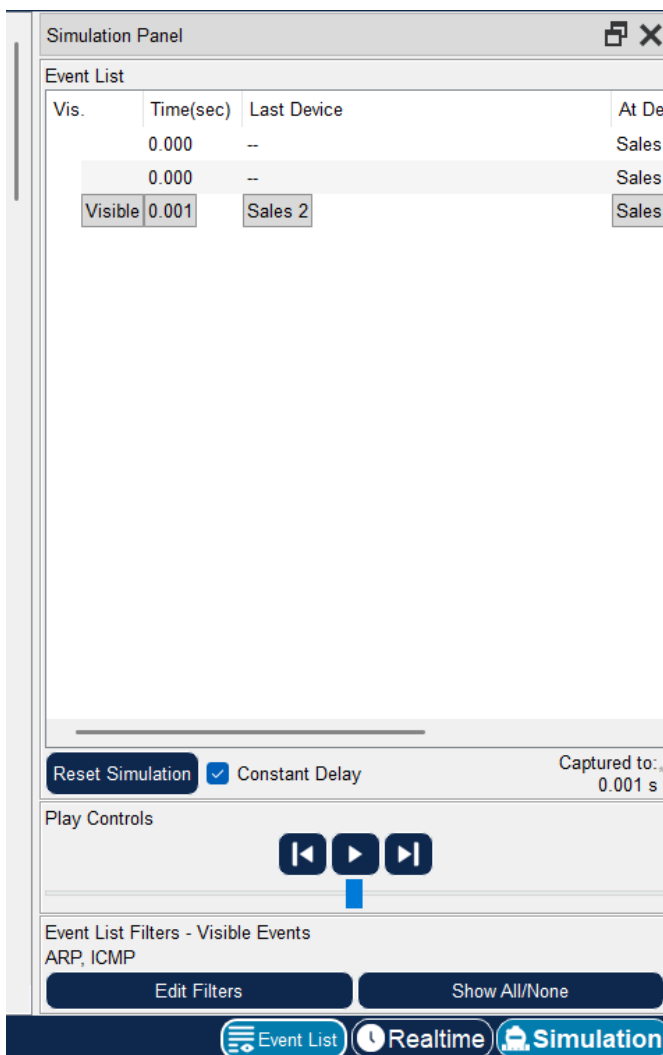
a. Enter Simulation mode

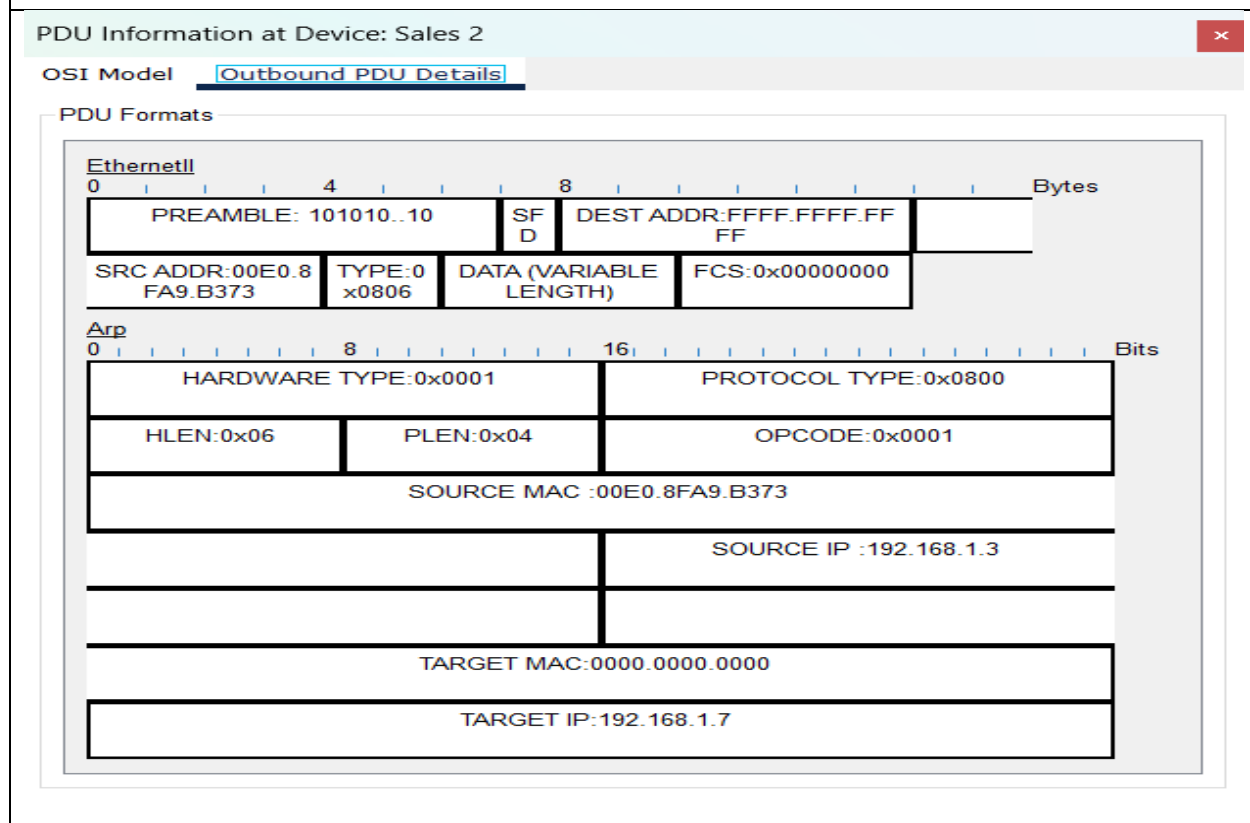
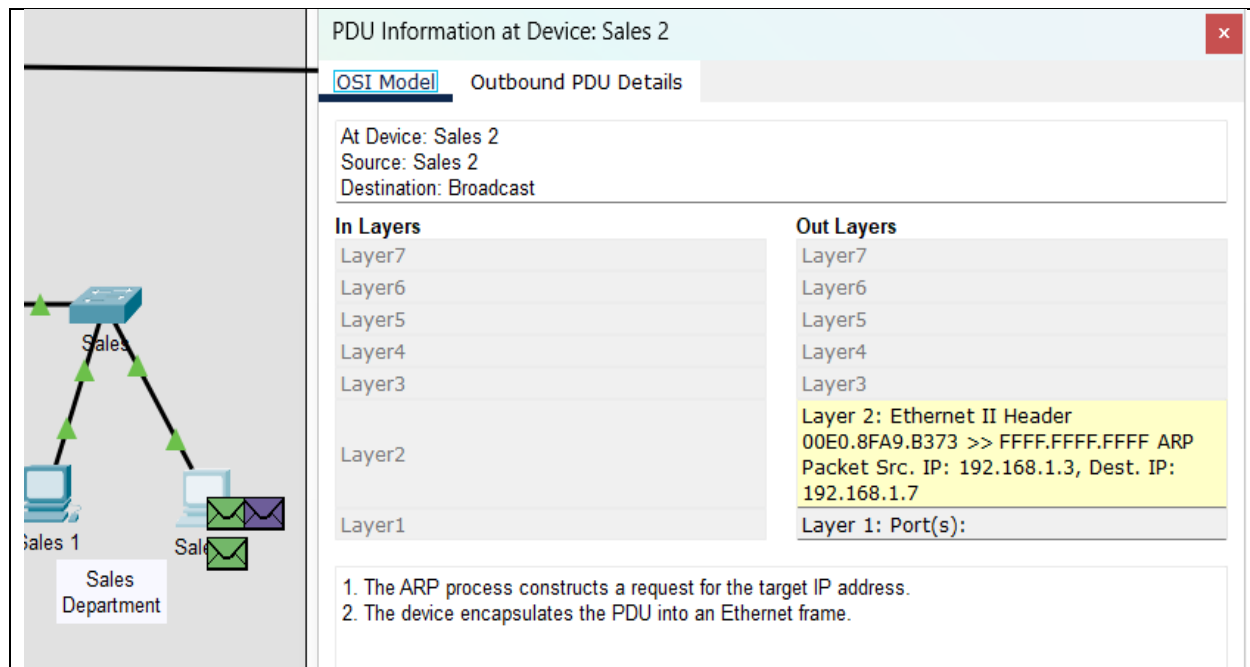


b. On Sales 2 run: ping 192.168.1.7 (Sales1_IP)



c. Use Capture / Forward to observe PDUs (the triangle pointing to the right with a vertical bar attached in the Play Controls of the Simulation Panel)





Initial PDU - You will see a colored envelope appear this envelope is the ARP request.

Source/Destination MAC/IP?

- Source MAC: Sales 2's MAC address (00E0.8FA9.B373)
- Destination MAC: ff:ff:ff:ff:ff:ff (broadcast)
- Source IP: Sales 2's IP address (192.168.1.3)
- Destination IP: Sales 1's IP address (192.168.1.7)

Why is the destination MAC broadcast?

- Because Sales 2 does not yet know Sales 1's MAC address, so it must send an **ARP request** to every device on the LAN to discover it.

d. Advance PDUs until new PDU appears

The screenshot shows the Simulation Panel with the Event List table and Play Controls.

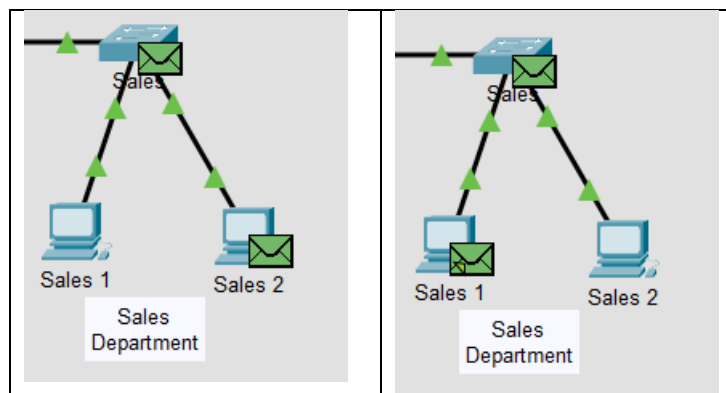
Vis.	Time(sec)	Last Device	At De
	0.000	--	Sales
	0.000	--	Sales
	0.000	--	Sales
	0.001	Sales 2	Sales
	0.001	--	Sales
	0.002	Sales 2	Sales
	0.002	Sales	Sales
	0.002	Sales	Finan
Visible	0.003	Sales	Sales
Visible	0.003	Sales	Finan
Visible	0.003	Finance	Finan
Visible	0.003	Finance	Finan
Visible	0.003	Finance	Accou

Below the table, there are buttons for "Reset Simulation", "Constant Delay" (checked), and "Captured to: 0.003 s".

Play Controls include buttons for "Previous", "Play", and "Next".

Event List Filters - Visible Events: ARP, ICMP. Buttons for "Edit Filters" and "Show All/None" are present.

At the bottom, there are tabs for "Event List", "Realtime", and "Simulation".



This movement is the "ARP Request Path"

Observation of ARP Request Movement

When Sales 2 sends the ping, it first creates an ARP request because it does not know Sales 1's MAC address. The ARP request is broadcast, so the PDU leaves Sales 2, goes to the switch, and is forwarded out all switch ports. Every device on the LAN receives the broadcast, including Sales 1. Sales 1 recognizes its own IP in the ARP request and prepares an ARP reply, while all other devices simply ignore it.

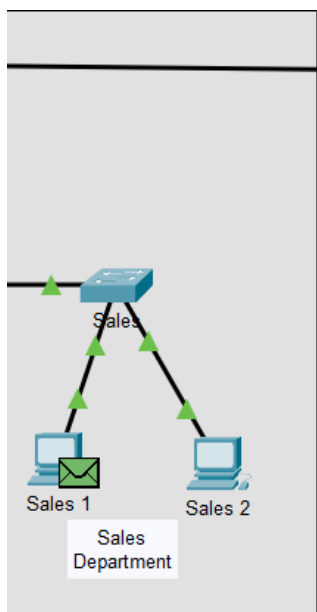
Which devices processed the ARP request packets?

All hosts and the switch on the LAN receive the ARP broadcast. Only Sales 1 replies, but every device must process the request.

How does this affect network efficiency?

Because ARP requests are broadcast, every device on the LAN is interrupted and must inspect the packet. As the LAN grows, these frequent broadcasts create unnecessary traffic and slow the network down.

e. Inspect new PDU



PDU Information at Device: Sales 1

OSI Model | Inbound PDU Details | Outbound PDU Details

At Device: Sales 1
Source: Sales 2
Destination: Broadcast

In Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer 2: Ethernet II Header
00E0.8FA9.B373 >> FFFF.FFFF.FFFF ARP
Packet Src. IP: 192.168.1.3, Dest. IP:
192.168.1.7
- Layer 1: Port FastEthernet0

Out Layers

- Layer7
- Layer6
- Layer5
- Layer4
- Layer3
- Layer 2: Ethernet II Header 0060.70EC.
83C3 >> 00E0.8FA9.B373 ARP Packet Src.
IP: 192.168.1.7, Dest. IP: 192.168.1.3
- Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

ARP Reply

What type of PDU is this?

It is an **ARP Reply** (also called an ARP Response).

Source/Destination MAC/IP?

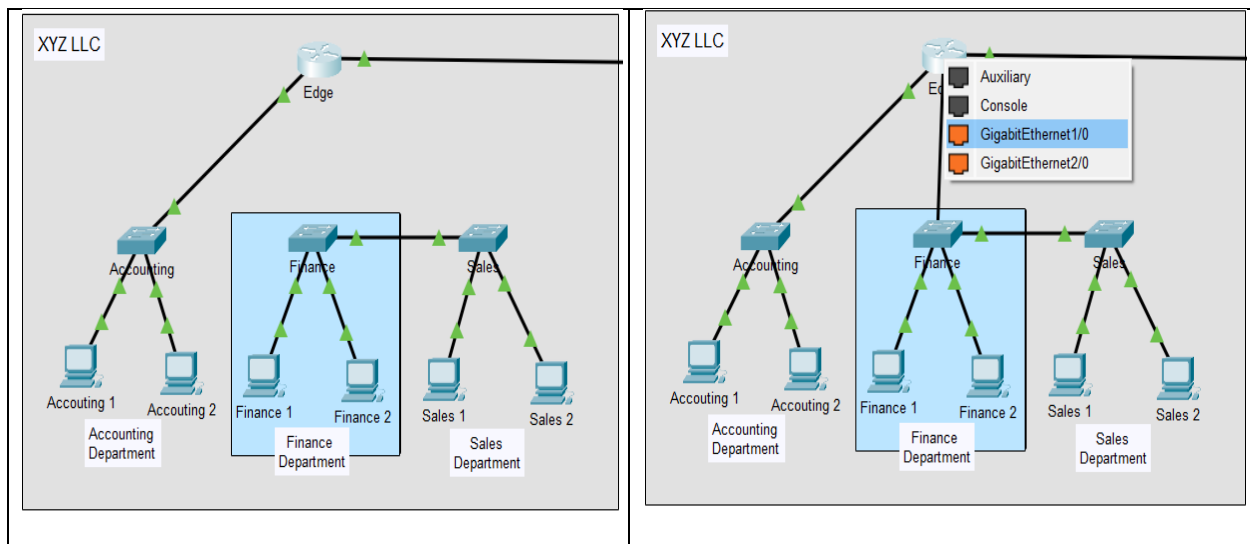
- Source MAC: This is the MAC address of Sales 1, the device replying. (00E0.8FA9.B373)
- Destination MAC: This is Sales 2's MAC address, the requester. (00E0.8FA9.B373)
- Source IP: Sales 1's IP address (192.168.1.7)
- Destination IP: Sales 2's IP address (192.168.1.7)

6. Part 2: Reconfiguring the Network for Routed Communication

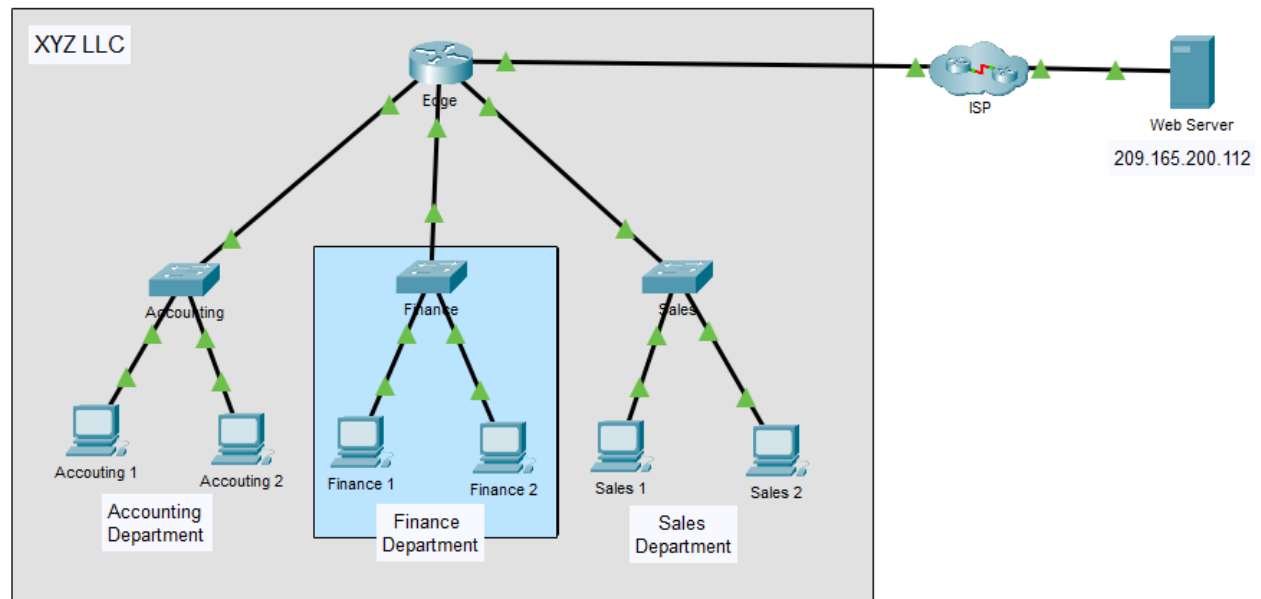
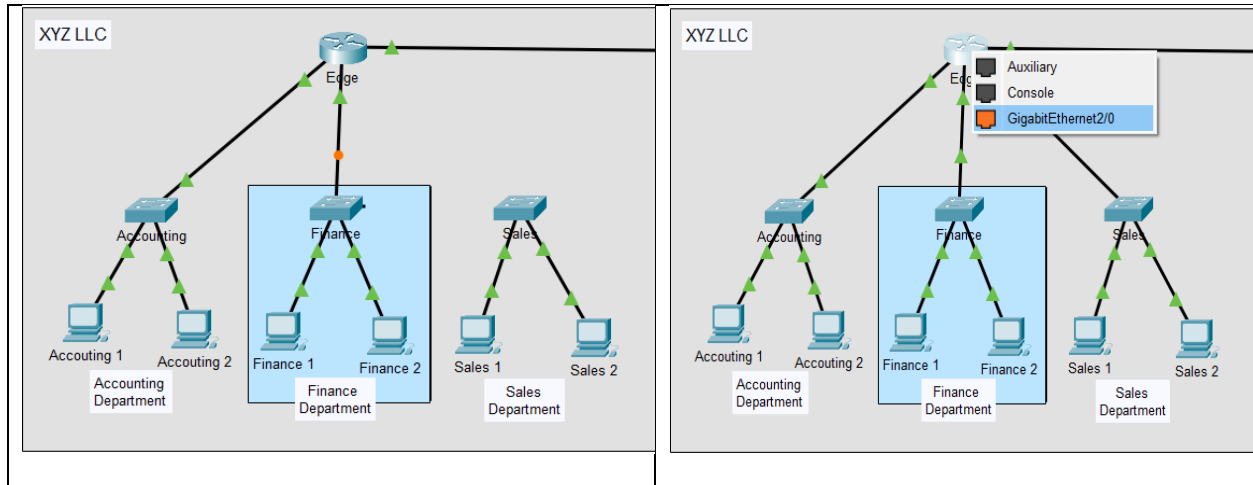
Step 1 – Re-cable Each Switch Directly to the Router

Sales, Finance, Accounting → connect individually to Edge Router GigabitEthernet interfaces.

- a. Disconnect Accounting-Finance link; reconnect Accounting switch to Edge router Gi1/0



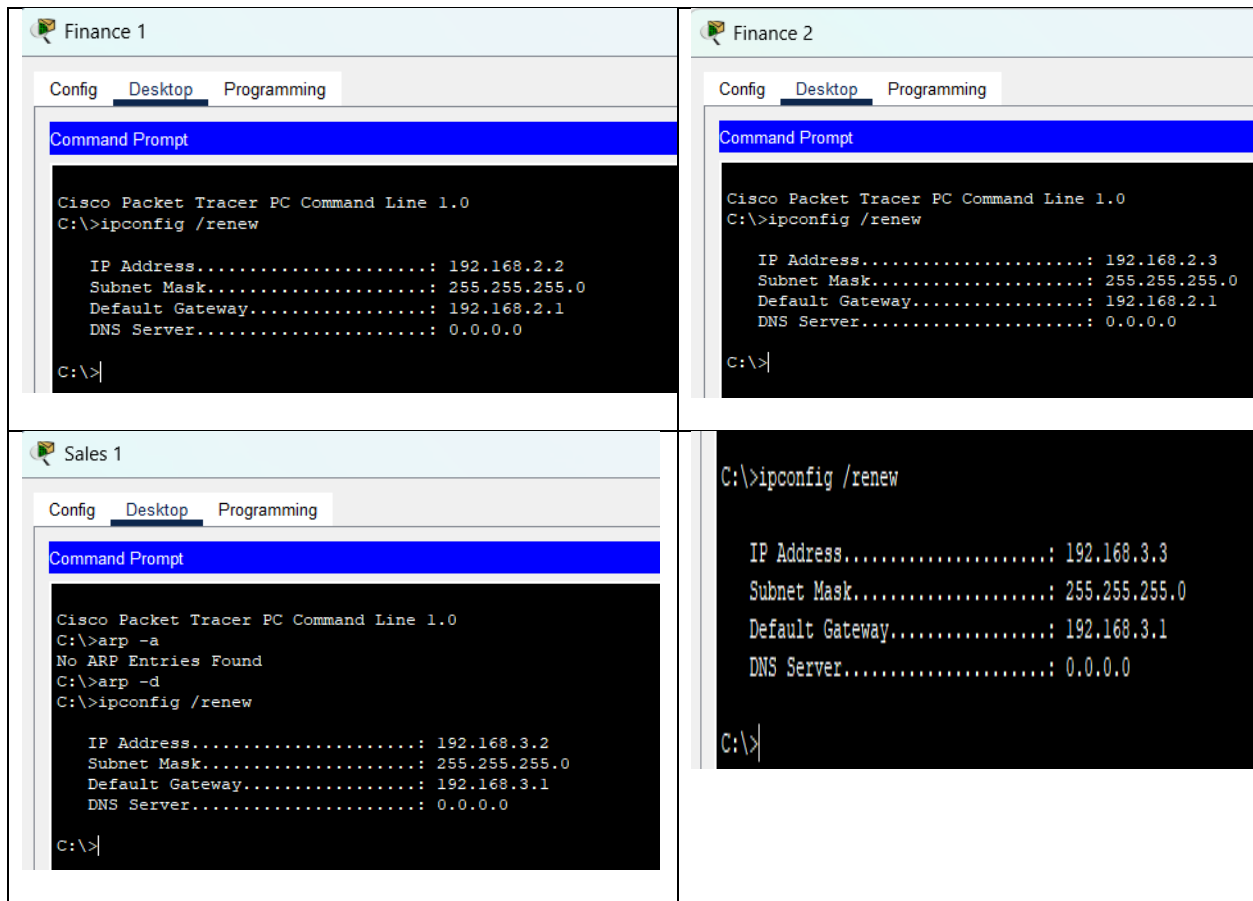
b. Repeat for Finance-Sales link; connect to available router port



Updated Topology

Step 2 – Force Clients to Renew IP Addresses

a. Open Command Prompt on Finance and Sales hosts; run ipconfig /renew



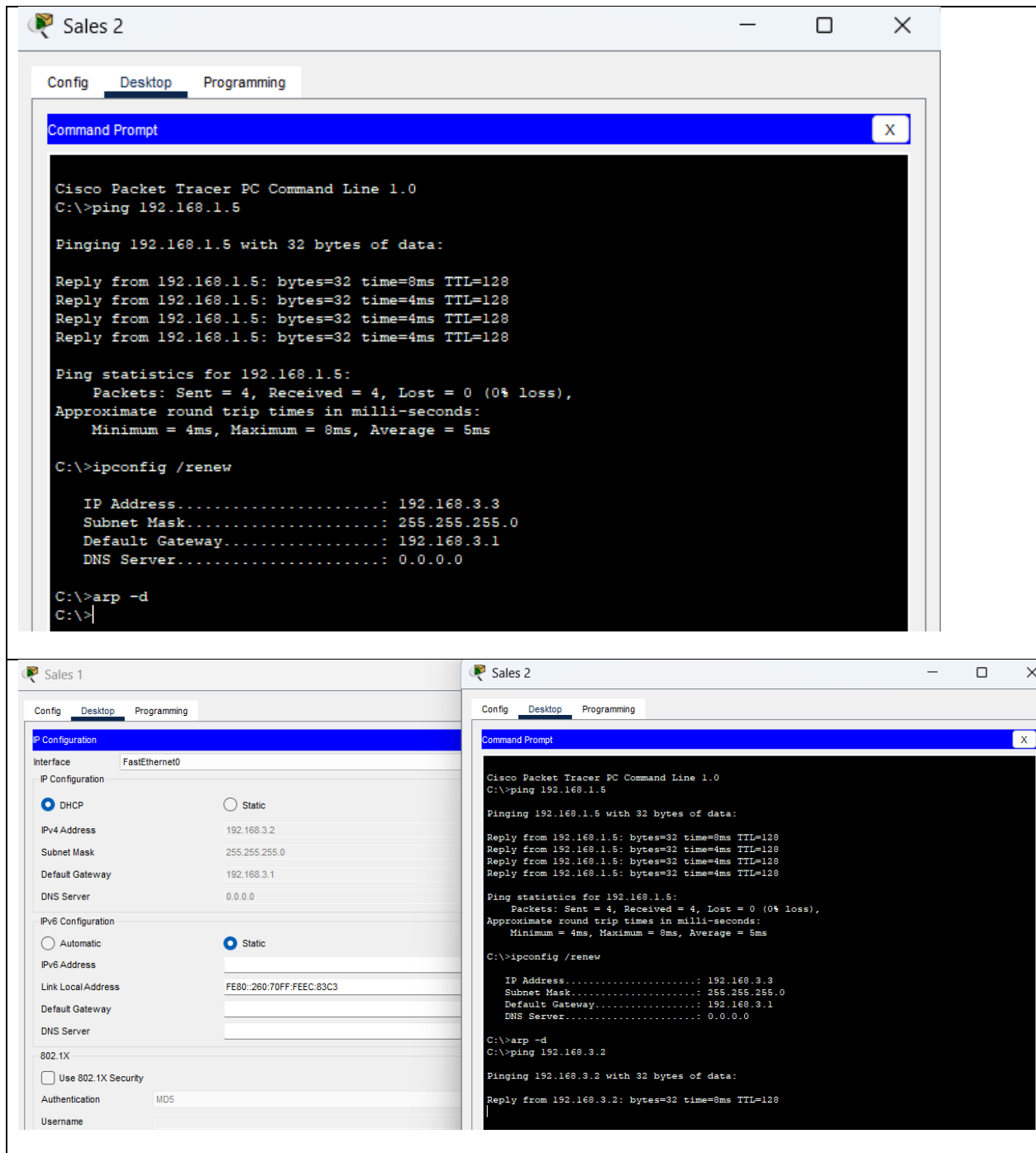
Record New Networks

Department	New IPv4 Network	Gateway Address
Finance	192.168.2.0/24	192.168.2.1
Sales	192.168.3.0/24	192.168.3.1
Accounting	192.168.1.0/24	192.168.1.1

7. Part 3 – Observe Traffic Flow in the Routed Network

Step 1 – Ping Sales 1 from Sales 2 Again

Repeat ARP + Ping in Simulation Mode.



Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device
	0.000	--	Sales 2
	0.000	--	Sales 2
	0.001	Sales 2	Sales
	0.002	Sales	Sales 1
	0.002	Sales	Edge
	0.003	Sales 1	Sales
	0.004	Sales	Sales 2
	0.004	--	Sales 2
	0.005	Sales 2	Sales
	0.006	Sales	Sales 1
	0.007	Sales 1	Sales
	0.008	Sales	Sales 2
	1.012	--	Sales 2
	1.013	Sales 2	Sales
Visible	1.014	Sales	Sales 1

Reset Simulation

☒ Constant Delay

Captured to: 1.014 s

Play Controls

⏮

▶

⏭

Event List Filters - Visible Events

ARP, ICMP

Edit Filters

Show All/None

Event List

Realtime

Simulation

Routed ARP Behaviour

Ping Finance 1 from Finance 2

Finance 1

Config Desktop Programming

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 192.168.2.2

Subnet Mask 255.255.255.0

Default Gateway 192.168.2.1

DNS Server 0.0.0.0

Finance 2

Config Desktop Programming

Command Prompt

Cisco Packet Tracer PC Command Line 1.0

C:\>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=1ms TTL=128

Reply from 192.168.2.2: bytes=32 time<1ms TTL=128

Reply from 192.168.2.2: bytes=32 time<1ms TTL=128

Reply from 192.168.2.2: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.2.2:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 1ms, Average = 0ms

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.002	--
	0.002	--
	0.003	Edge
	0.004	Finance
	0.004	Finance
	1.005	--
	1.005	--
	1.512	--
	1.513	Finance 2
Visible	1.514	Finance
Visible	1.514	Finance

Reset Simulation ☒ Constant Delay Captured to: 186.257 s

Play Controls

Event List Filters - Visible Events

ARP, ICMP

Edit Filters Show All/None

Event List Realtime Simulation

Ping Accounting 1 from Accounting 2

Accounting 1

Config Desktop Programming

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 192.168.1.2

Subnet Mask 255.255.255.0

Default Gateway 192.168.1.1

DNS Server 0.0.0.0

Accounting 2

Config Desktop Programming

Command Prompt

Cisco Packet Tracer PC Command Line 1.0

C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time=8ms TTL=128

Reply from 192.168.1.2: bytes=32 time=4ms TTL=128

Reply from 192.168.1.2: bytes=32 time=4ms TTL=128

Reply from 192.168.1.2: bytes=32 time=4ms TTL=128

Ping statistics for 192.168.1.2:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 4ms, Maximum = 8ms, Average = 5ms

C:\>

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.007	Accounting 1
	0.008	Accounting
	1.008	--
	1.009	Accounting 2
	1.010	Accounting
	1.011	Accounting 1
	1.012	Accounting
	2.013	--
	2.014	Accounting 2
	2.015	Accounting
	2.016	Accounting 1
	2.017	Accounting
	3.018	--
	3.019	Accounting 2
	3.020	Accounting
	3.021	Accounting 1
Visible	3.022	Accounting

Reset Simulation ☒ Constant Delay Captured to: 3.022 s

Play Controls

Event List Filters - Visible Events
ARP, ICMP

Edit Filters Show All/None

Event List Realtime Simulation

Question

Which devices receive ARP broadcasts now?

Only devices inside the same LAN subnet (Sales network only).

Broadcasts no longer propagate across the entire company network.

Question

Benefit of using multiple IPv4 subnets?

Reduced broadcast traffic, improved scalability, improved performance, easier network management, stronger security boundaries.

8. Results and Findings

Criteria	Before Routing	After Routing
Broadcast Traffic	High	Reduced
Network Efficiency	Low	Improved
Host Communication	Direct via LAN	Routed via Gateway
Scalability	Poor	Strong

Routing significantly improved performance and created a more scalable network structure.

9. Conclusion

This lab demonstrated the critical role of routing in enterprise networks.

By segmenting the network into multiple subnets:

- Broadcast traffic was reduced.
- Network efficiency and performance improved.
- Traffic paths became controlled and predictable.

Routing is essential as business networks grow.

10. Reflection Questions

Question	Answer
1. What types of cables were used?	Copper straight-through Ethernet cables.
2. Did cables change how PDUs were handled?	No, PDUs are handled the same regardless of copper cabling.
3. Did the Access Point modify PDUs?	No, it only forwards them.
4. Did the Access Point change addressing?	No, it retains original MAC/IP addressing.
5. Highest OSI layer used by AP?	Layer 2 Data Link.
6. Layer at which cables & APs operate?	Layer 1 (Physical) and Layer 2 (Data Link).
7. Which MAC appears first in PDU details?	Destination MAC appears first.
8. Meaning of Red X vs Green ✓?	Red X indicates drop or failure; Green ✓ means successful delivery.
9. Where did MAC addresses change?	At the router, which forwards between networks.
10. Which device uses MACs starting with 00D0:BA?	The router interface.
11. Other MAC addresses belonged to?	End devices (PCs) and switches.
12. Did IPv4 addresses change?	No, only MAC addresses changed.
13. What happens in reply (pong)?	Source and destination swap roles.
14. Why are router interfaces in different networks?	To enable routing between subnets.
15. Which networks are connected?	192.168.1.0/24, 192.168.2.0/24, 192.168.3.0/24, and ISP network.

