Lab 6: Subnetting a Network & IP Address Planning

Lab 7: Configuring IP Addresses on PCs, Routers, and Switches

## 🏢 ****Real-Time Scenario: Office Network Design****

You're hired by a small company called **TechNova**, which has:

* 🧑‍💼 **HR Department** (12 PCs)
* 🧑‍🔧 **IT Department** (28 PCs)
* 📞 **Sales Department** (6 PCs)
* 🎛️ one **Switch** different department( 3 Vlans)
* 🛜 One **Router** connecting all VLANs with sub interfaces.

**Goal**: Design a network, subnet it properly, and configure IPs so that each department is on its own subnet (VLAN) but can communicate via a router (Inter-VLAN Routing).

### 🧮 Company IP Block: 192.168.100.0/24

You need 3 subnets. Use **Variable Length Subnet Masking (VLSM)** to avoid wasting IPs.

| **Department** | **Hosts Needed** | **Subnet** | **Subnet Mask** | **Broadcast** |
| --- | --- | --- | --- | --- |
| IT | 28 | 192.168.100.0 | 255.255.255.224 (/27) | 192.168.100.31 |
| HR | 12 | 192.168.100.32 | 255.255.255.240 (/28) | 192.168.100.47 |
| Sales | 6 | 192.168.100.48 | 255.255.255.248 (/29) | 192.168.100.55 |

🧠 Add 1 IP per subnet for the **default gateway** (router sub-interface).

### 📚 ****Objective****

* Subnet a network for three departments: HR, IT, and Finance.
* Implement VLANs and inter-VLAN routing using subinterfaces.
* Connect a router to a switch using a trunk link.
* Assign IP addresses based on subnetting.
* Verify connectivity across VLANs.

### 🌐 ****Topology Diagram****

lua

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| Router R1 |

| G0/0.10 192.168.10.1|

| G0/0.20 192.168.20.1|

| G0/0.30 192.168.30.1|

+----------|----------+

|

Trunk Link (G0/0 <-> G0/1)

|

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| Switch SW1 |

| VLAN 10 - HR PCs |

| VLAN 20 - IT PCs |

| VLAN 30 - Finance PCs|

+----------|----------+

|

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| | |

PC1 PC2 PC3

(HR VLAN) (IT VLAN) (Finance VLAN)

192.168.10.2 192.168.20.2 192.168.30.2

### 🗂️ ****IP Address Plan****

| **VLAN** | **Department** | **Subnet** | **Default Gateway** | **Host Range** |
| --- | --- | --- | --- | --- |
| VLAN 10 | HR | 192.168.10.0/24 | 192.168.10.1 | 192.168.10.2 - .254 |
| VLAN 20 | IT | 192.168.20.0/24 | 192.168.20.1 | 192.168.20.2 - .254 |
| VLAN 30 | Finance | 192.168.30.0/24 | 192.168.30.1 | 192.168.30.2 - .254 |

### 🛠️ ****Configuration Steps****

#### 1. **Switch VLAN & Trunk Config (SW1)**

bash

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enable

configure terminal

vlan 10

name HR

vlan 20

name IT

vlan 30

name Finance

interface range fa0/1 - 3

switchport mode access

switchport access vlan 10

interface range fa0/4 - 5

switchport mode access

switchport access vlan 20

interface range fa0/6 - 8

switchport mode access

switchport access vlan 30

interface f0/9

switchport mode trunk

switchport trunk allowed vlan 10,20,30

Switch(config)#int vlan 10

Switch(config-if)#

%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up

Switch(config-if)#ip add

Switch(config-if)#ip address 192.168.10.10 255.255.255.224

Switch(config-if)#no shut

Switch(config-if)#

Switch(config-if)#ex

Switch(config)#ip defa

Switch(config)#ip default-gateway 192.168.10.1

Switch(config)#

Switch(config)#ex

Switch#

%SYS-5-CONFIG\_I: Configured from console by console

Switch#conf t

Enter configuration commands, one per line. End with CNTL/Z.

Switch(config)#

Switch(config)#int vlan 20

Switch(config-if)#

%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

Switch(config-if)#ip address 192.168.20.10 255.255.255.240

Switch(config-if)#

Switch(config-if)#no shut

Switch(config-if)#

Switch(config-if)#ex

Switch(config)#

Switch(config)#ip default-gateway 192.168.20.1

Switch(config)#

Switch(config)#int vlan 30

Switch(config-if)#

%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up

Switch(config-if)#ip address 192.168.30.10 255.255.255.248

Switch(config-if)#no shut

Switch(config-if)#

Switch(config-if)#ex

Switch(config)#ip default-gateway 192.168.30.1

exit

#### 2. **Router Subinterface Config (R1)**

bash

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enable

configure terminal

interface gigabitEthernet0/0

no ip address

no shutdown

interface gigabitEthernet0/0.10

encapsulation dot1Q 10

ip address 192.168.10.1 255.255.255.0

interface gigabitEthernet0/0.20

encapsulation dot1Q 20

ip address 192.168.20.1 255.255.255.0

interface gigabitEthernet0/0.30

encapsulation dot1Q 30

ip address 192.168.30.1 255.255.255.0

#### 3. **Assign IPs to PCs**

* **PC1 (HR):** 192.168.10.2 / 255.255.255.0, Gateway: 192.168.10.1
* **PC2 (IT):** 192.168.20.2 / 255.255.255.0, Gateway: 192.168.20.1
* **PC3 (Finance):** 192.168.30.2 / 255.255.255.0, Gateway: 192.168.30.1

### ✅ ****Verification****

On each PC:

bash

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ping 192.168.10.1 # Router gateway

ping 192.168.20.2 # Another PC in IT VLAN

ping 192.168.30.2 # Another PC in Finance VLAN

Router:

bash

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show ip interface brief

show running-config

Switch:

bash

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show vlan brief

show interfaces trunk

### 📝 ****Conclusion****

This lab demonstrates subnetting and IP address planning by segmenting a network using VLANs and router subinterfaces. It simulates a real-world “router-on-a-stick” setup often used in small to mid-sized enterprise networks.

**The range of ips which can allocate to departments**

**📊 Summary Table**

| **Department** | **Subnet** | **Subnet Mask** | **Usable IP Range** | **Broadcast** | **Suggested Gateway** |
| --- | --- | --- | --- | --- | --- |
| IT | 192.168.100.0/27 | 255.255.255.224 | 192.168.100.1–100.30 | 192.168.100.31 | 192.168.100.1 |
| HR | 192.168.100.32/28 | 255.255.255.240 | 192.168.100.33–100.46 | 192.168.100.47 | 192.168.100.33 |
| Sales | 192.168.100.48/29 | 255.255.255.248 | 192.168.100.49–100.54 | 192.168.100.55 | 192.168.100.49 |

**Output**

C:\>ping 192.168.10.4

Pinging 192.168.10.4 with 32 bytes of data:

Reply from 192.168.10.4: bytes=32 time<1ms TTL=128

Reply from 192.168.10.4: bytes=32 time<1ms TTL=128

Reply from 192.168.10.4: bytes=32 time=11ms TTL=128

Reply from 192.168.10.4: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.10.4:

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

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 11ms, Average = 2ms

C:\>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Reply from 192.168.10.3: bytes=32 time=1ms TTL=128

Reply from 192.168.10.3: bytes=32 time=20ms TTL=128

Ping statistics for 192.168.10.3:

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

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 20ms, Average = 5ms

C:\>ping 192.168.10.1

Pinging 192.168.10.1 with 32 bytes of data:

Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.10.1:

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

Approximate round trip times in milli-seconds:

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

PC1:\>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Reply from 192.168.10.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.10.3:

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

Approximate round trip times in milli-seconds:

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

PC6:\>ping 192.168.30.1

Pinging 192.168.30.1 with 32 bytes of data:

Reply from 192.168.30.1: bytes=32 time=1ms TTL=255

Reply from 192.168.30.1: bytes=32 time<1ms TTL=255

Reply from 192.168.30.1: bytes=32 time<1ms TTL=255

Reply from 192.168.30.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.30.1:

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

Approximate round trip times in milli-seconds:

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

C:\>ping 192.168.30.3

Pinging 192.168.30.3 with 32 bytes of data:

Reply from 192.168.30.3: bytes=32 time<1ms TTL=128

Reply from 192.168.30.3: bytes=32 time=12ms TTL=128

Reply from 192.168.30.3: bytes=32 time<1ms TTL=128

Reply from 192.168.30.3: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.30.3:

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

Approximate round trip times in milli-seconds:

Switch#ping 192.168.10.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.10.1, timeout is 2 seconds:

.!!!!

Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/0 ms

Switch#ping 192.168.20.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.20.1, timeout is 2 seconds:

.!!!!

Success rate is 80 percent (4/5), round-trip min/avg/max = 0/4/17 ms

Switch#ping 192.168.30.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.30.1, timeout is 2 seconds:

.!!!!

Success rate is 80 percent (4/5), round-trip min/avg/max = 0/3/15 ms

Switch#SH mac add

Switch#SH mac address-table

Mac Address Table

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Vlan Mac Address Type Ports

---- ----------- -------- -----

1 0006.2a71.aa01 DYNAMIC Fa0/9

10 0006.2a71.aa01 DYNAMIC Fa0/9

20 0006.2a71.aa01 DYNAMIC Fa0/9

30 0006.2a71.aa01 DYNAMIC Fa0/9