Design and Deployment of a Small Office/Home Office (SOHO) Network

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1. Project Objective

The goal of this project was to design and implement a practical SOHO network that could support the daily operations of three departments: IT, Finance, and Customer Service. The design focuses on security, segmentation, and scalability. VLANs were used to separate departmental traffic, while inter-VLAN routing was enabled to allow controlled communication. Dynamic Host Configuration Protocol (DHCP) ensured devices automatically received IP addresses, and WPA3-secured wireless access points extended connectivity to mobile devices.

2. Networking Technologies Applied

To bring the design to life, the following networking techniques were applied: - Constructed a basic topology with a router and a layer-2 switch. - Connected devices using correct cabling standards. - Created VLANs and assigned switch ports accordingly. - Designed a subnetting plan and allocated IP addresses. - Configured inter-VLAN routing using router-on-a-stick. - Enabled DHCP services directly on the router. - Set up WLAN access points for each VLAN with WPA3 protection. - Integrated end devices including PCs, laptops, and smartphones. - Conducted functionality testing through ping and connectivity checks.
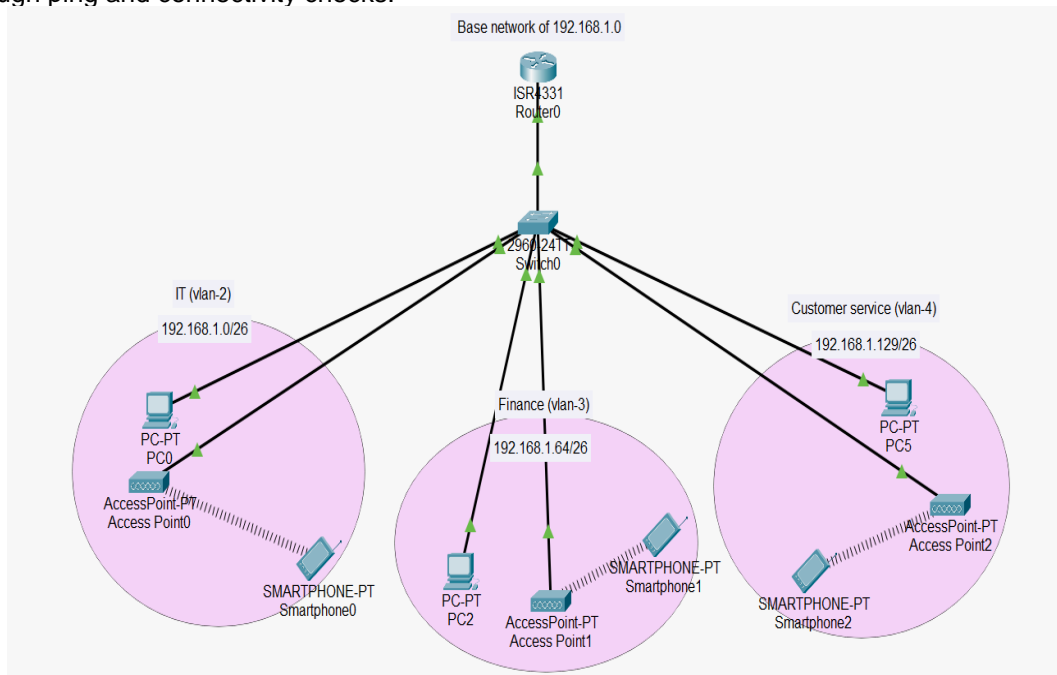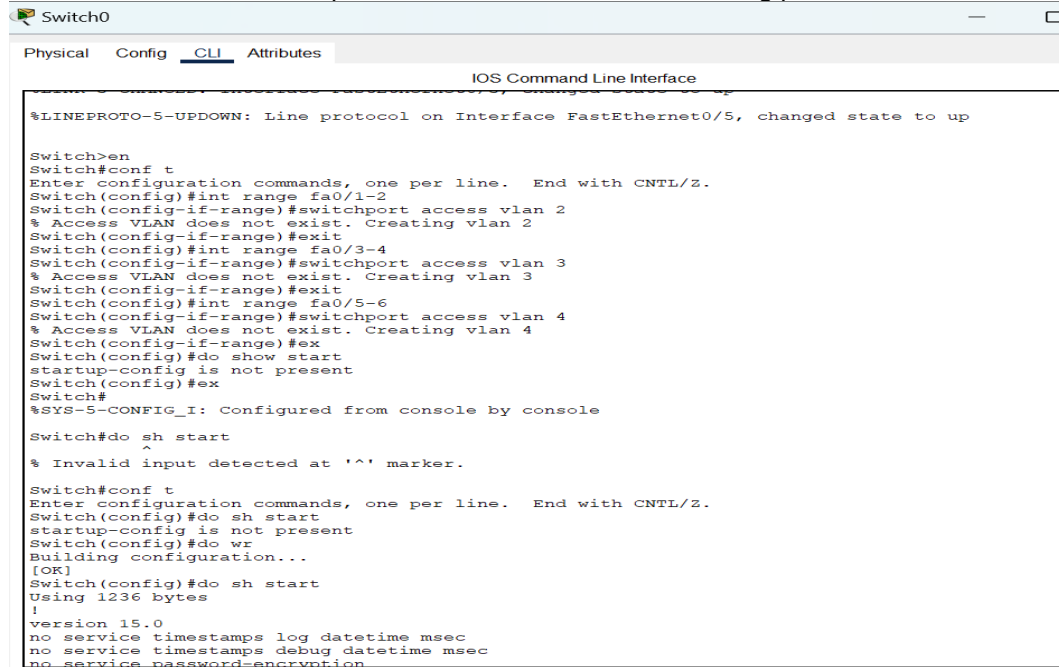

Figure 1: SOHO Network Topology

3. Configuration Process

The configuration was divided into switch, router, and access point setups. On the switch, VLANs were created, and ports were assigned to their respective VLANs. A trunk link was established to carry VLAN traffic to the router. The router was configured with sub-interfaces for each VLAN, each assigned with an IP address and linked to DHCP pools. Wireless access points were given static IPs and SSIDs to match their department VLANs, secured with strong passwords.


```
Switch0                                                                    —    □

Physical   Config   CLI   Attributes
                              IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up

Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int range fa0/1-2
Switch(config-if-range)#switchport access vlan 2
% Access VLAN does not exist. Creating vlan 2
Switch(config-if-range)#exit
Switch(config)#int range fa0/3-4
Switch(config-if-range)#switchport access vlan 3
% Access VLAN does not exist. Creating vlan 3
Switch(config-if-range)#exit
Switch(config)#int range fa0/5-6
Switch(config-if-range)#switchport access vlan 4
% Access VLAN does not exist. Creating vlan 4
Switch(config-if-range)#ex
Switch(config)#do show start
startup-config is not present
Switch(config)#ex
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#do sh start
              ^
% Invalid input detected at '^' marker.

Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#do sh start
startup-config is not present
Switch(config)#do wr
Building configuration...
[OK]
Switch(config)#do sh start
Using 1236 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
```

Figure 2: VLAN and Router Configuration

4. Results and Analysis

The implemented network achieved all targeted objectives: - VLAN segmentation successfully isolated departmental traffic. - Inter-VLAN routing enabled communication while preserving separation. - DHCP simplified IP address management and allocation. - Wireless access points provided reliable connectivity for mobile devices. - Testing confirmed seamless communication between departments and stable wireless performance. Performance was stable, with reduced broadcast traffic due to segmentation. The use of VLANs and WPA3 improved security, while the hierarchical IP plan ensured the network could easily scale to accommodate more departments or devices.

```
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up


Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int gig0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Switch(config-if)#ex
Switch(config)#ex
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

Figure 3: Testing and Validation

5. Conclusion

This project highlighted the process of designing and deploying a functional SOHO network. By leveraging VLANs, inter-VLAN routing, DHCP, and secured wireless access, the design provided a balance of performance, security, and scalability. The setup serves as a blueprint for small organizations seeking a reliable, expandable, and secure network foundation.