1. Design and Implementation of a Small Office Home Office (SOHO) Network

Objective

The primary aim of this project is to develop a robust and efficient network infrastructure of a Small Office Home Office (SOHO) Network with three departments IT, Finance and Customer Services. This involves the creation of segmented VLANs to manage traffic effectively between all the IT, Finance and Customer Service departments, configuring routers to enable inter-VLAN communication between them, implementing Password setting on Access Points for Wireless Security, ensuring WPA3 is used for wireless networks and integrating DHCP service pool for automatically IP address allocation.

Network Technology implemented

- o Creating a Simple Network using a Router and Access Layer Switch
- o Connecting Networking devices with Correct cabling
- o Creating VLANs and assigning ports VLAN numbers
- o Subnetting and IP Addressing
- o Configuring Inter-VLAN Routing (Router on a stick)
- o Configuring DHCP Server (Router as the DHCP Server)
- o Configuring WLAN or wireless network (Access Point)
- o Configuring Host devices including laptops, smartphones
- o Testing and Verifying Network

Network Topology diagram
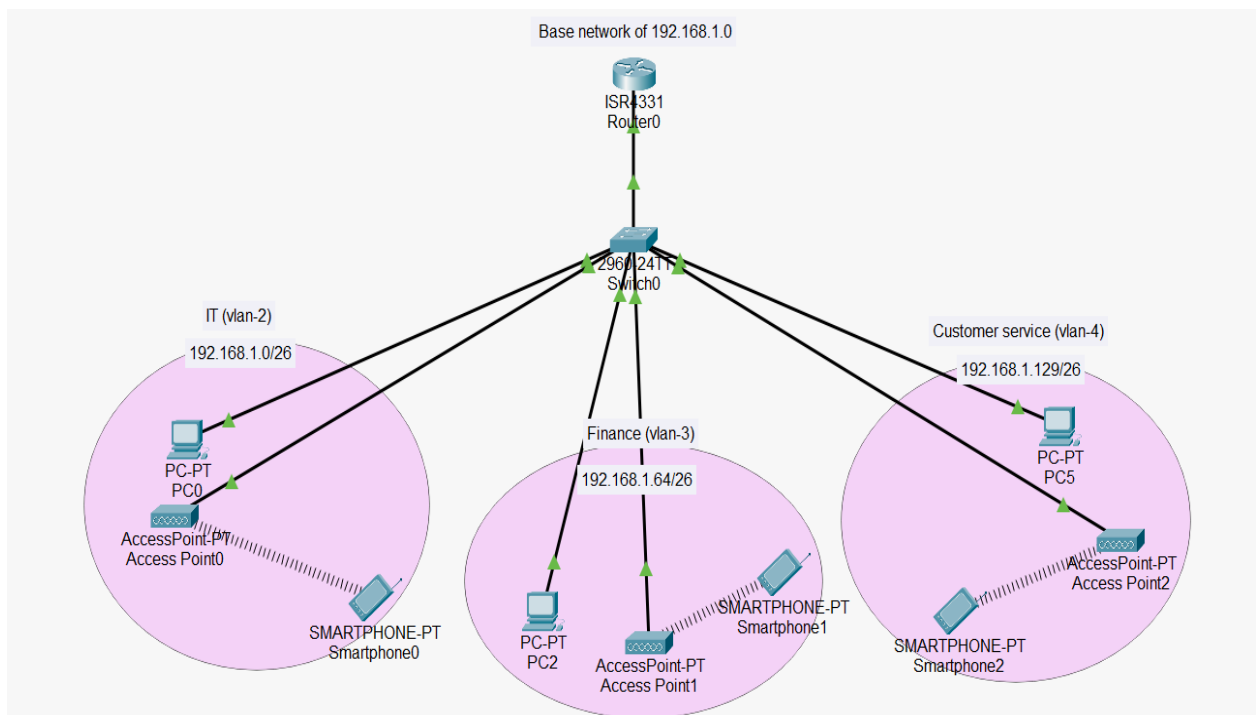
Configuration details

Stick VLAN implementation on Switch

```
Switch0                                                              —    □

Physical   Config   CLI   Attributes
                        IOS Command Line Interface

%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 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
```

Configure Trunk link on Switch

```
%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
```

Stick VLAN implementation on Router by creating sub-interfaces for every VLAN

```
Router0                                                        —    □

Physical  Config  CLI  Attributes

                        IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.2, changed state to up


Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#encapsulation dot1Q 2
                        ^
% Invalid input detected at '^' marker.

Router(config)#int gig0/0/0
Router(config-if)#ex
Router(config)#int gig0/0/0.2
Router(config-subif)#encapsulation dot1Q 2
Router(config-subif)#ip add 192.168.1.1 255.255.255.192
Router(config-subif)#ex
Router(config)#int gig0/0/0.3
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0.3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.3, changed state to up

Router(config-subif)#encapsulation dot1Q 3
Router(config-subif)#ip add 192.168.1.65 255.255.255.192
Router(config-subif)#ex
Router(config)#
Router(config)#int gig0/0/0.4
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0.4, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0.4, changed state to up

Router(config-subif)#encapsulation dot1Q 4
Router(config-subif)#ip add 192.168.1.129 255.255.255.192
Router(config-subif)#ex
Router(config)#ex
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#
```

DHCP implementation on Router

```
% Invalid input detected at '^' marker.

Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#service dhcp
Router(config)#ip dhcp pool IT-pool
Router(dhcp-config)#
Router(dhcp-config)#network 192.168.1.0 255.255.255.192
Router(dhcp-config)#default-router 192.168.1.1
Router(dhcp-config)#
Router(dhcp-config)#dns-server 192.168.1.1
Router(dhcp-config)#domain name IT.com
                        ^
% Invalid input detected at '^' marker.

Router(dhcp-config)#domain-name IT.com
Router(dhcp-config)#ex
Router(config)#
Router(config)#
Router(config)#ip dhcp pool Finance-pool
Router(dhcp-config)#network 192.168.1.65 255.255.255.192
Router(dhcp-config)#network 192.168.1.64 255.255.255.192
Router(dhcp-config)#ex
Router(config)#ip dhcp pool Finance-pool
Router(dhcp-config)#network 192.168.1.64 255.255.255.192
Router(dhcp-config)#default-router 192.168.1.65
Router(dhcp-config)#dns-server 192.168.1.65
Router(dhcp-config)#domain-name Finance.com
Router(dhcp-config)#ex
Router(config)#
Router(config)#ip dhcp pool Customer-pool
Router(dhcp-config)#network 192.168.1.128 255.255.255.192
Router(dhcp-config)#default-router 192.168.1.129
Router(dhcp-config)#dns-server 192.168.1.129
Router(dhcp-config)#domain-name Customer.com
Router(dhcp-config)#ex
Router(config)#ex
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

Password setting on Access Points of IT, Finance, Customer service departments

Access Point0   — □ ✕

Physical   Config   Attributes

GLOBAL
Settings
INTERFACE
Port 0
Port 1

Port 1

Port Status	☑ On
SSID	AdminIT
2.4 GHz Channel	6 ⌄
Coverage Range (meters)	140.00 ⬍

Authentication

- ◯ Disabled   ◯ WEP   WEP Key
- ◯ WPA-PSK   ⦿ WPA2-PSK   PSK Pass Phrase   adminit@123
- User ID
- Password

Encryption Type   AES ⌄

Access Point1   — □ ✕

Physical   Config   Attributes

GLOBAL
Settings
INTERFACE
Port 0
Port 1

Port 1

Port Status	☑ On
SSID	AdminFinance
2.4 GHz Channel	6 ⌄
Coverage Range (meters)	140.00 ⬍

Authentication

- ◯ Disabled   ◯ WEP   WEP Key
- ◯ WPA-PSK   ⦿ WPA2-PSK   PSK Pass Phrase   adminfinance@123
- User ID
- Password

Encryption Type   AES ⌄

Access Point2   — □ ✕

Physical   Config   Attributes

GLOBAL
Settings
INTERFACE
Port 0
Port 1

Port 1

Port Status	☑ On
SSID	AdminCustomer
2.4 GHz Channel	6 ⌄
Coverage Range (meters)	140.00 ⬍

Authentication

- ◯ Disabled   ◯ WEP   WEP Key
- ◯ WPA-PSK   ⦿ WPA2-PSK   PSK Pass Phrase   admincustomer@123
- User ID
- Password

Encryption Type   AES ⌄

Result and analysis

Key achievements

1. **VLAN Segmentation**:
   - VLANs were successfully created for each department, effectively isolating traffic and improving security and performance.
   - Ports were assigned correctly to their respective VLANs.
2. **Inter-VLAN Routing**:
   - Inter-VLAN communication was enabled using a Router on a Stick configuration. Sub-interfaces for each VLAN were created and correctly configured.
   - This setup ensured seamless communication between different departments while maintaining network segmentation.
3. **DHCP Configuration**:
   - A DHCP server was configured on the router, allowing for automatic IP address allocation. This simplified network management and ensured efficient use of IP addresses.
   - DHCP pools were defined for each VLAN, ensuring proper IP allocation within the segmented network.
4. **Wireless Network Setup**:
   - Wireless access points were configured for each department, providing wireless connectivity for laptops and smartphones.
   - Password protection was implemented to secure the wireless networks of IT, Finance, and Customer Services departments.
5. **Testing and Verification**:
   - Network connectivity and communication between devices in different VLANs were tested and verified using ping tests and connectivity checks.
   - Wireless connectivity was also tested, ensuring that devices could connect to the network and access resources seamlessly.

Analysis and Performance

1. **Network Performance**:
   - The network showed stable performance with minimal latency during internal communications and access to shared resources.
   - VLAN segmentation improved overall network performance by reducing broadcast traffic and potential network congestion.
2. **Security**:
   - VLANs provided a basic level of security by isolating departmental traffic.
   - Wireless networks were secured with passwords using WPA3 encryption security.
3. **Scalability**:
   - The current design allows for easy scalability. New departments or devices can be added with minimal reconfiguration.
   - The hierarchical IP addressing scheme and use of DHCP ensure that IP management remains simple as the network grows.