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Computer Networks

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Company Network Project in Cisco Packet Tracer

1. Description and Requirements

Apple Inc. has hired you to set up a LAN for their new headquarters in Krakow. The following are the requirements for the Network you will establish in the new building.

1. Use Cisco Packet Tracer to implement solution.
2. The network address that the company allocated is 192.168.1.0/20
3. Various departments work on each floor of the 4-storey building. Each of these departments will have different VLANs and different subnetworks.
4. On the third floor, there will be a wireless access point to which a maximum of 1000 devices can be connected. The details of the floors and departments are given below.

1. floor:

Administration and HR:	90 devices needed
Sales and marketing:	200 devices needed

2. floor:

Finance:	80 devices needed
Public Relations:	100 devices needed

3. floor:

IT and Communications:	200 devices needed
Access Point:	Maximum 1000 device should connect

4. floor:

Server Room:	20 devices needed
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5. There should be a core router connected to the ISP, and two multilayer switches connected to this core router.

Network address between Core Router and ISP:	193.168.16.0/30
Network address between Multilayer S1 and Core Router:	192.168.19.164/30
Network address between Multilayer S2 - Core Router:	192.168.19.168/30

6. Devices in all departments are required to communicate with each other with the respective multilayer switch configured for inter-VLAN routing.
7. The multilayer switches are expected to carry out both routing and switching.
8. All devices in the network are expected to obtain an IP address dynamically from the DHCP server located at server room.
9. Devices in the server room are to be allocated IP addresses statically.
10. Use OSPF as the routing protocol to advertise routes between routers and multilayer switches.
11. Configure NAT on core router.

2. Subnetting

Base Network: 192.168.16.0/20

11000000.10101000.00010000.00000000 / 11111111.11111111.1111 0000.00000000

Administration and HR Department

Network: 192.168.16.0/25

Broadcast: 192.168.16.127

Devices Needed: 90

Allocated IP addresses for Hosts: 126

Finance Department

Network: 192.168.16.128/25

Broadcast: 192.168.16.255

Devices Needed: 90

Allocated IP addresses for Hosts: 126

Sales and Marketing Department

Network: 192.168.17.0/24

Broadcast: 192.168.17.255

Devices Needed: 200

Allocated IP Addresses for Hosts: 254

IT and Communications Department

Network: 192.168.18.0/24

Broadcast: 192.168.18.255

Devices Needed: 200

Allocated IP Addresses for Hosts: 254

Public Relations Department

Network: 192.168.19.0/25

Broadcast: 192.168.19.127

Devices Needed: 90

Allocated IP Addresses for Hosts: 126

Server Room

Network: 192.168.19.128/27

Broadcast: 192.168.19.159

Devices Needed: 20

Allocated IP Addresses for Hosts: 30

Wireless Network Information

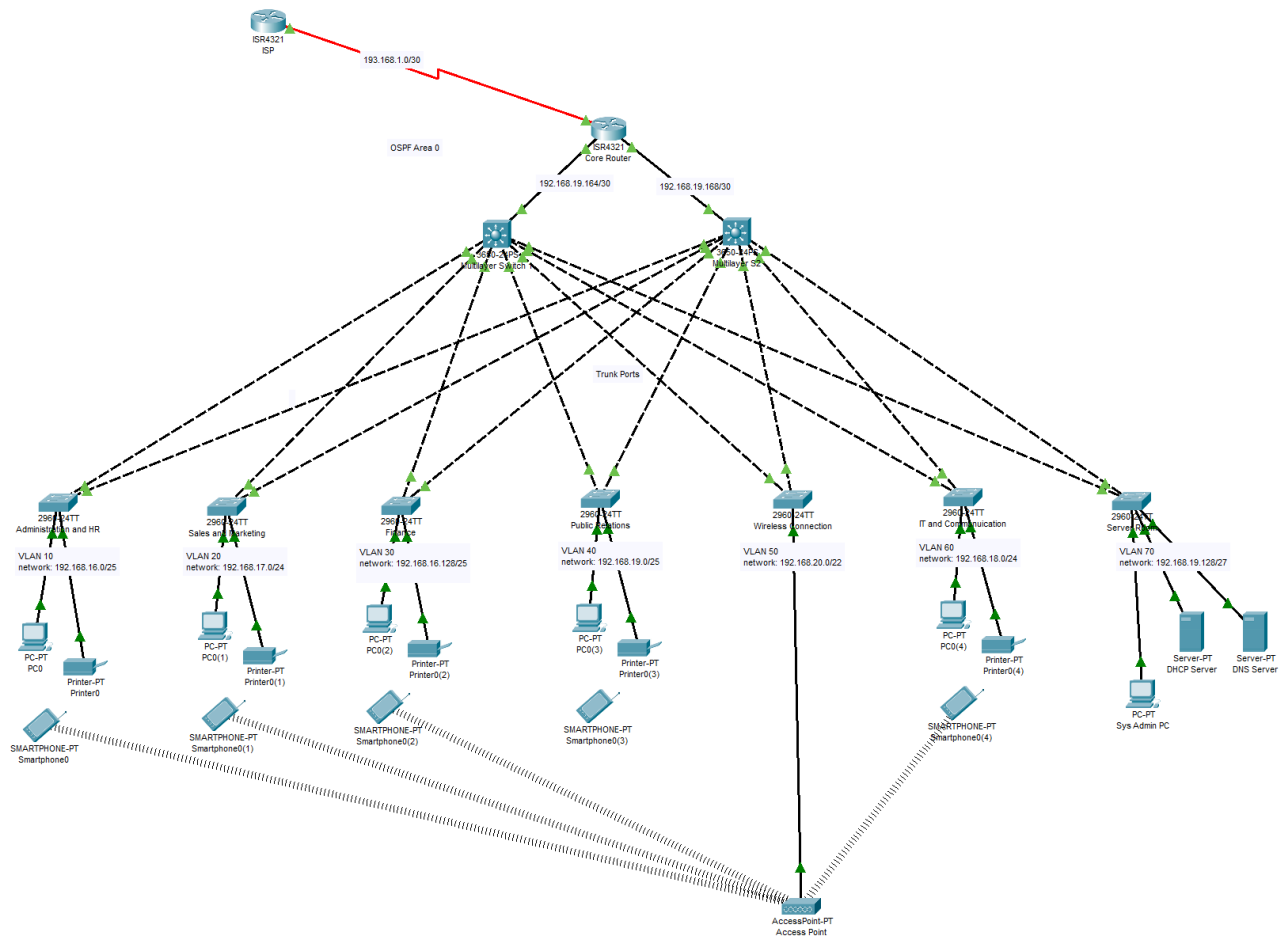
Network: 192.168.20.0/22

Broadcast: 192.168.23.255

Devices Needed: 1000

Allocated IP Addresses for Hosts: 1022

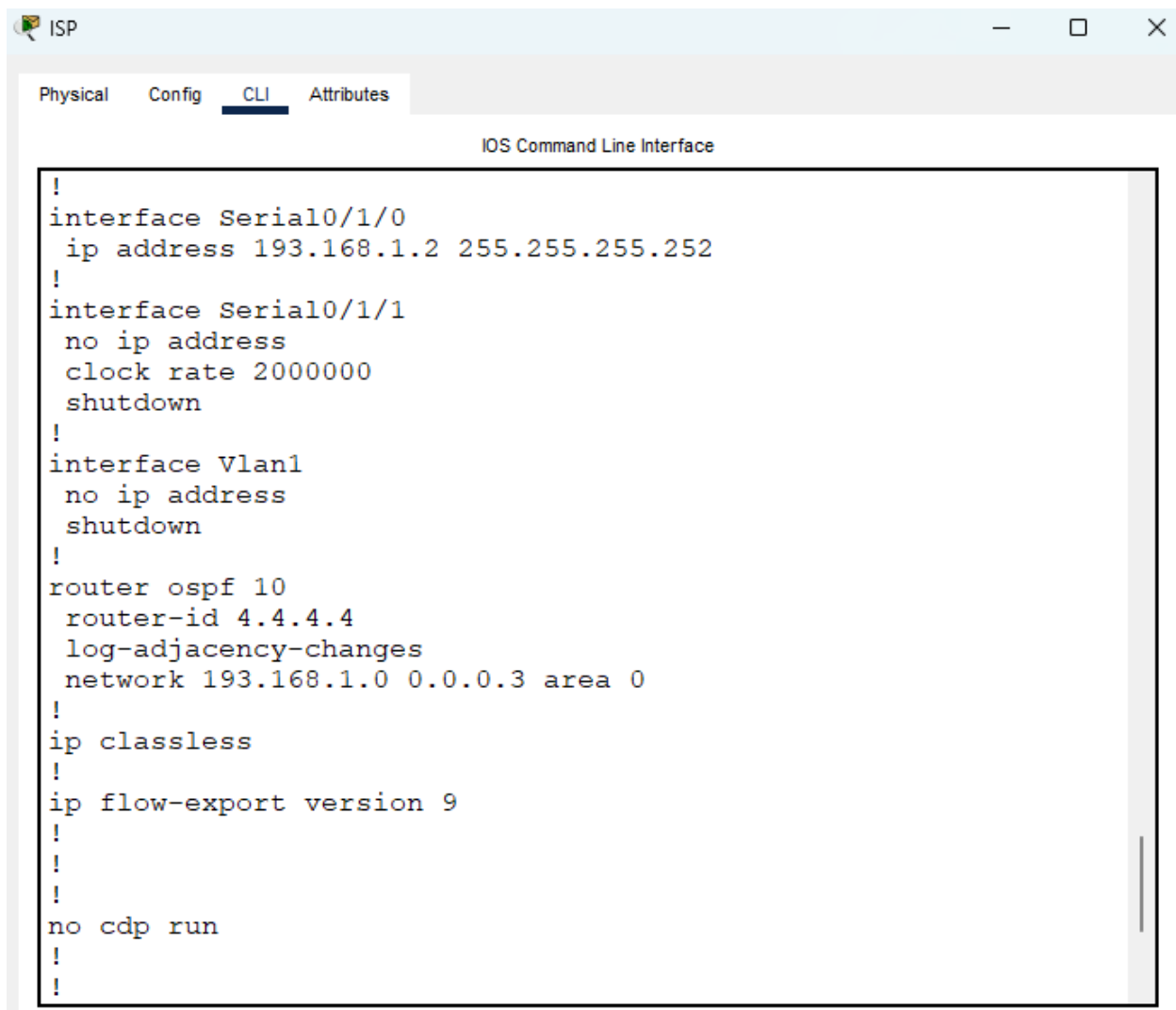
3. Topology



- OSPF used as routing protocol on the routers and multi-layer switches.
- NAT configured on core router.
- Multi-layer switches configured for inter-VLAN routing.
- Ports between multi-layer switches and 2960 model switches configured as trunk ports.
- Ports between 2960 model switches and end-devices configured as access ports.
- Access Point has a password on WPA2-PSK Authentication. Since smart phone in public relations department doesn't have correct password, it's not connected to the wireless network.

4. Screenshots of Configurations

4.1. ISP Router



The screenshot shows a window titled "ISP" with a tabbed interface. The "CLI" tab is selected, displaying the "IOS Command Line Interface". The configuration text is as follows:

```
!  
interface Serial0/1/0  
  ip address 193.168.1.2 255.255.255.252  
!  
interface Serial0/1/1  
  no ip address  
  clock rate 2000000  
  shutdown  
!  
interface Vlan1  
  no ip address  
  shutdown  
!  
router ospf 10  
  router-id 4.4.4.4  
  log-adjacency-changes  
  network 193.168.1.0 0.0.0.3 area 0  
!  
ip classless  
!  
ip flow-export version 9  
!  
!  
!  
no cdp run  
!  
!
```

Figure 1: Statically typed IP addresses of Serial interfaces and OSPF configuration

4.2. Core Router

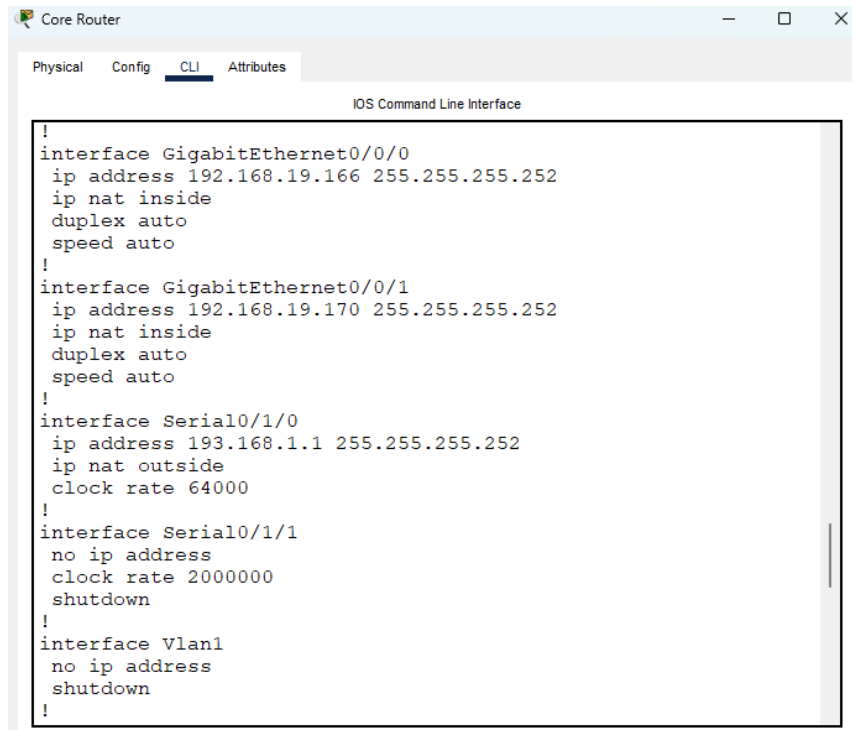


Figure 2: Statically typed IP addresses

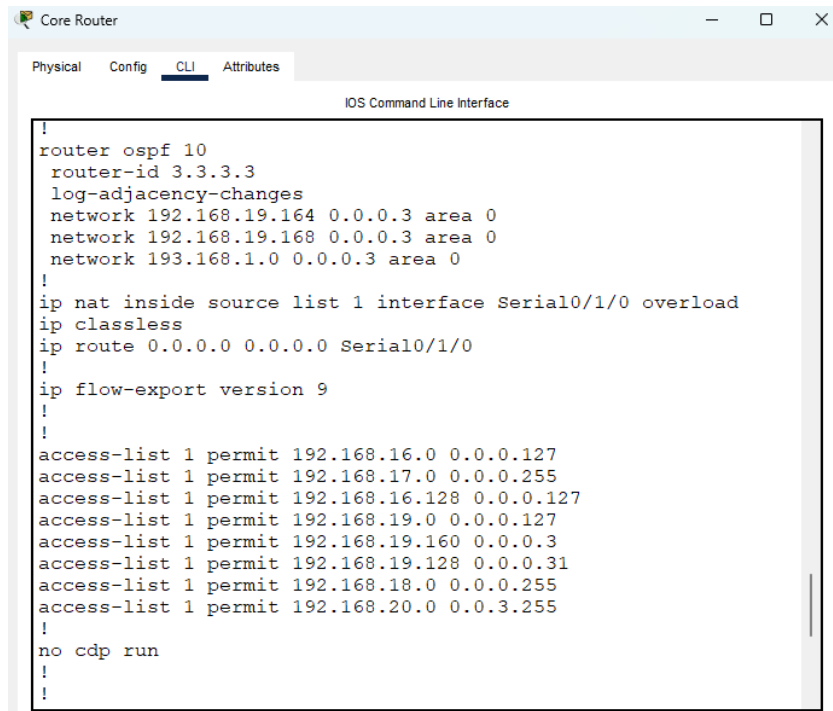


Figure 3: OSPF and NAT configuration

4.3. Multi-Layer Switches

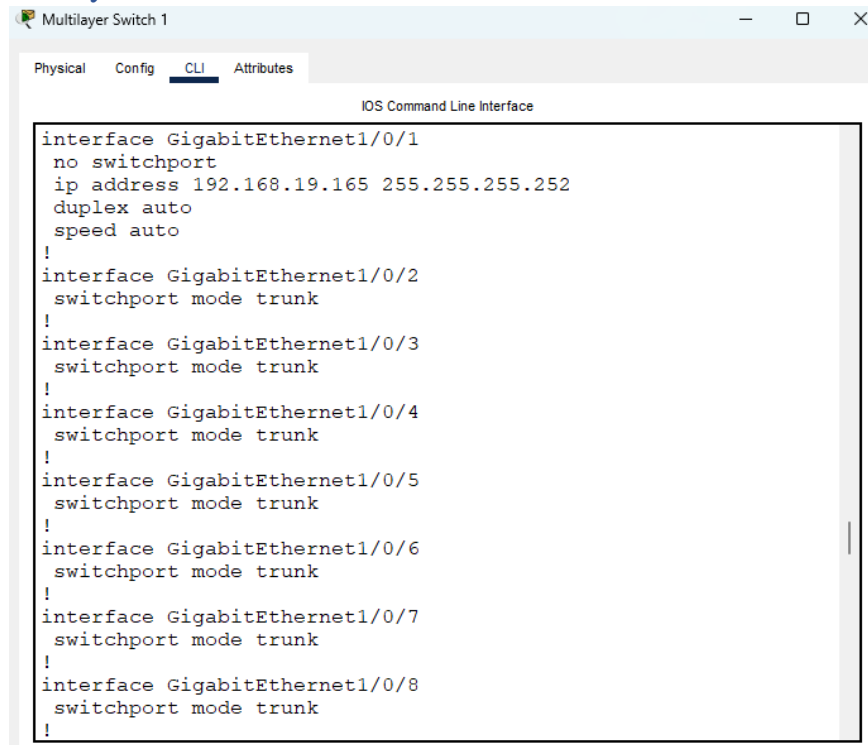


Figure 4: Statically typed IP on Gig1/0/1 and trunk interfaces

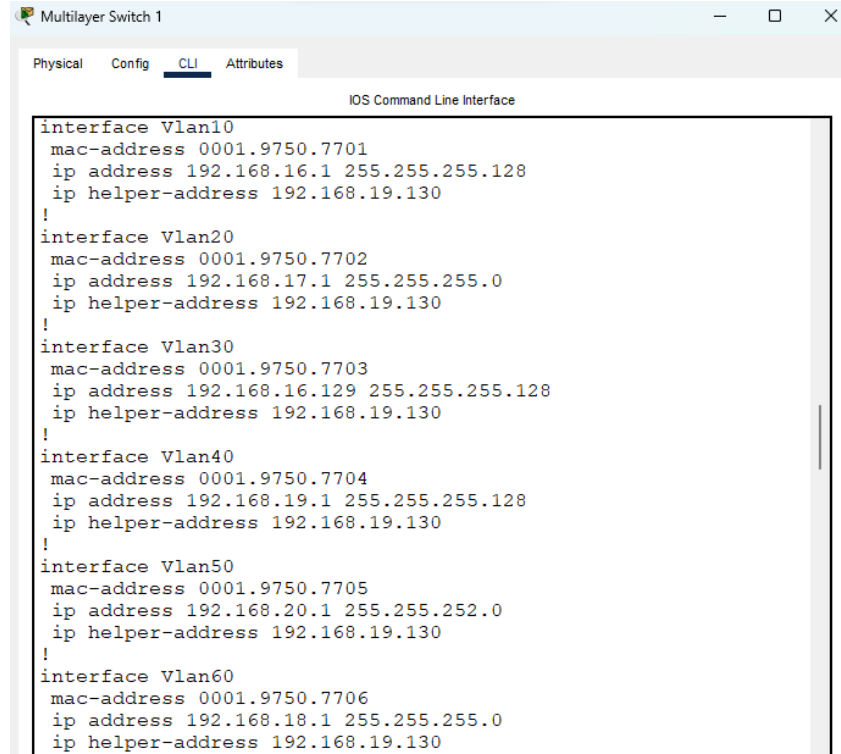


Figure 5: inter-VLAN routing and IP DHCP helper-addresses

Multilayer Switch 1

Physical Config CLI Attributes

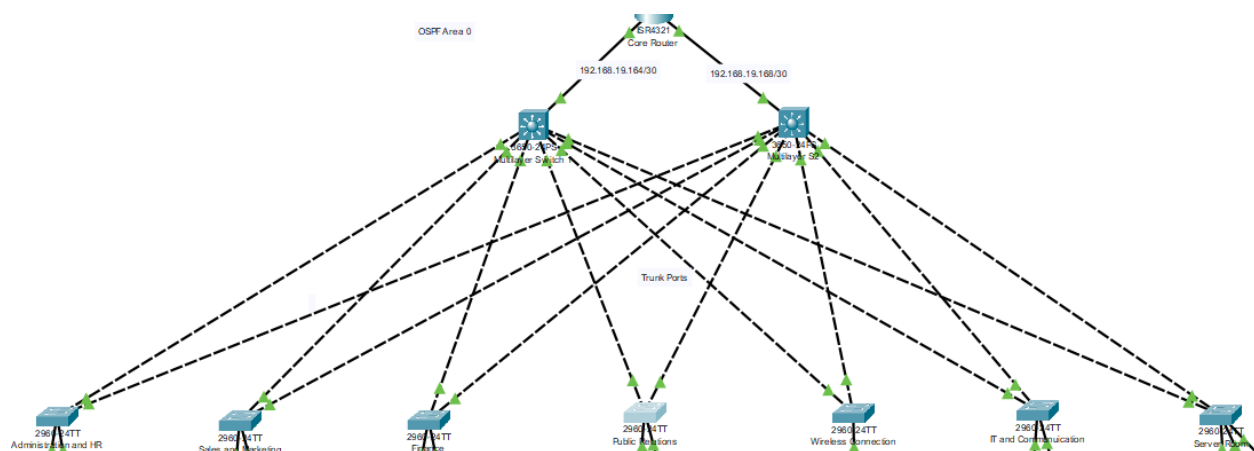
IOS Command Line Interface

```

interface Vlan60
  mac-address 0001.9750.7706
  ip address 192.168.18.1 255.255.255.0
  ip helper-address 192.168.19.130
!
interface Vlan70
  mac-address 0001.9750.7707
  ip address 192.168.19.129 255.255.255.224
  ip helper-address 192.168.19.130
!
router ospf 10
  router-id 1.1.1.1
  log-adjacency-changes
  network 192.168.16.0 0.0.0.127 area 0
  network 192.168.17.0 0.0.0.255 area 0
  network 192.168.16.128 0.0.0.127 area 0
  network 192.168.19.0 0.0.0.127 area 0
  network 192.168.19.160 0.0.0.3 area 0
  network 192.168.18.0 0.0.0.3 area 0
  network 192.168.19.128 0.0.0.31 area 0
  network 192.168.19.164 0.0.0.3 area 0
  network 192.168.18.0 0.0.0.255 area 0
  network 192.168.20.0 0.0.3.255 area 0
!
router rip
!
ip classless
ip route 0.0.0.0 0.0.0.0 GigabitEthernet1/0/1
!

```

Figure 6: OSPF configuration



- Multi-layer S2 has similar configuration as Multilayer S1

4.4. Layer 2 Switches

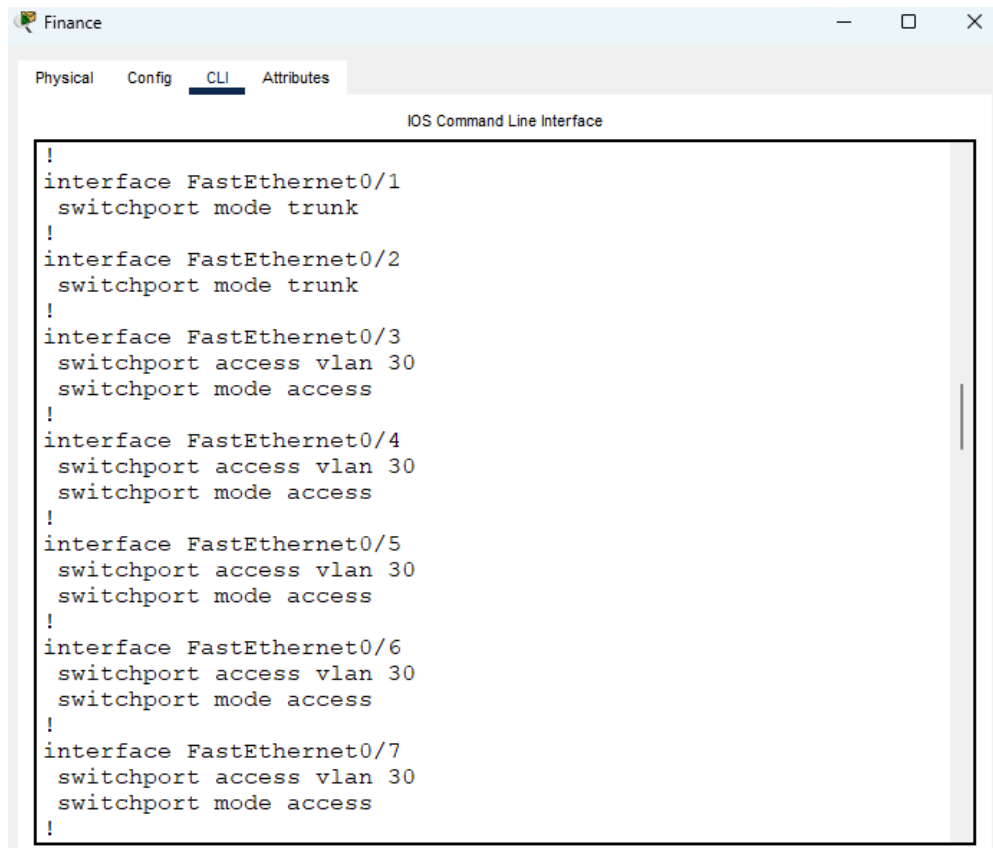


Figure 7: Access and trunk ports

4.5. DHCP Server

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
wirelessPool	192.168.19.161	192.168.19.131	192.168.20.6	255.255.252.0	1000	0.0.0.0	0.0.0.0
ITandCommunicationsPool	192.168.18.1	192.168.19.131	192.168.18.6	255.255.255.0	200	0.0.0.0	0.0.0.0
publicRelationsPool	192.168.19.1	192.168.19.131	192.168.19.6	255.255.255.128	90	0.0.0.0	0.0.0.0
financePool	192.168.16.129	192.168.19.131	192.168.16.134	255.255.255.128	90	0.0.0.0	0.0.0.0
salesAndMarketingPool	192.168.17.1	192.168.19.131	192.168.17.6	255.255.255.0	200	0.0.0.0	0.0.0.0
adminAndHRPool	192.168.16.1	192.168.19.131	192.168.16.6	255.255.255.128	90	0.0.0.0	0.0.0.0
AdminPool	192.168.19.129	192.168.19.131	192.168.19.135	255.255.255.224	20	0.0.0.0	0.0.0.0

Figure 8: Pools of DHCP server

5. Testing

5.1. Testing DHCP

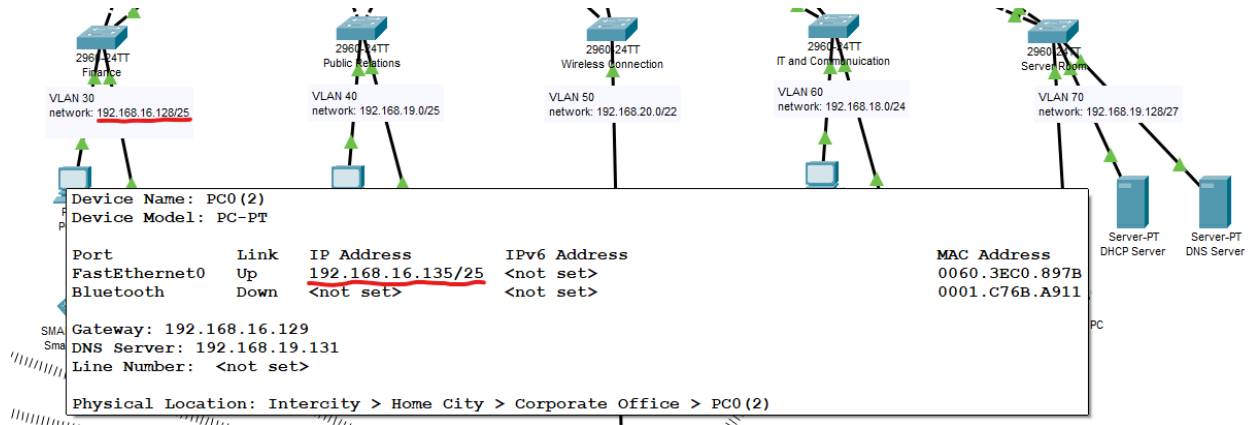


Figure 9: As soon as packet tracer opened all devices get IP addresses from DHCP server

5.2. Ping Testing

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.18.6

Pinging 192.168.18.6 with 32 bytes of data:

Request timed out.
Reply from 192.168.18.6: bytes=32 time<1ms TTL=127
Reply from 192.168.18.6: bytes=32 time<1ms TTL=127
Reply from 192.168.18.6: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.18.6:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.19.130

Pinging 192.168.19.130 with 32 bytes of data:

Reply from 192.168.19.130: bytes=32 time<1ms TTL=127
Reply from 192.168.19.130: bytes=32 time<1ms TTL=127
Reply from 192.168.19.130: bytes=32 time<1ms TTL=127
Reply from 192.168.19.130: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.19.130:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Figure 10: First ping is from finance dep. to IT dept.

Second ping is from finance dept. to the DHCP server

5.3. Testing NAT

```
Router>
Router>
Router>en
Router#
Router#show ip nat translation
```

Pro	Inside global	Inside local	Outside local	Outside global
icmp	193.168.1.1:13	192.168.16.135:13	193.168.1.2:13	193.168.1.2:13
icmp	193.168.1.1:14	192.168.16.135:14	193.168.1.2:14	193.168.1.2:14
icmp	193.168.1.1:15	192.168.16.135:15	193.168.1.2:15	193.168.1.2:15
icmp	193.168.1.1:16	192.168.16.135:16	193.168.1.2:16	193.168.1.2:16

Figure 11: NAT translation in core router

5.4. Testing DNS

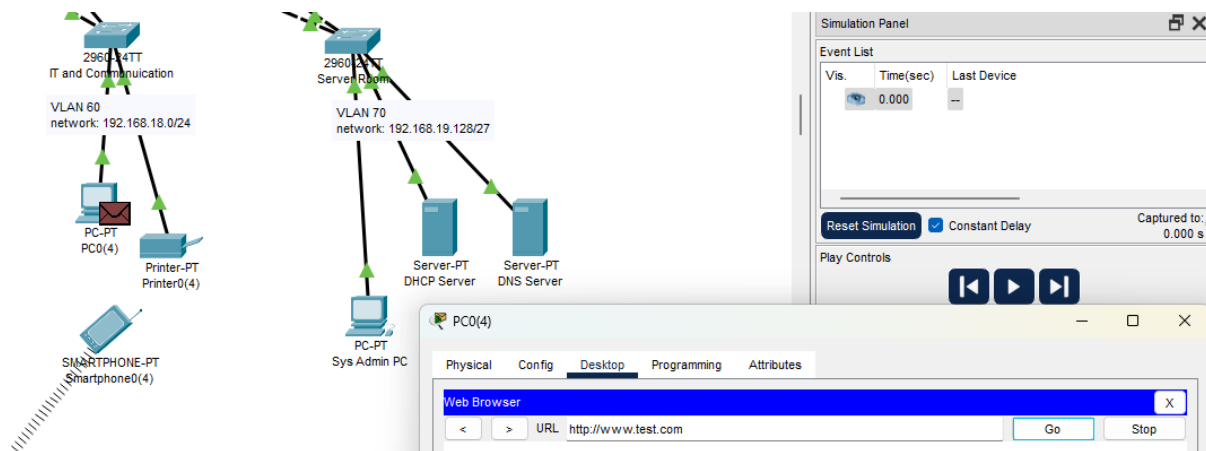


Figure 12: Searching www.test.com on a PC

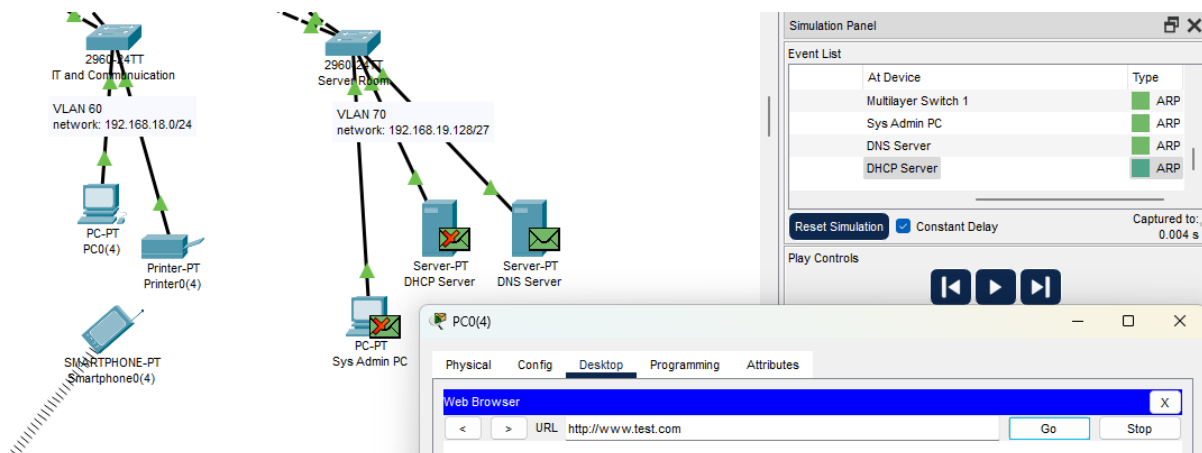


Figure 13: Our query goes to the DNS server to get an IP address for specified domain