

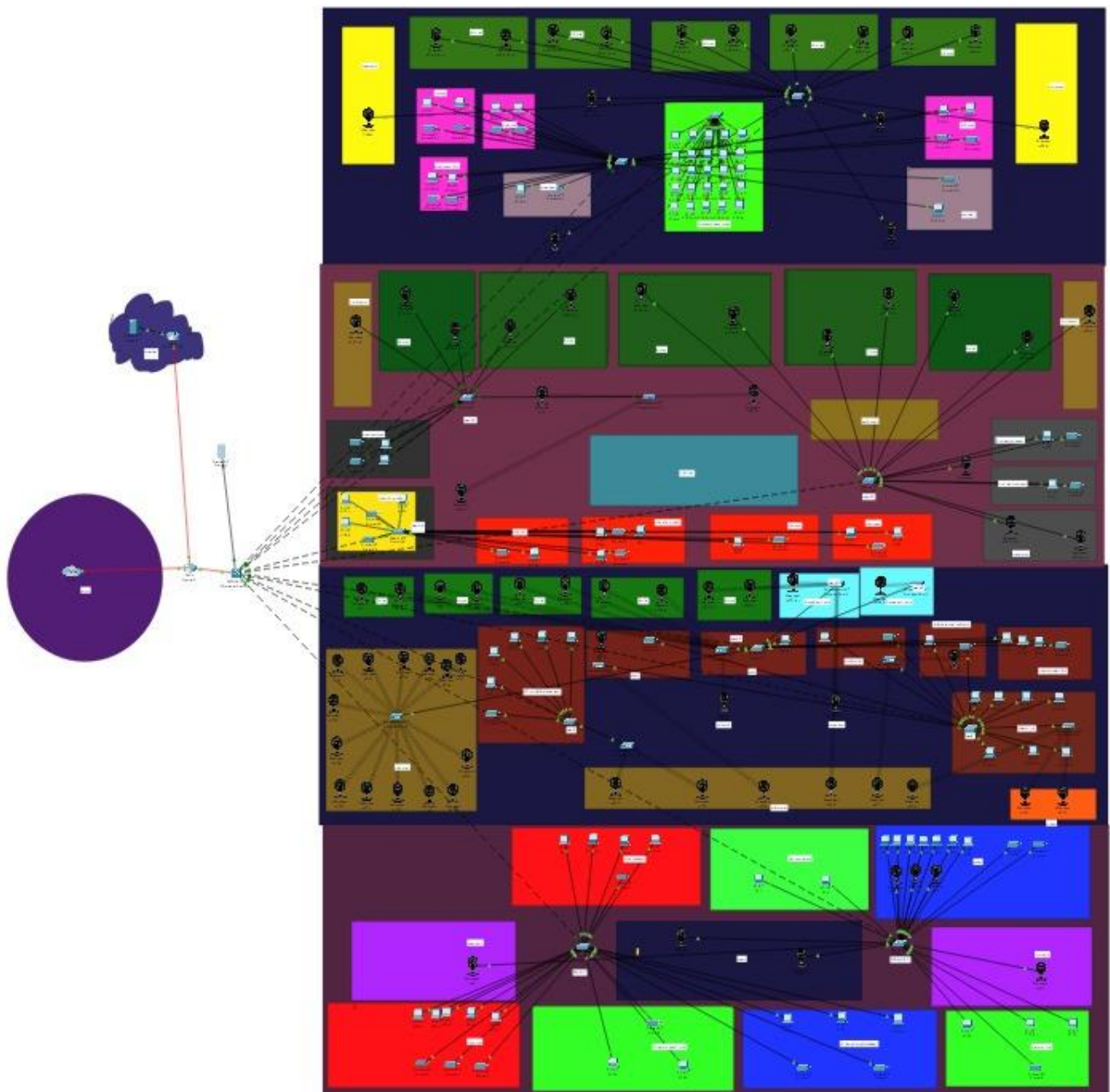


Project Report: Campus Multi-Building Network Design

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1-Network Topology:



BASEMENT:

VLANs	start IP Address /Subnet mask	Default gateway
VLAN5	192.168.5.3 255.255.255.0	192.168.5.1
VLAN6	192.168.6.3 255.255.255.0	192.168.6.1
VLAN7	192.168.7.3 255.255.255.0	192.168.7.1

Room	Computers	Printers	Cameras
شؤون الخريجين	3	1	0
استحقاقات أعضاء هيئة التدريس	3	2	0
شؤون أعضاء هيئة التدريس	2	1	0
شؤون ماليه	5	3	0
استحقاقات عاملين	4	1	0
قسم الدراسات العليا	2	0	0
المكتبه	7	2	3
الطرقه	0	0	2
السلم اليمين	0	0	1
السلم الشمال	0	0	1

(2 switches are used)

Ground Floor:

VLANS	start IP Address /Subnet mask	Default gateway
VLAN8	192.168.8.5 255.255.255.0	192.168.8.1
VLAN9	192.168.9.5 255.255.255.0	192.168.9.1
VLAN10	192.168.10.5 255.255.255.0	192.168.10.1

Room	Computers	Printers	Cameras
مدرج 1	0	0	2
مدرج 2	0	0	2
مدرج 3	0	0	2
مدرج 4	0	0	2
قاعة برامج خاصه1	0	0	1
قاعة برامج خاصه2	0	0	1
مركز استشارات هندسيه	3	1	0
غرفة الامن	1	1	1
شؤون الادرايه	1	1	0
الامن	1	0	0
الخنه	0	1	1
IT	5	1	0
المسرح	0	0	2

(3 switches are used)

First Floor:

VLANS	start IP Address /Subnet mask	Default gateway
VLAN14	192.168.14.5 255.255.255.0	192.168.14.1
VLAN15	192.168.15.5 255.255.255.0	192.168.15.1

Room	Computers	Printers	Cameras
مدرج 6	0	0	2
مدرج 7	0	0	2
مدرج 8	0	0	2
مدرج 9	0	0	2
مدرج 10	0	0	2
مدرج اعدادي	0	0	2
مجلس قسم عماره	2	2	0
عميد الكليه	1	1	0
سكرتاريه عميد الكليه	3	2	0
وكيل الكليه	1	1	0
سكرتاريه وكيل الكليه	3	2	0
مجلس الكليه	2	1	0
أعضاء هيئة التدريس 1	1	1	0
أعضاء هيئة التدريس 2	1	1	0
طرق الكليه	0	0	4
السلم اليمين	0	0	1
السلم الشمال	0	0	1

(3 switches are used)

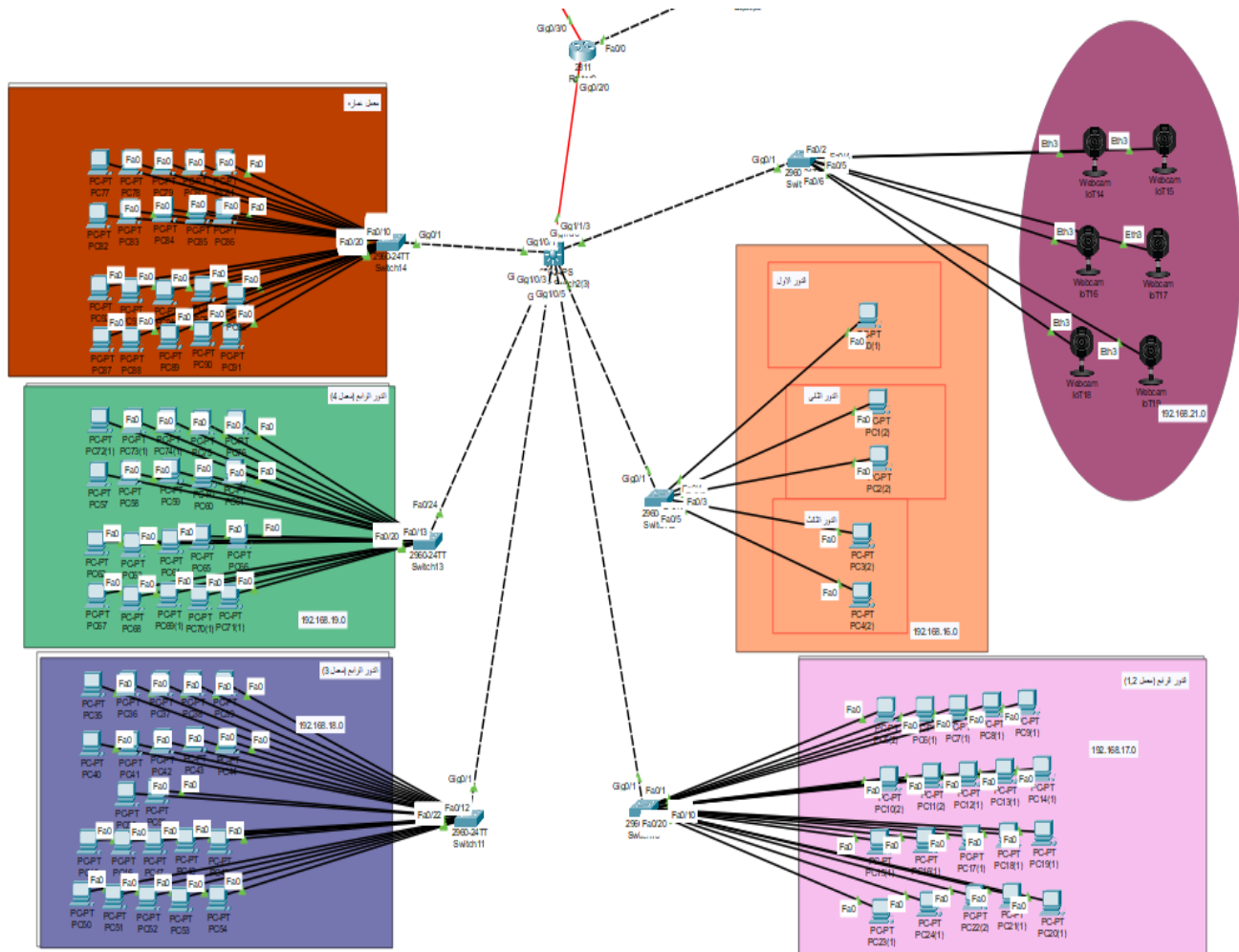
Second Floor:

VLANS	start IP Address /Subnet mask	Default gateway
VLAN26	192.168.26.5 255.255.255.0	192.168.8.1
VLAN27	192.168.27.5 255.255.255.0	192.168.9.1
VLAN28	192.168.28.5 255.255.255.0	192.168.10.1
VLAN29	192.168.29.5 255.255.255.0	192.168.29.10

Room	Computers	Printers	Cameras
مدرج 11	0	0	2
مدرج 12	0	0	2
مدرج 13	0	0	2
مدرج 14	0	0	2
مدرج 15	0	0	2
مجلس قسم كهرباء	2	2	0
اتحاد الطلبة	1	1	0
وحدة الدعم	1	1	0
مجلس قسم بدني	2	2	0
مجلس قسم ميكانيكا	2	2	0
مركز ضمان الجودة	2	2	0
معمل أعضاء هيئته التدريس	25	0	0
طرق الكليه	0	0	4
السلم اليمين	0	0	1
السلم الشمال	0	0	1

(3 switches are used)

Workshops Building:



VLANs	start IP Address /Subnet mask	Default gateway
VLAN16	192.168.16.5 255.255.255.0	192.168.16.1
VLAN17	192.168.17.5 255.255.255.0	192.168.17.1
VLAN18	192.168.18.5 255.255.255.0	192.168.18.1
VLAN19	192.168.19.5 255.255.255.0	192.168.19.1
VLAN20	192.168.20.5 255.255.255.0	192.168.20.1
VLAN21	192.168.21.5 255.255.255.0	192.168.21.1

Room	Computers	Printers	Cameras
الدور الأول	1	0	3
الدور الثاني	2	0	3
الدور الثالث	2	0	0
الدور الرابع (معمل 1,2)	20	0	0
الدور الرابع - معمل 3	22	0	0
لدور الرابع - معمل 4	20	0	0
معمل عماره	20	0	0

(6 switches are used)

2-VLAN Configuration:

- **2.1-VLAN Config for the College building: -**

We can configure VLANs by entering to each switch so we can configure them easily using the VLAN Database :

The screenshot shows the 'VLAN Configuration' window. On the left is a sidebar with a tree view containing 'GLOBAL' (Settings, Algorithm Settings), 'SWITCHING' (VLAN Database), and 'INTERFACE' (FastEthernet0/1 to FastEthernet0/10). The 'VLAN Database' is selected. The main area is titled 'VLAN Configuration' and contains input fields for 'VLAN Number' and 'VLAN Name', 'Add' and 'Remove' buttons, and a table of existing VLANs.

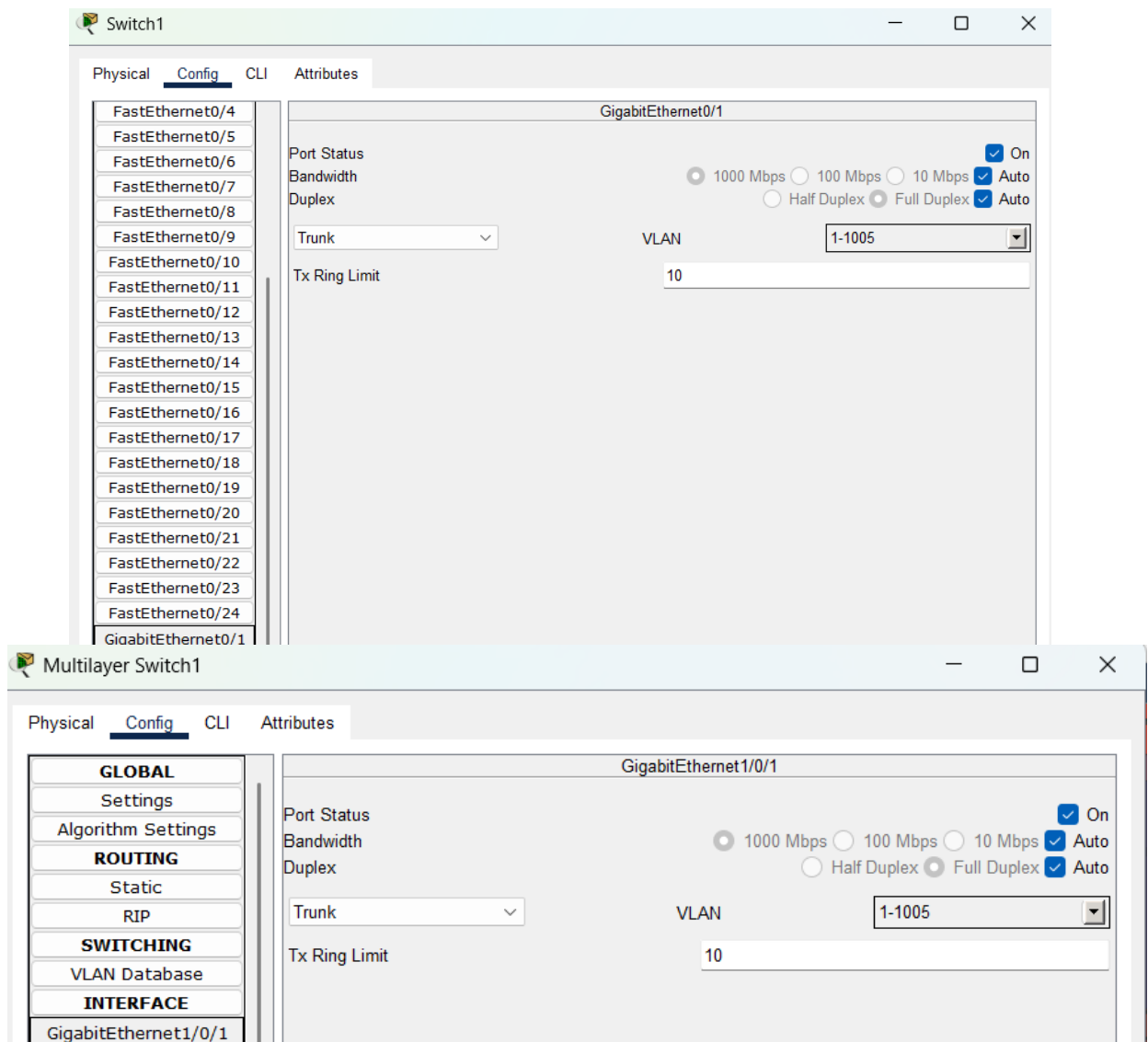
VLAN No	VLAN Name
1	default
5	VLAN5
6	VLAN6
7	VLAN7
1002	fddi-default
1003	token-ring-default
1004	fddinet-default
1005	trnet-default

The screenshot shows the 'FastEthernet0/1' configuration window. The left sidebar is similar to the previous one, but 'FastEthernet0/1' is selected under the 'INTERFACE' section. The main area shows configuration options for the interface: 'Port Status' (On), 'Bandwidth' (100 Mbps), 'Duplex' (Full Duplex), 'Access' (dropdown), 'VLAN' (5), and 'Tx Ring Limit' (10). Checkmarks are present for 'On', 'Auto' for both 'Bandwidth' and 'Duplex'.

- Then go to each interface for propre configuration

- **Trunking between MLS and switches:-**

Trunking between the MLS and access switches is essential to carry multiple VLANs over a single link, enable inter-VLAN routing.



- **Inter-VLAN Routing (MLS Configuration):**

Key Commands Used:

```
ip routing
interface vlan 9
  ip address 192.168.9.1 255.255.255.0
  no shutdown
! Repeated for all VLANs
```

• 2.2- Configuration between VLAN for workshop buliding: -

Access between switches and PCs:-

```
Switch(config)#vlan 16
Switch(config-vlan)#name vlan16
Switch(config-vlan)#exit
Switch(config)#interface range fa0/1 - 20
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 16
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#
```

SVI (switch virtual interface) at MLS (multi layer switch) :-

```
Switch(config)#vlan 17
Switch(config-vlan)#name vlan17
Switch(config-vlan)#exit
Switch(config)#vlan 16
Switch(config-vlan)#name vlan16
Switch(config-vlan)#exit

Switch(config)#interface vlan 16
Switch(config-if)#ip address 192.168.16.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
```

Trunk between switches and MLS at switch:-

```
Switch(config)#interface fa0/6
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan 16,17,18,19,20,21
Switch(config-if)#no shutdown
```

Trunk between switches and MLS at MLS:-

```
Switch(config)#interface fa0/7
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan 16,17,18,19,20,21
Switch(config-if)#no shutdown
```

3-Dynamic Routing:

OSPF Area 0 is configured to exchange routes between College Building, the Workshops Building, and the Internet Edge.

Key Commands Used:

```
MLS1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
MLS1(config)#route ospf 1
MLS1(config-router)#network 192.168.0.0 0.0.255.255 area 0
MLS1(config-router)#network 10.0.0.0 0.0.255.255 area 0
MLS1(config-router)#exit
MLS1(config)#exit
```

- **Showing IP route:**

```
Router1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
        * - candidate default, U - per-user static route, o - ODR
        P - periodic downloaded static route

Gateway of last resort is 173.16.0.2 to network 0.0.0.0

    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.0.0.0/30 is directly connected, GigabitEthernet0/3/0
L       10.0.0.1/32 is directly connected, GigabitEthernet0/3/0
O       10.0.1.0/30 [110/2] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
    173.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       173.16.0.0/26 is directly connected, GigabitEthernet0/1/0
L       173.16.0.1/32 is directly connected, GigabitEthernet0/1/0
O       192.168.1.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.3.0/24 [110/2] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.5.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.6.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.7.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.8.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.9.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.10.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.14.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.15.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.16.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.17.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.18.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.19.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.20.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.21.0/24 [110/3] via 10.0.0.2, 00:51:50, GigabitEthernet0/3/0
O       192.168.26.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.27.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.28.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
O       192.168.29.0/24 [110/2] via 192.168.100.2, 00:51:50, GigabitEthernet0/0/0
    192.168.100.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.100.0/30 is directly connected, GigabitEthernet0/0/0
L       192.168.100.1/32 is directly connected, GigabitEthernet0/0/0
S*     0.0.0.0/0 [1/0] via 173.16.0.2
```

Key Reasons for Choosing OSPF:

- **Fast convergence** compared to RIP
- **No hop count limitation**, unlike RIP
- **Open standard**, unlike EIGRP
- **Scalable design** using areas (suitable for campus networks)
- **Efficient bandwidth usage** due to event-driven updates

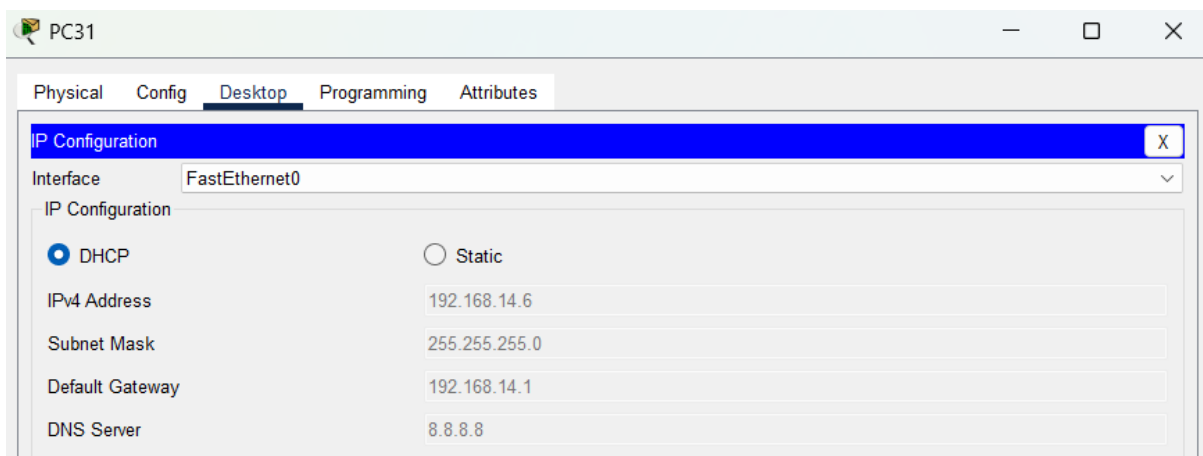
4-Configure DHCP (Services): -

A centralized Server located at 192.168.1.2 handles dynamic IP allocation for the network. The DHCP pool is configured to assign the correct Default Gateway for each VLAN and uses Google's Public DNS (8.8.8.8) for external name resolution.

- DHCP Services (in server 0):**

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
vlan 28	192.168.28.1	8.8.8.8	192.168.28.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 27	192.168.27.1	8.8.8.8	192.168.27.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 26	192.168.26.1	8.8.8.8	192.168.26.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 10	192.168.10.1	8.8.8.8	192.168.10.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 9	192.168.9.1	8.8.8.8	192.168.9.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 8	192.168.8.1	8.8.8.8	192.168.8.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 21	192.168.21.1	8.8.8.8	192.168.21.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 20	192.168.20.1	8.8.8.8	192.168.20.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 19	192.168.19.1	8.8.8.8	192.168.19.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 18	192.168.18.1	8.8.8.8	192.168.18.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 17	192.168.17.1	8.8.8.8	192.168.17.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 16	192.168.16.1	8.8.8.8	192.168.16.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 7	192.168.7.1	8.8.8.8	192.168.7.3	255.255.255.0	253	0.0.0.0	0.0.0.0
vlan 5	192.168.5.1	8.8.8.8	192.168.5.3	255.255.255.0	253	0.0.0.0	0.0.0.0
vlan 6	192.168.6.1	8.8.8.8	192.168.6.3	255.255.255.0	253	0.0.0.0	0.0.0.0
at router1	192.168.2.1	8.8.8.8	192.168.2.5	255.255.255.0	251	0.0.0.0	0.0.0.0
experiment	192.168.3.1	8.8.8.8	192.168.3.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan14	192.168.14.1	8.8.8.8	192.168.14.5	255.255.255.0	251	0.0.0.0	0.0.0.0
vlan 15	192.168.15.1	8.8.8.8	192.168.15.5	255.255.255.0	251	0.0.0.0	0.0.0.0
serverPool	192.168.1.1	8.8.8.8	192.168.1.5	255.255.255.0	251	0.0.0.0	0.0.0.0

- Example of getting successful DHCP IP (e.g vlan 14):**



5-Apply Access Control Lists (ACLs): -

Requirement: Restrict access to Top Level VLANs (9, 14, 28) while maintaining operational functionality.

Strategy: A Stateful Extended ACL was implemented. It denies all unauthorized internal traffic from initiating connections to VIP VLANs, but uses the established keyword to allow VIPs to receive replies when they initiate the connection.

Configuration Script:

```
MLSl>enable
MLSl#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
MLSl(config)#
MLSl(config)#no ip access-list extended SECURE_VIPS
MLSl(config)#
MLSl(config)#ip access-list extended SECURE_VIPS
MLSl(config-ext-nacl)# permit ip host 192.168.1.2 any
MLSl(config-ext-nacl)# permit tcp 192.168.0.0 0.0.255.255 any established
MLSl(config-ext-nacl)# permit icmp 192.168.0.0 0.0.255.255 any echo-reply
MLSl(config-ext-nacl)# deny ip 192.168.0.0 0.0.255.255 any
MLSl(config-ext-nacl)# permit ip any any
MLSl(config-ext-nacl)# exit
MLSl(config)#
MLSl(config)#interface vlan 9
MLSl(config-if)# ip access-group SECURE_VIPS out
MLSl(config-if)# exit
MLSl(config)#
MLSl(config)#interface vlan 14
MLSl(config-if)# ip access-group SECURE_VIPS out
MLSl(config-if)# exit
MLSl(config)#
MLSl(config)#interface vlan 28
MLSl(config-if)# ip access-group SECURE_VIPSout
% Incomplete command.
MLSl(config-if)#exit|
```

6-Internet Simulation (Bonus): -

Network Address Translation (NAT) Overload is configured on the Edge Router to allow internal private IPs to share a single Public IP.

Key Commands Used:

```
ip nat inside source list 1 interface g0/0 overload
access-list 1 permit 192.168.0.0 0.0.255.255
ip route 0.0.0.0 0.0.0.0 [ISP_IP]
```

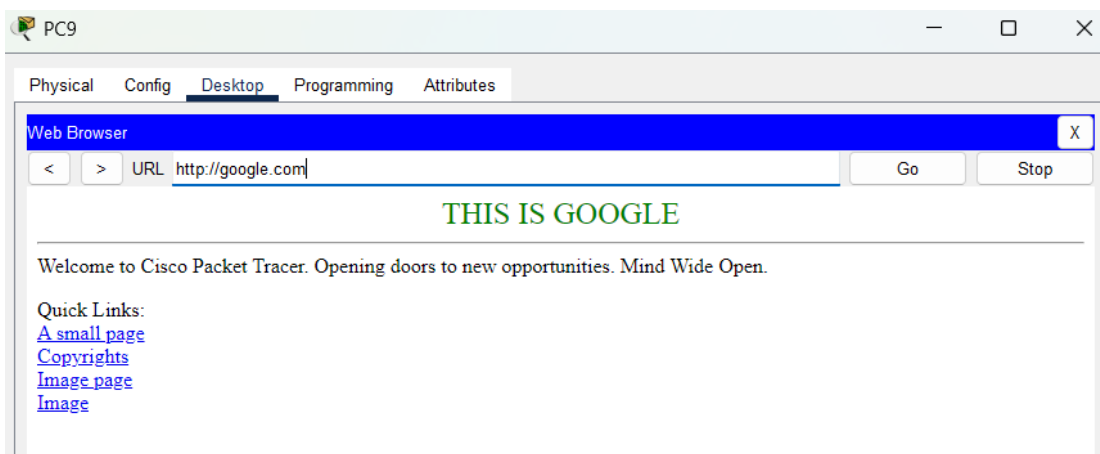
- Pinging from any PC to 8.8.8.8 showing Reply “e.g from google”:

```
C:\>ping 8.8.8.8

Pinging 8.8.8.8 with 32 bytes of data:

Reply from 8.8.8.8: bytes=32 time<1ms TTL=125
Reply from 8.8.8.8: bytes=32 time<1ms TTL=125
Reply from 8.8.8.8: bytes=32 time<1ms TTL=125
Reply from 8.8.8.8: bytes=32 time<1ms TTL=125

Ping statistics for 8.8.8.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```



7-Testing & Verification: -

Test 1: Security (ACL) Verification

Scenario: A Student (VLAN 10) attempts to ping the Admin Manager (VLAN 9).

Result: Failed (Blocked by ACL), as required

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.9.7

Pinging 192.168.9.7 with 32 bytes of data:

Reply from 192.168.10.1: Destination host unreachable.
Reply from 192.168.10.1: Destination host unreachable.
Reply from 192.168.10.1: Destination host unreachable.
Reply from 192.168.10.1: Destination host unreachable.

Ping statistics for 192.168.9.7:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Test 2: Admin Functionality

Scenario: An Admin (VLAN 9) attempts to ping a Student (VLAN 10) to troubleshoot.

Result: Success (Allowed by echo-reply rule).

```
C:\>ping 192.168.10.33

Pinging 192.168.10.33 with 32 bytes of data:

Reply from 192.168.10.33: bytes=32 time<1ms TTL=127
Reply from 192.168.10.33: bytes=32 time<1ms TTL=127
Reply from 192.168.10.33: bytes=32 time<1ms TTL=127
Reply from 192.168.10.33: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.10.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Note: we saw previously that the DHCP assignment and internet reachability is done successfully!