**Variable Length Subnet Mask (VLSM)**

**VLSM Design and Implementation Practice**

**Design the VLSM Addressing Scheme**

* **10.0.0.0/8 255.255.255.255.0**
* **VLAN 100** will require **31** host IP addresses

∙   **VLAN 100** LAN will require **40** host IP addresses

∙   **VLAN 130** LAN will require **7** host IP addresses

∙   **VLAN 400** LAN will require **15** host IP addresses

∙   **VLAN 500** LAN will require **61** host IP addresses

∙   **VLAN 600** LAN will require **25** host IP addresses

∙   **VLAN 700** LAN will require **12** host IP addresses

∙   **VLAN 800** LAN will require **8** host IP addresses

* Server site will require **7** host IP addresses
* Each layer 3 switch will require 2 to connect the GW router

**Solution**

**10.10.00000000.00000000 /8**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x | x | x | x | x | x | x | x |
| 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

**Reorder**

1. **VLAN 500** LAN will require **61** host IP addresses    No. of Hosts= 2h-2=2^6-2 = 62  host   / 26
2. **VLAN 200** LAN will require **40** host IP addresses No. of Hosts= 2h-2=2^6-2 = 62 host  /  26
3. **VLAN 100** LAN will require **31** host IP addresses No. of Hosts= 2h-2=2^6-2 = 62  host  / 26
4. **VLAN 600** LAN will require **25** host IP addresses No. of Hosts= 2h-2=2^5-2 = 30 host   / 27
5. **VLAN 400** LAN will require **15**  host IP addresses No. of Hosts= 2h-2=2^5-2 = 30 host   / 27
6. **VLAN 700** LAN will require **12** host IP addresses No. of Hosts= 2h-2=2^4-2 = 14 host   / 28
7. **VLAN 800** LAN will require **8**  host IP addresses No. of Hosts= 2h-2=2^4-2 = 14 host   / 28
8. Servers site will require **7** host IP addresses No. of Hosts= 2h-2=2^4-2 = 14 host   / 28
9. GW-MAIN MLS REQUIRE 2 HOSTS 2^2 -2 = 2 /30
10. GW-S MLS REQUIRE 2 HOSTS 2^2 -2 = 2 /30
11. GW-N MLS REQUIRE 2 HOSTS 2^2 -2 = 2 /30
12. GW-R MLS REQUIRE 2 HOSTS 2^2 -2 /30

**subnet Table**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subnet Description** | **VLAN ID** | **VLAN Name** | **Required Number of Hosts** | **Network Address/CIDR** | **First Usable Host Address** | **Last Usable Host Address** | **Broadcast Address** |
| **Main** | VLAN 100 | VLAN\_100 | 31 | 10.0.0.128/26 | 10.0.0.129 | 10.0.0.62 | 10.0.0.63 |
| VLAN 200 | VLAN\_200 | 40 | 10.0.0.64/26 | 10.0.0.65 | 10.0.0.126 | 10.10.0.127 |
| **S** | VLAN 130 | VLAN\_130 | 7 | 10.10.1.32/28 | 10.10.1.33 | 10.10.1.46 | 10.0.1.47 |
| VLAN 400 | VLAN\_400 | 15 | 10.0.0.224/27 | 10.0.0.225 | 10.0.0.254 | 10.0.0.255 |
| **N** | VLAN 500 | VLAN\_500 | 61 | 10.0.0.0/26 | 10.0.0.1 | 10.0.0.62 | 10.0.0.63 |
| VLAN 600 | VLAN\_600 | 25 | 10.0.0.192/27 | 10.0.0.193 | 10.0.0.222 | 10.0.0.223 |
| **R** | VLAN 700 | VLAN\_700 | 12 | 10.0.1.0/28 | 10.0.1.1 | 10.0.1.14 | 10.0.1.15 |
| VLAN 800 | VLAN\_800 | 8 | 10.0.1.16/28 | 10.0.1.17 | 10.0.1.30 | 10.0.1.31 |
| **From Main-MLS to MIU-MIU-GW** | - |  | 2 | 10.0.1.64/30 | 10.0.1.65 | 10.0.1.66 | 10.0.1.67 |
| **From N-MLS to MIU-MIU-GW** | - |  | 2 | 10.0.1.72/30 | 10.0.1.73 | 10.0.1.74 | 10.0.1.75 |
| **From S-MLS to MIU-MIU-GW** | - |  | 2 | 10.0.1.68/30 | 10.0.1.69 | 10.0.1.70 | 10.0.1.71 |
| **From R-MLS to MIU-MIU-GW** | - |  | 2 | 10.0.1.76/30 | 10.0.1.77 | 10.0.1.78 | 10.0.1.79 |
| **From SW-S to MIU-MIU-GW** | - |  | 7 | 10.0.1.48/28 | 10.0.1.49 | 10.0.1.62 | 10.0.1.63 |

**Addressing Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Device** | **Interface** | **Address** | **Subnet Mask** | **Default Gateway** | **VLAN ID** |
| **Main-MLS** | G1/1/1 | 10.0.1.66 | 255.255.255.252 | - |  |
| VLAN 100 | 10.0.0.129 | 255.255.255.192 | - | 100 |
| VLAN 200 | 10.0.0.65 | 255.255.255.192 | - | 200 |
| **S-MLS** | G1/1/1 | 10.0.1.74 | 255.255.255.252 | - |  |
| VLAN  130 | 10.0.1.33 | 255.255.255.240 | - | 130 |
| VLAN  400 | 10.0.0.225 | 255.255.255.224 | - | 400 |
| **N-MLS** | G1/1/1 | 10.0.1.70 | 255.255.255.252 | - |  |
| VLAN  500 | 10.0.0.1 | 255.255.255.192 | - | 500 |
| VLAN  600 | 10.0.0.193 | 255.255.255.224 | - | 600 |
| **R-MLS** | G1/0/5 | 10.0.1.78 | 255.255.255.252 | - |  |
| VLAN  700 | 10.0.1.1 | 255.255.255.240 | - | 700 |
| VLAN  800 | 10.0.1.17 | 255.255.255.240 | - | 800 |
| **MIU-MIU-GW** | Gig0/0 | 209.165.200.226 | 255.255.255.252 | - |  |
| Gig0/1 | 10.0.1.77 | 255.255.255.252 | - |  |
| Gig0/0/0 | 10.0.1.49 | 255.255.255.252 | - |  |
| Gig0/1/0 | 10.0.1.65 | 255.255.255.252 | - |  |
| Gig0/2/0 | 10.0.1.73 | 255.255.255.252 | - |  |
| Gig0/3/0 | 10.0.1.69 | 255.255.255.252 | - |  |
| **ISP** | Gig 0/0 | 209.165.200.225 | 255.255.255.240 |  |  |
| Gig 0/1 | 64.100.1.1 | 255.255.255.224 |  |  |
| Gig 0/2 | 64.100.2.1 | 255.255.255.224 |  |  |
| **Branch-GW** | Gig 0/0.2 | 192.168.2.1 | 255.255.255.0 |  | 2 |
| Gig 0/0.3 | 192.168.3.1 | 255.255.255.0 |  | 3 |
| Gig 0/1 | 64.100.1.2 | 255.255.255.224 |  |  |
| **Wireless Home Router** | G0/1 | 64.100.2.2 | 255.255.255.224 |  |  |
| Router IP | 192.168.10.1 | 255.255.255.128 |  |  |

**Hosts Address**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PC-number** | **VLAN ID** | **IP Address** | **Subnet Mask** | **Default Gateway** |
| **MIU** | | | | |
| **PC-1** | 100 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-2** | 100 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-3** | 200 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-4** | 130 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-5** | 130 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-6** | 400 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-7** | 500 | 10.0.0.62 | 255.255.255.192 | 10.0.0.1 |
| **PC-8** | 600 | 10.0.0.222 | 255.255.255.224 | 10.0.0.193 |
| **PC-9** | 700 | 10.0.1.14 | 255.255.255.240 | 10.0.1.1 |
| **PC-10** | 800 | 10.0.1.30 | 255.255.255.240 | 10.0.1.17 |
| **MIU\_ Branch 1** | | | | |
| **PC-11** | 2 | From DHCP Server | From DHCP Server | From DHCP Server |
| **PC-12** | 3 | From DHCP Server | From DHCP Server | From DHCP Server |
| **Wireless Home Network** | | | | |
| **Laptop** |  | 192.168.10.10 | 255.255.255.128 | 64.100.2.2 |
| **Tablet** |  | 192.168.10.30 | 255.255.255.128 | 64.100.2.2 |
| **Smartphone** |  | 192.168.10.20 | 255.255.255.128 | 64.100.2.2 |
| **Servers** | | | | |
| **DHCP Server** |  | 10.0.1.51 | 255.255.255.240 | 10.0.1.50 |
| **Email Server** |  | 10.0.1.52 | 255.255.255.240 | 10.0.1.50 |
| **Web server** |  | 10.0.1.53 | 255.255.255.240 | 10.0.1.50 |
| **DNS server** |  | 10.0.1.55 | 255.255.255.240 | 10.0.1.50 |
| **NTP and Syslog server** |  | 10.0.1.54 | 255.255.255.240 | 10.0.1.50 |

Part 2

no ip domain-lookup

hostname HOSTNAME

security passwords min-length 10

line console 0

password MIU1234567

login

exit

enable secret CSC1234567

service password-encryption

banner motd ^

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\* Authorized Access Only - MIU Network System \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

interface g0/0

ip address 209.165.200.226 255.255.255.252

no shutdown

interface g0/1

ip address 10.0.1.65 255.255.255.252

no shutdown

interface g0/0/0

ip address 10.0.1.49 255.255.255.252

no shutdown

interface g0/1/0

ip address 10.0.1.65 255.255.255.252

no shutdown

interface g0/2/0

ip address 10.0.1.73 255.255.255.252

no shutdown

interface g0/3/0

ip address 10.0.1.69 255.255.255.252

no shutdown

ip routing

ip domain-name miu.edu.eg

username admin privilege 15 secret MIUadmin123

crypto key generate rsa

1024

ip ssh version 2

line vty 0 4

transport input ssh

login local

exit

end

wr

Part 3

On switch layer-3:

1)int range g1/0/1-2 (and make the same for g1/0/3-4)

2)channel-group 2 mode active (it will be 3 for g1/0/3-4)

3)int port channel 2

4)switchport mode trunk

5)int g1/1/1

6)no switchport

7)ip address (ip) (subnet)

8)int vlan (no) (do the same for the second vlan)

9)ip address (ip) (subnet)

10)vlan (no)

11) name VLAN\_no (do the same for the second vlan)

12)ip routing

On switch layer-2:

1)int range g0/1-2 (and make the same for f0/1-2)

2)channel-group 2 mode active (it will be 3 for f0/1-2)

3)int port channel 2

4)switchport mode trunk

5)int f0/3 (do the same f0/4 if exist)

6)switchport mode access

7)switchport access vlan no

8)vlan (no)

9) name VLAN\_no (do the same for the second vlan)

Part 4

On MIU-GW:

1)router ospf 100

2)router-id 1.1.1.1

3)network between (Main,S,SW-S)->MIU-GW (wild card)(area 0)

4)redistribute eigrb 10 subnets

5)passive-interface default

6)no passive interface (on interfaces that need ospf)

7)router eigrb 10

8) network between (N,R)->MIU-GW (wild card)(area 0)

9) redistribute OSPF 100 metric 10000 100 255 1 1 1500

10)ip route 0.0.0.0 0.0.0.0 (next hop)

On Main,S:

1)router ospf 100

2)router id 2.2.2.2 (will be 3.3.3.3 in S)

3)network between (MIU,S,Main)

4)network between (Main,S)->VLAN\_no

5)passive interface default

6) no passive interface (on interfaces that need ospf)

On N,R:

1)router eigrb 10

2)network between (N,R,Main)

3)network between (N,R)->vlans

4)passive interface default

5) no passive interface (on interfaces that need ospf)

On isp:

1)ip route 10.0.0.0 255.255.0.0 209.165.200.226

2)ip route 192.168.2.0 255.255.0.0 64.100.1.2

3) ip route 192.168.3.0 255.255.0.0 64.100.1.2

4) ip route 192.168.10.0 255.255.0.0 64.100.2.2

On branch:

Ip route 0.0.0.0 0.0.0.0 64.100.1.1

On wireless:

Ip route 0.0.0.0 0.0.0.0 64.100.2.1

Part 5

On DHCP server :

1)services->DHCP

2)check if it is on

3)fill inputs of the poll name, default gateway, DNS server, start ip address, subnet mask

4)press add after finish

On switch layer-3 :

1)int vlan (no)

2)ip helper-address (DHCP ip)

On branch-GW:

1)ip dhcp execlude-address (start ip)(end ip)->(for each vlan)

2)ip dhcp poll (name)

3)network (ip)(subnet)

4)default-router(ip)

5)dns-server (dns ip)

Part 6

On MIU-GW:

1)access-list 1 permit 10.0.0.0 0.255.255.255

2)ip nat pool NAT-POOL 209.165.200.227 209.165.200.227 netmask 255.255.255.240

3)ip nat inside source list 1 pool NAT-POOL overload

4)ip nat inside source static 10.0.1.53 209.165.200.228

5)int g0/0

6)ip nat outside

7)ip g0/0/0

8)ip nat inside

9)ip g0/1/0

8)ip nat inside

7)ip g0/2/0

8)ip nat inside

7)ip g0/3/0

8)ip nat inside

7)ip g0/1

8)ip nat inside

Part 7

**On each router and switch (e.g., MIU-GW, Main-MLS, S-MLS, etc.):**

**conf t**

**ntp server 10.0.1.50**

**Email Server Configuration**

1. On the **Email Server**:
   * Go to **Services > Email**.
   * Set:
     + **Domain Name**: miu.edu.eg
     + **SMTP & POP3**: Enable both
   * Create users:
     + Example:
       - Username: admin, Password: admin123
2. On **Client PCs**:
   * Go to **Email** tab.
   * Configure:
     + Username: admin
     + Password: admin123
     + Incoming/Outgoing server: miu.edu.eu

DNS Server Configuration:

1. On the DNS **Server**:
   * Go to **Services > DNS**
   * Add a record:
     + **Name**: miu.edu.eg
     + **Type**: A
     + **Address**: 10.0.1.50 (Web Server IP)
2. On **Client PCs**:
   * Set DNS IP to 10.0.1.50

**PART 8**

### On MIU-GW

conf t

crypto isakmp policy 10

encr aes

authentication pre-share

group 5

lifetime 86400

exit

crypto isakmp key MIU123 address 209.165.201.226

crypto ipsec transform-set TS esp-aes esp-sha-hmac

mode tunnel

exit

! Define ACL for interesting traffic (traffic to encrypt)

access-list 110 permit ip 10.0.0.0 0.0.255.255 192.168.1.0 0.0.0.255

! Create the crypto map

crypto map VPN-MAP 10 ipsec-isakmp

set peer 209.165.201.226

set transform-set TS

match address 110

exit

interface g0/0

crypto map VPN-MAP

exit

### Branch\_GW (mirror config)

conf t

crypto isakmp policy 10

encr aes

authentication pre-share

group 5

exit

crypto isakmp key MIU123 address 209.165.200.226

crypto ipsec transform-set TS esp-aes esp-sha-hmac

mode tunnel

exit

access-list 110 permit ip 192.168.1.0 0.0.0.255 10.0.0.0 0.0.255.255

crypto map VPN-MAP 10 ipsec-isakmp

set peer 209.165.200.226

set transform-set TS

match address 110

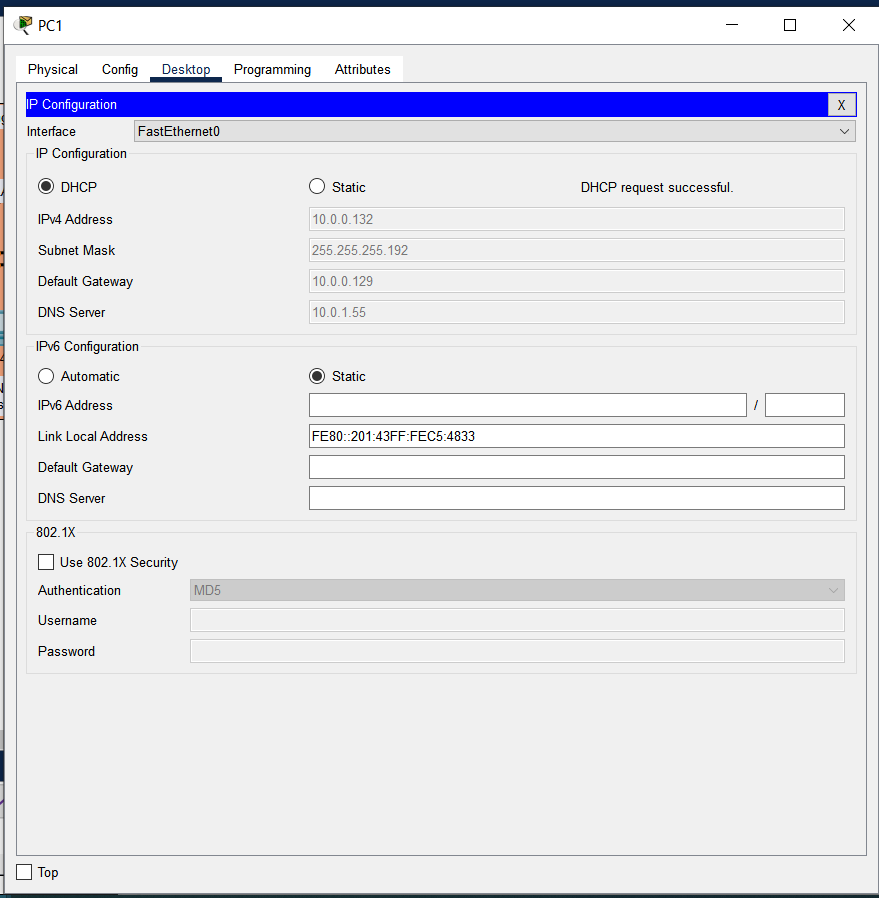
exit

interface g0/0

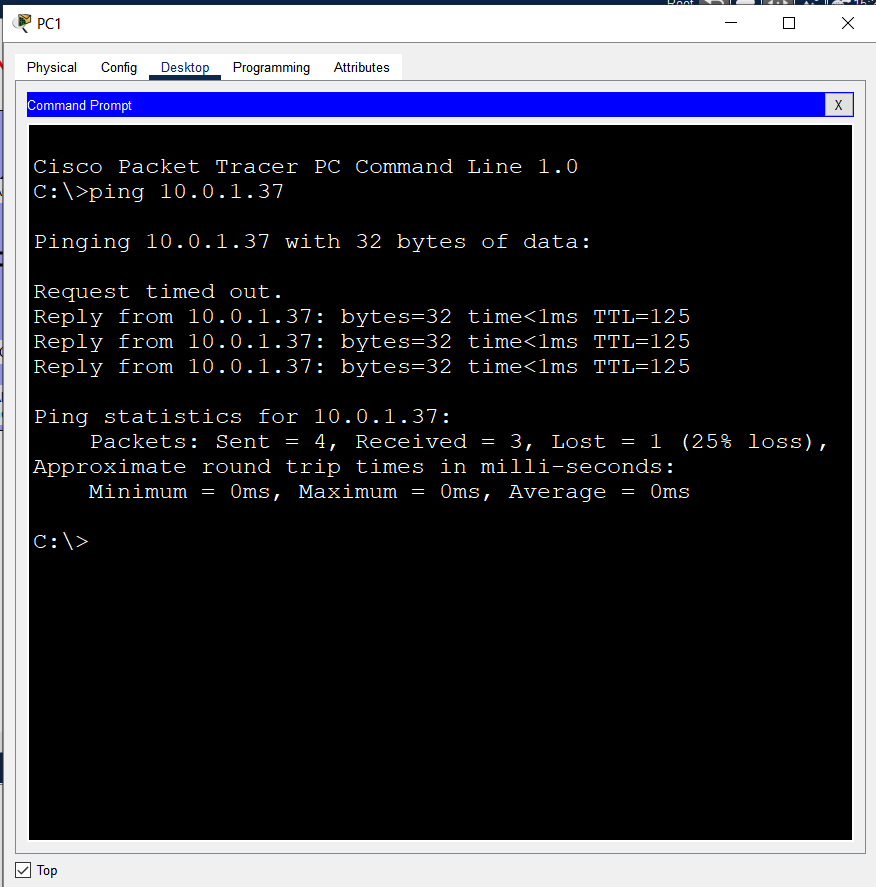
crypto map VPN-MAP

exit

**PING**

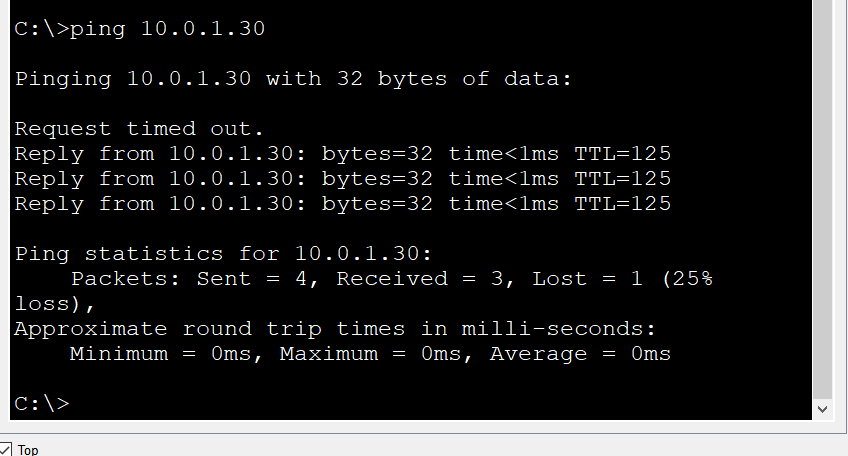
****

**Request From dhcp**

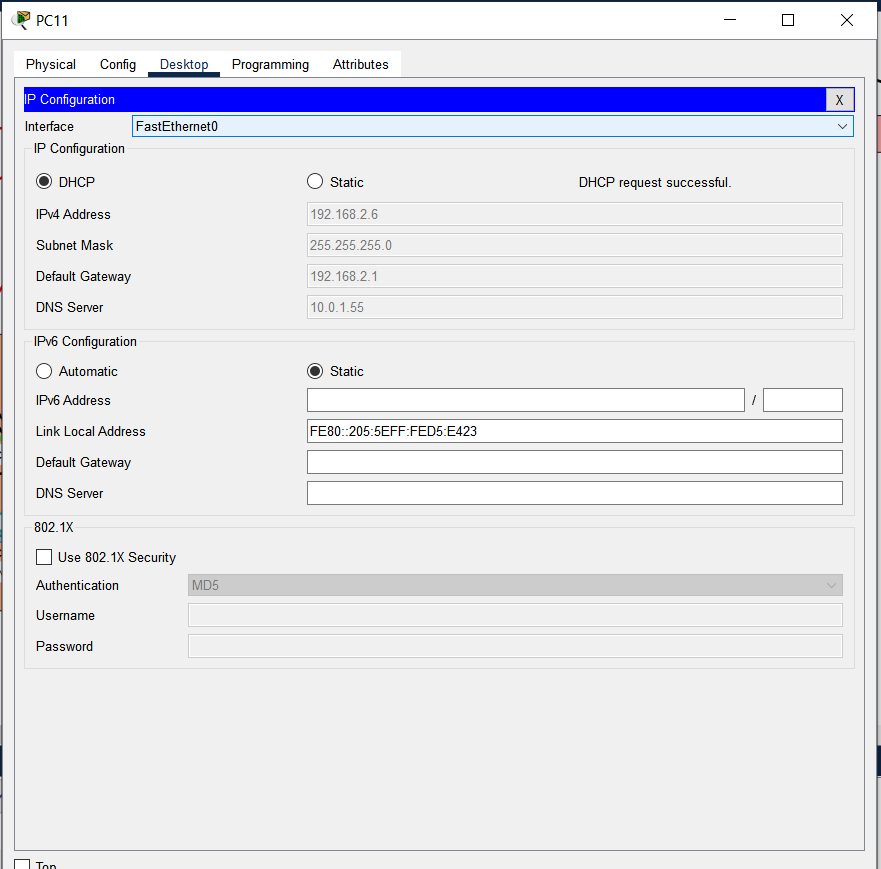
****

**Ping from pc1 to pc 4**

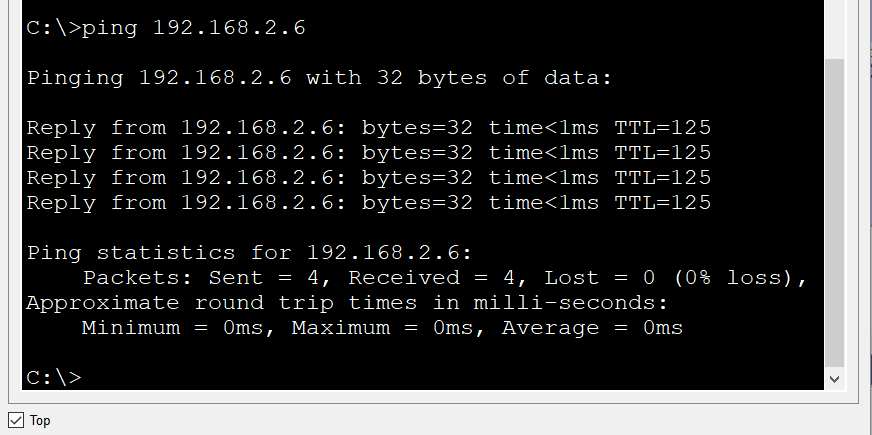
**(same protocol bet ospf and ospf)**

**ping from Pc1 to Pc10**

**(differ protocol bet eigrp and ospf)**

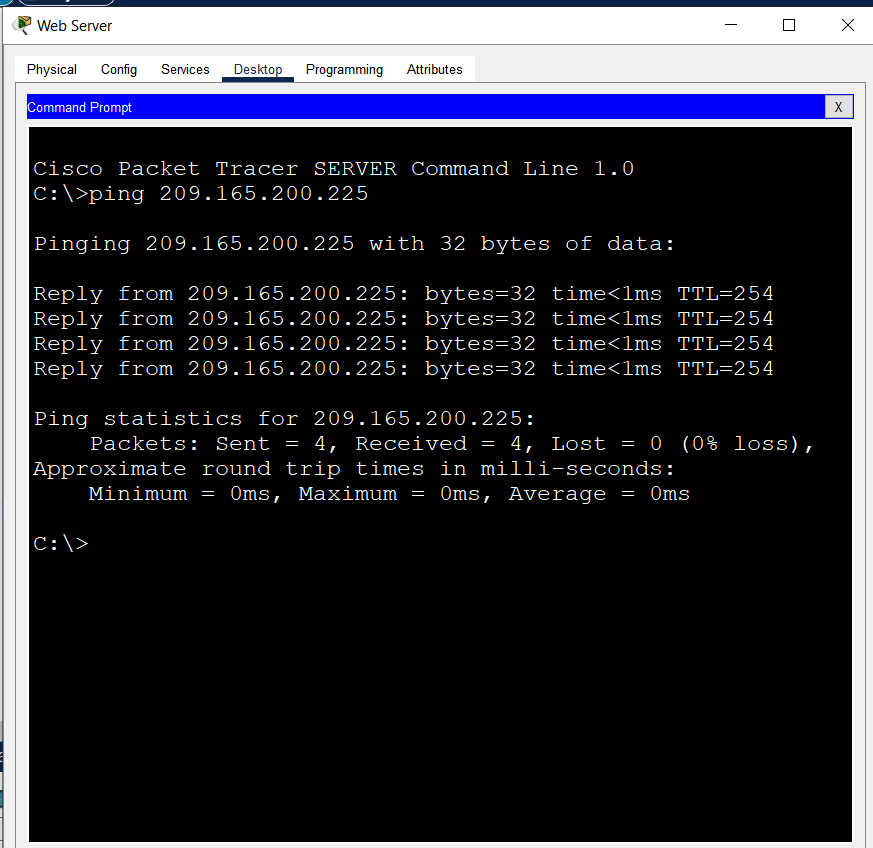
****

**Pc 11 req a DHCP from the Branch-GW**

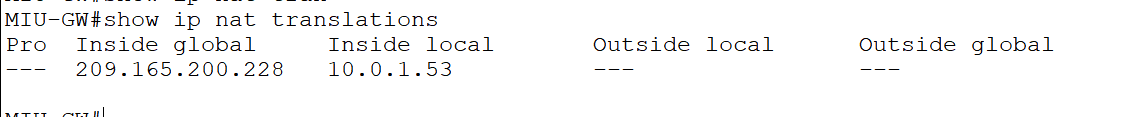
****

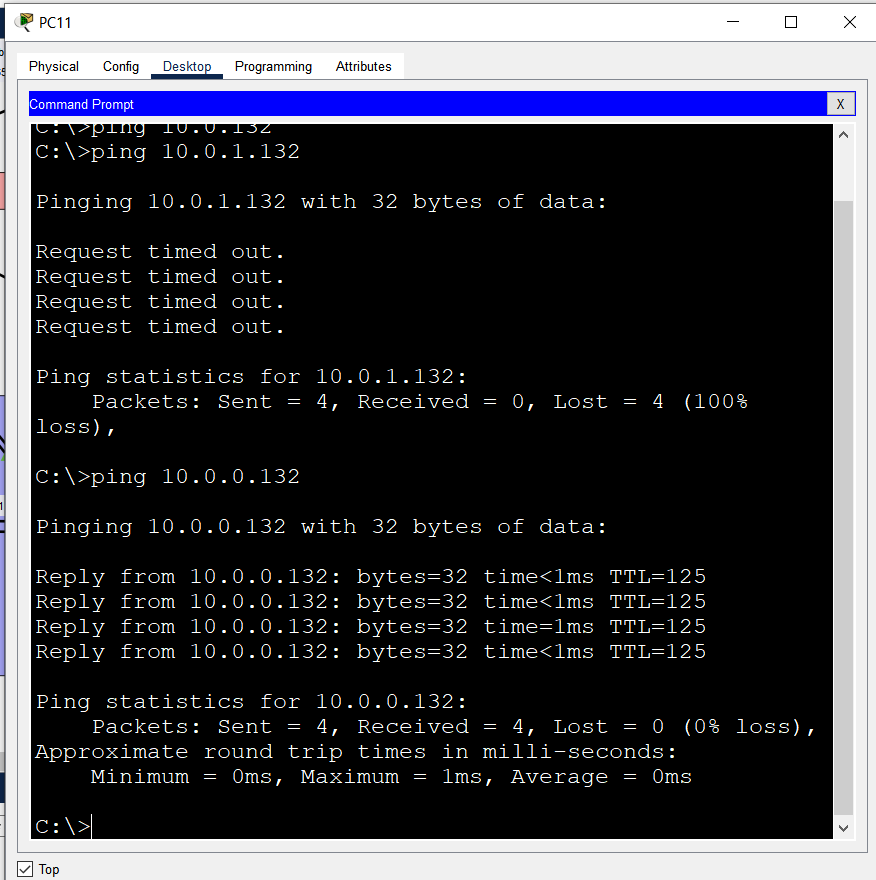
**Pc 1 to Pc 11**

**Outside the MIU-GW**

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**Web server ping outside to check the nat and pat staticlly**

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**Pc 11 pinging pc 1**