Retele de calculatoare – asignare IP-uri

Calculul IP-urilor

Fie IP-ul 139.209.121.110/12 si urmatoarea descriere de topologie:

- 15 utilizatori
- 1023 de utilizatori
- 63 de utilizatori
- 2047 de utilizatori
- 1022 de utilizatori
- 511 utilizatori
- 7 utilizatori

Sortam descrescator numarul de utilizatori si ii incadram intre puteri ale lui 2:

Numar de utilizatori (se adauga un +2 pentru ca N.A. si B.A. nu sunt asignabile)	**Puierea superioara a lui 2**	**Observatii**	**Subnet mask-ul (se calculeaza ca 32 – puterea lui 2)**
2047 + 2	12		32 – 12 = 20
1023 + 2	11		32 – 11 = 21
1022 + 2	10	1024 se incadreaza exact in 2^{10}, nu trebuie ingalitate stricta	32 – 10 = 22
511 + 2	10		32 – 10 = 22
63 + 2	7		32 – 7 = 25
15 + 2	5		32 – 5 = 27
7 + 2	4		32 – 4 = 28

Determinam **N.A. (network address)**, **B.A. (broadcast address)** si **R.A. (range address)** pentru fiecare output din topologie (host/calculator), incepand cu IP-ul care ne-a fost dat.

IP 139.209.121.110/12

Scriem in binar cei 4 octeti:

Val. octeti	139								209								121								110							
Val. in binar	1	0	0	0	1	0	1	1	1	1	0	1	0	0	0	1	0	1	1	1	1	0	0	1	0	1	1	0	1	1	1	0
S.Mask	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AND	1	0	0	0	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

N.A. reprezinta transformarea in zecimal (tot pe grupuri de 4 octeti) a liniei obtinute prin AND (bit cu bit) intre valoarea in binar a IP-ului si subnet mask-ul (obs. ca daca subnet mask-ul a fost 12, atunci am pus, de la stanga la dreapta, 12 de 1).

B.A. se obtine din **N.A.**, unde se considera ca bitii care sunt cu 0 din cauza Subnet Mask-ului (cei marcati cu rosu) ar fi egali cu 1. Astfel, daca in octetul 2 avem 1111.0000, acei patru de 0 finali se considera 1 (acei 0000 considerati ca fiind 1111 reprezinta 15 in binar, deci in octetul 2 al lui N.A. vom aduna un 15, iar octetii 3 si 4, fiind formati doar din 0000.0000 si fiind considerati 1111.1111, vor deveni 255).

Astfel, avem

N.A.	139.208.0.0/12
B.A.	139.223.255.255/12
R.A.	139.208.0.1 – 139.223.255.224/12

Acum, putem incepe sa calculam LAN-urile.

LAN 2047

N.A. pentru primul LAN este dat de **N.A.** al IP-ului de la care am plecat (acel 139.209.121.110/12), doar ca pe subnet mask-ul din tabel (2047 era incadrat in 2^{12}, deci el are subnet mask-ul 32 – 12 = 20)

B.A. este calculat ca cel anterior, in functie de Subnet Mask. Acum, pentru ca Subnet Mask-ul este 20, inseamna ca el acopera complet primul octet (8 de 1), al doilea octet (8 de 1) si doar 4 biti din cel de-al

treilea (pentru ca Subnet Mask-ul va fi de forma 1111.0000 in octetul 3). Acei 4 biti finali sunt considerati 1, adica in valorea de la **N.A.** vom adauga, in octetul 3, 1111 in binar, adica 15). Octetul 4 va fi 0000.0000 in Subnet Mask, astfel ca in **B.A.** il vom avea ca fiind 255).

Obtinem:

N.A.	139.208.0.0/20
B.A.	139.208.15.255/20
R.A.	139.208.0.1 – 139.208.15.254/20

LAN 1023

Incepand cu al doilea LAN, mereu noul **N.A.** se va obtine din ultimul **B.A.** caruia i se adauga 1 la ultimul octet. Daca valoarea ultimului octet este 255, atunci el devine 0 si se incrementeaza penultimul octet, altfel se face doar +1.

In plus, nu uitam sa schimbam Subnet Mask-ul (voi lua direct valorile pe care le-am scris in primul tabel, unde am incadrat dupa puterile lui 2).

B.A. se calculeaza dupa acelasi algoritm. (aici, Subnet Mask-ul fiind 21, inseamna ca el ocupa complet primii doi octeti (16 biti din cei 21), iar restul de 5 biti sunt in octetul 3, de forma 1111.1000 – acei 3 de 0 in final se considera 3 de 1, iar la **N.A.** se va adauga, in octetul 3, 111 in binar, adica 7).

N.A.	139.208.16.0/21
B.A.	139.208.23.255/21
R.A.	139.208.16.1 – 139.208.23.254/21

LAN 1022

N.A.	139.208.24.0/22
B.A.	139.208.27.255/22
R.A.	139.208.24.1 – 139.208.27.254/22

LAN 511

N.A.	139.208.28.0/22
B.A.	139.208.31.255/22
R.A.	139.208.28.1 – 139.208.31.254/22

LAN 63

In LAN 63 avem Subnet Mask-ul 25, adica se acopera complet primii 3 octeti, si ramane un singur bit liber in octetul 4, deci octetul 4 va fi de forma 1000.0000. Fata de **N.A.**, acei 7 de 0 se vor considera 1, deci in octetul 4 vom adauga 111 1111 in binar = 127).

N.A.	139.208.32.0/25
B.A.	139.208.32.127/25
R.A.	139.208.32.1 – 139.208.32.126/25

LAN 15

Aici, cand vom face +1 pe vechiul **B.A.**, vedem ca nu mai trebuie sa facem octetul 4 egal cu 0 si sa incrementam octetul 3, ci e suficient sa facem 127 + 1 = 128. (pentru **B.A.**, ne ramane in octetul 4 al Subnet Mask-ului 1110.0000, iar acei 5 de 0 finali se considera 1, adaugand in octetul 4 din **N.A.** valoarea 11111 = 31)

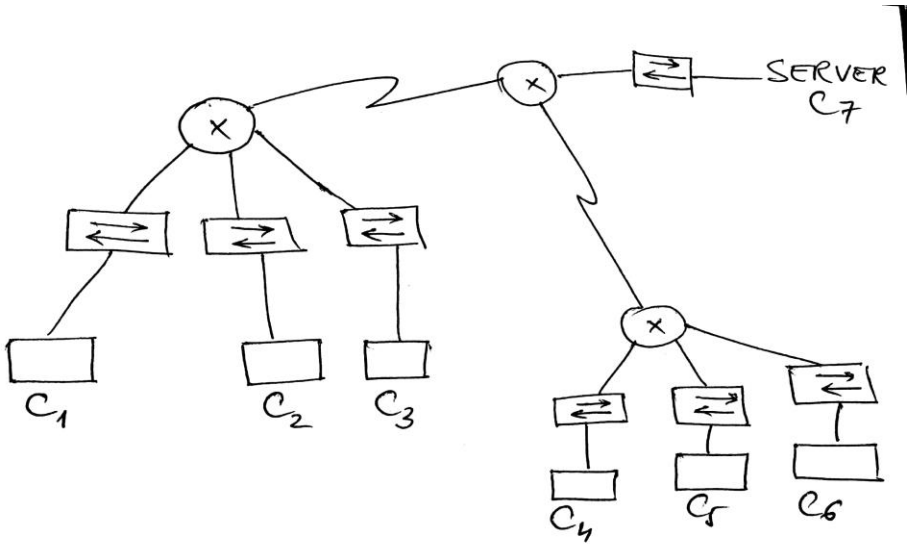
N.A.	139.208.32.128/27
B.A.	139.208.32.159/27
R.A.	139.208.32.129 – 139.208.32.158/27

LAN 7

N.A.	139.208.32.160/28
B.A.	139.208.32.175/28
R.A.	139.208.32.161 – 139.208.32.174/28

Implementarea topologiei in CISCO Packet Tracer

Schema topologiei:

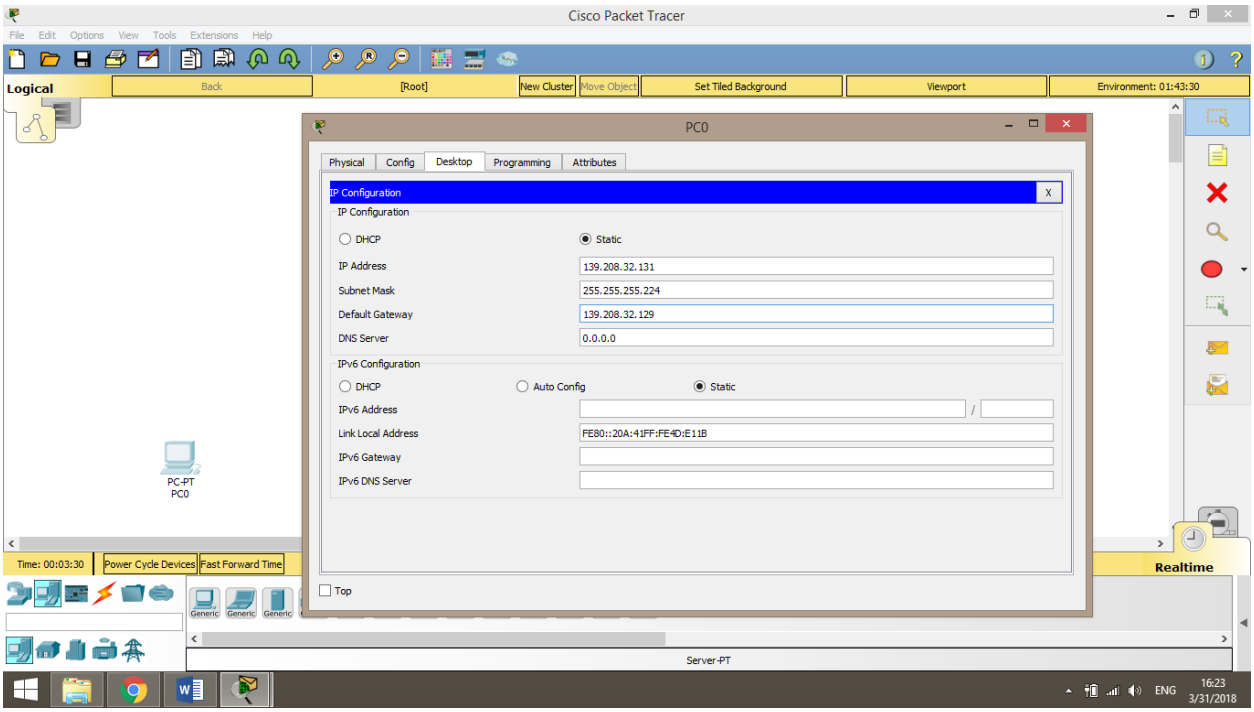


Pentru a implementa mai usor, voi rescrie tabelele si voi transforma Subnet Mask-urile in grupuri de 4 octeti (de exemplu Subnet Mask-ul 24 = 1111.1111/1111.1111/1111.1111/0000.0000 este 255.255.255.0). Tabelele vor fi puse in ordinea initiala, nu in cea sortata (in schema, C1 este cel cu 15 utilizatori, C2 este cel cu 1023 etc.)

Host	LAN	Subnet Mask zecimal	Subnet Mask in octeti	Range Address
C1	LAN 15	27	255.255.255.224	139.208.32.129 – 139.208.32.158
C2	LAN 1023	21	255.255.248.0	139.208.16.1 – 139.208.23.254
C3	LAN 63	25	255.255.255.128	139.208.32.1 – 139.208.32.126
C4	LAN 2047	20	255.255.240.0	139.208.0.1 – 139.208.15.254
C5	LAN 1022	22	255.255.252.0	139.208.24.1 – 139.208.27.254
C6	LAN 511	22	255.255.252.0	139.208.28.1 – 139.208.31.254
C7	LAN 7	28	255.255.255.240	139.208.32.161 – 139.208.32.174

Vom incepe sa facem schema in CISCO Packet Tracer, completand informatiile Hosturilor.

Adaugam C1, schimbam placa de retea in CGE, mergem la Desktop -> IP Configuration, si completam datele primului Host:



Obs. ca Default Gateway se alege ca fiind **cel mai mic IP din R.A.** Restul informatiilor sunt preluate din tabel, nu avem nevoie de serviciu DNS.

IP-ul host-ului l-am ales ca fiind al 3-lea din range, adica 139.208.32.129 pentru Router (default gateway), **139.208.32.130** pentru Switch si 139.208.32.131 pentru Host. Se poate alege orice IP din range, dar in special cele mai mici (ultimele IP-uri din range sunt tinute pentru Server).

Pana sa adaugam celelalte calculatoare, vom configura Switch-ul: adaugam un Switch 2960, un laptop, le legam cu un cablu de tip consola (port RS 232 pe laptop, Console pe Switch), intram pe Laptop -> Desktop -> Terminal -> Ok in dreapta jos, si programam Switch-ul cu liniile standard de comanda:

```
Switch>enable
Switch#configure terminal
Switch(config)#no ip domain lookup
Switch(config)#hostname SWINFO1
SWINFO1(config)#enable secret cisco12345
```

```
SWINFO1(config)#enable password cisco54321
SWINFO1(config)#service password-encryption
SWINFO1(config)#banner motd "Vineri la ora 14:00 va fi mentenanta"
SWINFO1(config)#line console 0
SWINFO1(config-line)#password ciscoconpass
SWINFO1(config-line)#login
SWINFO1(config-line)#logging synchronous
SWINFO1(config-line)#exec-timeout 15 10
SWINFO1(config-line)#exit
SWINFO1(config)#line vty 0 15
SWINFO1(config-line)#password ciscovtypass
SWINFO1(config-line)#login
SWINFO1(config-line)#logging synchronous
SWINFO1(config-line)#exit
SWINFO1(config)#exit
SWINFO1#
SWINFO1#copy running-config startup-config
```

Configuram timpul si SSH-ul:

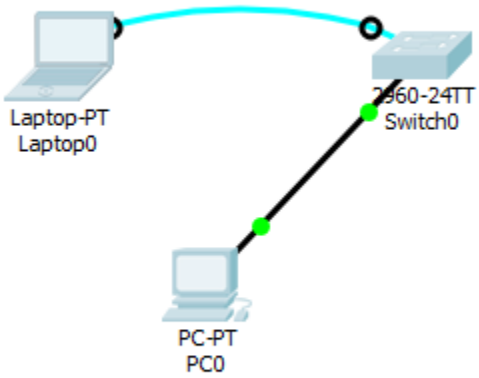
```
SWINFO1#clock set 16:28:00 31 MAR 2018
SWINFO1#configure terminal
SWINFO1(config)#ip domain name cti-info.ro
SWINFO1(config)#username admin privilege 15 secret adminpass1
SWINFO1(config)#line vty 0 15
SWINFO1(config-line)#transport input ssh
SWINFO1(config-line)#login local
SWINFO1(config-line)#exit
SWINFO1(config)#crypto key generate rsa
The name for the keys will be: SWINFO1.cti-info.ro
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
```

```
SWINFO(config)#exit
SWINFO#
SWINFO#copy running-config startup-config
```

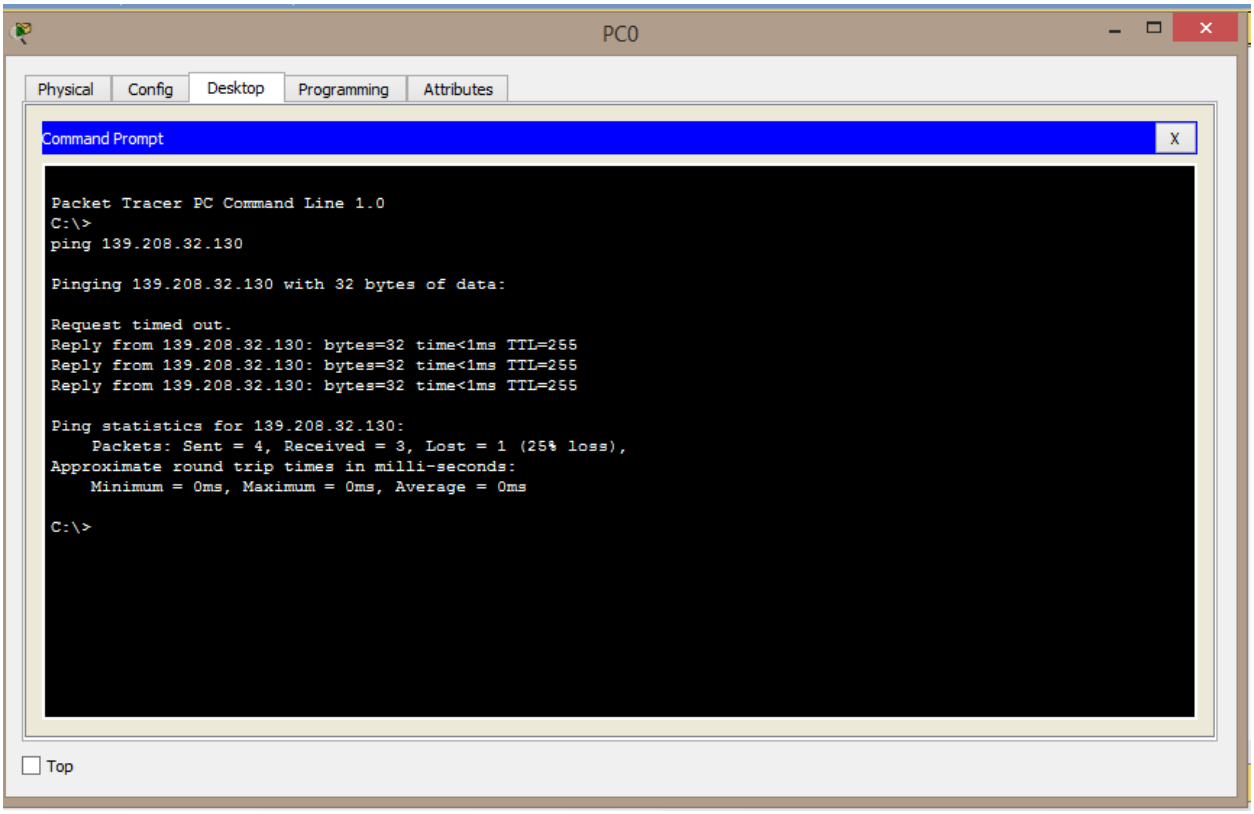
Configuram interfata VLAN 1

```
SWINFO#configure terminal
SWINFO(config)#interface vlan 1
SWINFO(config-if)#description "Legatura cu CALC1"
SWINFO(config-if)#ip address 139.208.32.130 255.255.255.224
SWINFO(config-if)#no shutdown
SWINFO(config-if)#exit
SWINFO(config)#exit
SWINFO#
SWINFO#copy running-config startup-config
Destination filename [startup-config]?
```

Pentru a testa, legam **calculatorul** de **Switch**, folosind cablul **Copper Straight-Through** (portul *GigabitEthernet0* pe **calculator** si *GigabitEthernet0/2* pe **Switch**) si asteptam sa avem conexiune (verde in ambele capete ale cablului):



Verificam conexiunea dand un Ping pe Host la IP-ul Switchului (139.208.32.130):



Conectam acum **Routerul** (2911) respectand tot pasii clasici (conectez cablul consola acum la Router, intru la Desktop -> Terminal -> OK in dreapta jos):

```
Would you like to enter the initial configuration dialog? [yes/no]: no
```

Liniile de sintaxa:

```
Router>enable
Router#configure terminal
Router(config)#no ip domain lookup
Router(config)#hostname INFO1
INFO1(config)#enable secret cisco12345
INFO1(config)#enable password cisco54321
INFO1(config)#service password-encryption
INFO1(config)#security password min-length 10
INFO1(config)#login block-for 120 attempts 3 within 30
```

```
INFO1(config)#banner login "Accesul persoanelor neautorizate este strict interzis!"
INFO1(config)#banner motd "Vineri la ora 14:00 serverul va intra in mentenanta"
INFO1(config)#line console 0
INFO1(config-line)#password ciscoconpass
INFO1(config-line)#login
INFO1(config-line)#logging synchronous
INFO1(config-line)#exec-timeout 10 10
INFO1(config-line)#exit
INFO1(config)#line vty 0 15
INFO1(config-line)#password ciscovtypass
INFO1(config-line)#login
INFO1(config-line)#logging synchronous
INFO1(config-line)#exec-timeout 20 0
INFO1(config-line)#exit
INFO1(config)#exit
INFO1#
INFO1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Configuram timpul si SSH-ul pe **Router**:

```
INFO1#clock set 16:42:00 31 MAR 2018
INFO1#configure terminal
INFO1(config)#ip domain name cti-info.ro
INFO1(config)#username admin privilege 15 secret adminpass1
INFO1(config)#line vty 0 15
INFO1(config-line)#transport input ssh
INFO1(config-line)#login local
INFO1(config-line)#exit
INFO1(config)#crypto key generate rsa
The name for the keys will be: INFO1.cti-info.ro
```

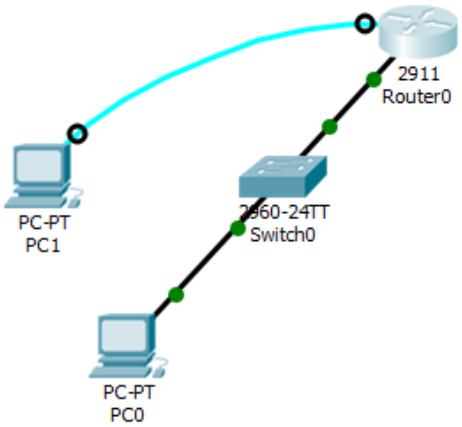
```
Choose the size of the key modulus in the range of 360 to 2048 for your
General Purpose Keys. Choosing a key modulus greater than 512 may take
a few minutes.

How many bits in the modulus [512]: 1024
```

Si setam interfata *gigabitethernet 0/0* pe *ip-ul 139.208.32.129* cu *Subnet mask-ul 255.255.255.224*, astfel:

```
INFO(config)#configure terminal
INFO(config)#interface gigabitethernet 0/0
INFO(config-if)#description "Legatura realizata"
INFO(config-if)#ip address 139.208.32.129 255.255.255.224
INFO(config-if)#no shutdown
INFO(config-if)#
INFO(config-if)#exit
INFO(config)#exit
INFO#
INFO#copy running-config startup-config
Destination filename [startup-config]?
```

Leg acum **Switch**-ul de **Router**, folosind tot un cablu **Copper Straight-Through**, avand portul *GigabitEthernet 0/1* pe **Switch** si portul *GigabitEthernet 0/0* pe **Router**, si astept sa am conexiune (verde in ambele capete).

Pana acum, reteaua trebuie sa arate astfel:



Vom verifica daca s-a conectat tot printr-un ping, de data aceasta din Host in Router:

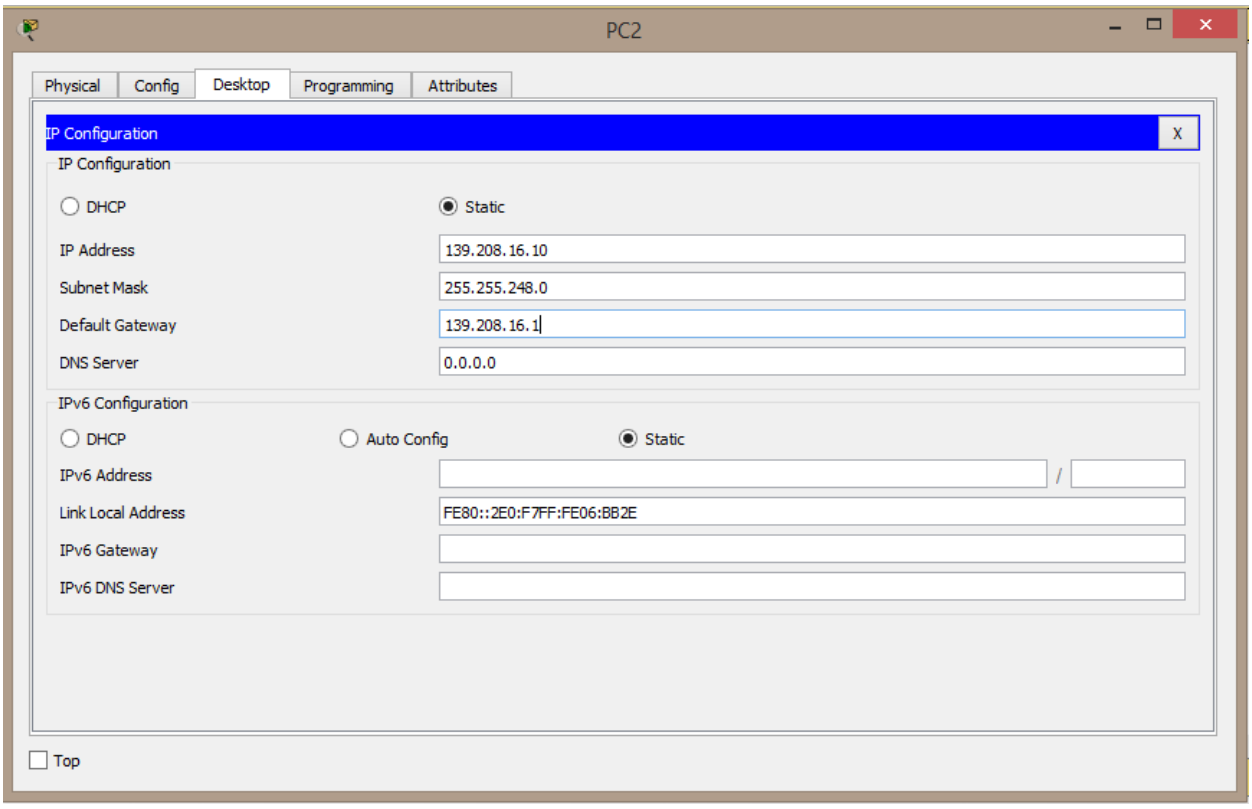
```
C:\>ping 139.208.32.129

Pinging 139.208.32.129 with 32 bytes of data:

Reply from 139.208.32.129: bytes=32 time=35ms TTL=255
Reply from 139.208.32.129: bytes=32 time<1ms TTL=255
Reply from 139.208.32.129: bytes=32 time<1ms TTL=255
Reply from 139.208.32.129: bytes=32 time<1ms TTL=255

Ping statistics for 139.208.32.129:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 35ms, Average = 8ms
```

Analog se vor lega si calculatoarele C2, C3 in Switch-ul asociat si apoi in Router, eu voi mai adauga doar un calculator (C2 din LAN 1023), fara sa detaliez etapele (sunt fix cele de mai sus). Pun doar informatiile despre IP-uri:

Subnet mask: 255.255.248.0; **IP Host:** 139.208.16.10

IP Switch: (pentru interface vlan) 139.208.16.2

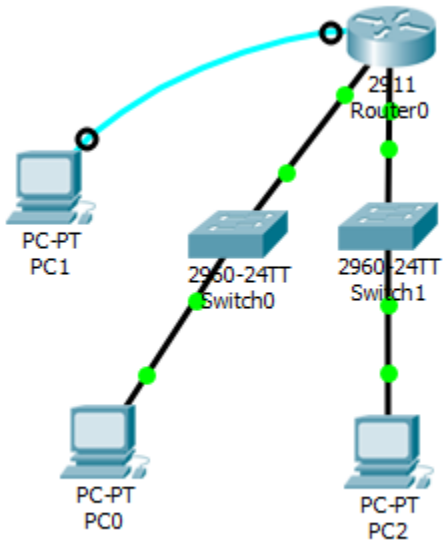
IP Router: (pentru legatura Switch – Router) 139.208.16.1



Obs. ca **Routerul** este deja configurat, noi avem doar de pus interfata Gigabitethernet 0/1, adica in momentul in care conectam **Laptopul** la **Router** prin cablul **consola** (portul GigabitEthernet 0/1 pe ambele si mergem in Laptop -> Desktop -> Terminal), tot ce vom avea de scris in **Router** este:

```
INFO1(config)#interface gigabitethernet 0/1
INFO1(config-if)#description "Legatura realizata"
INFO1(config-if)#ip address 139.208.16.1 255.255.248.0
INFO1(config-if)#no shutdown
INFO1(config-if)#exit
INFO1(config)#exit
INFO1#
INFO1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Acum, reteaua va arata astfel:



si o putem verifica printr-un ping de pe Host-ul 2 spre Router:

```
Packet Tracer PC Command Line 1.0
C:\>
ping 139.208.16.1

Pinging 139.208.16.1 with 32 bytes of data:

Reply from 139.208.16.1: bytes=32 time=1ms TTL=255
Reply from 139.208.16.1: bytes=32 time<1ms TTL=255
Reply from 139.208.16.1: bytes=32 time<1ms TTL=255
Reply from 139.208.16.1: bytes=32 time<1ms TTL=255

Ping statistics for 139.208.16.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

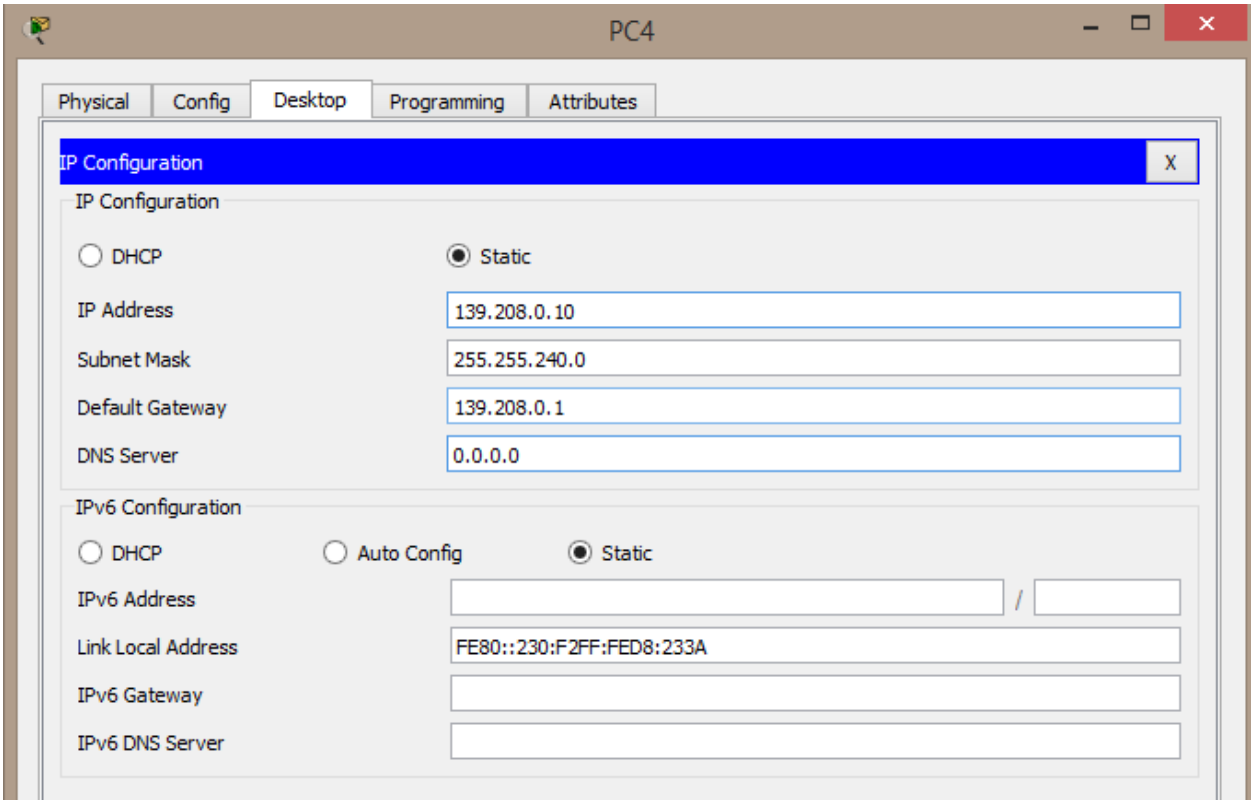
Acum, voi adauga calculatorul C4 din schema (LAN 2047), asociat cu Switch-ul si Router-ul. Voi da IP-urile si voi configura folosind aceiasi pasi:

Subnet mask: 255.255.240.0; **IP Host:** 139.208.0.10

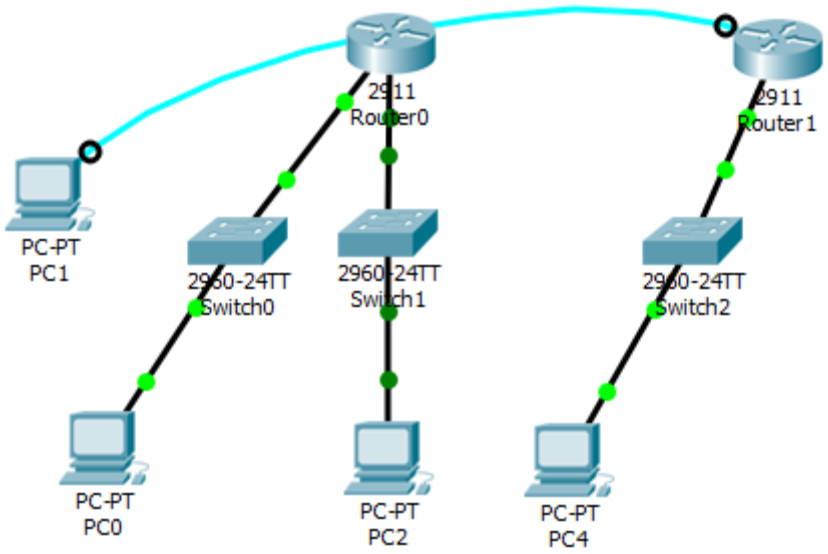
IP Switch: (pentru interface vlan) 139.208.0.2

IP Router: (pentru legatura Switch – Router) 139.208.0.1

(evident, ca si pana acum, nu uit sa modific placa de retea in CGE)



Reteaua trebuie sa arate astfel:



si verificam Ping-ul de pe Host 4 spre Router:

```
Packet Tracer PC Command Line 1.0
C:\>
ping 139.208.0.1

Pinging 139.208.0.1 with 32 bytes of data:

Reply from 139.208.0.1: bytes=32 time=1ms TTL=255
Reply from 139.208.0.1: bytes=32 time<1ms TTL=255
Reply from 139.208.0.1: bytes=32 time<1ms TTL=255
Reply from 139.208.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 139.208.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Acum, mai adaug doar C7 (Serverul) cu Switch-ul corespunzator, iar apoi vom lega Routerele intre ele pentru a finaliza topologia (fara C3, C5 si C6 care oricum se pun analog).

Pentru C7 (LAN 7) avem:

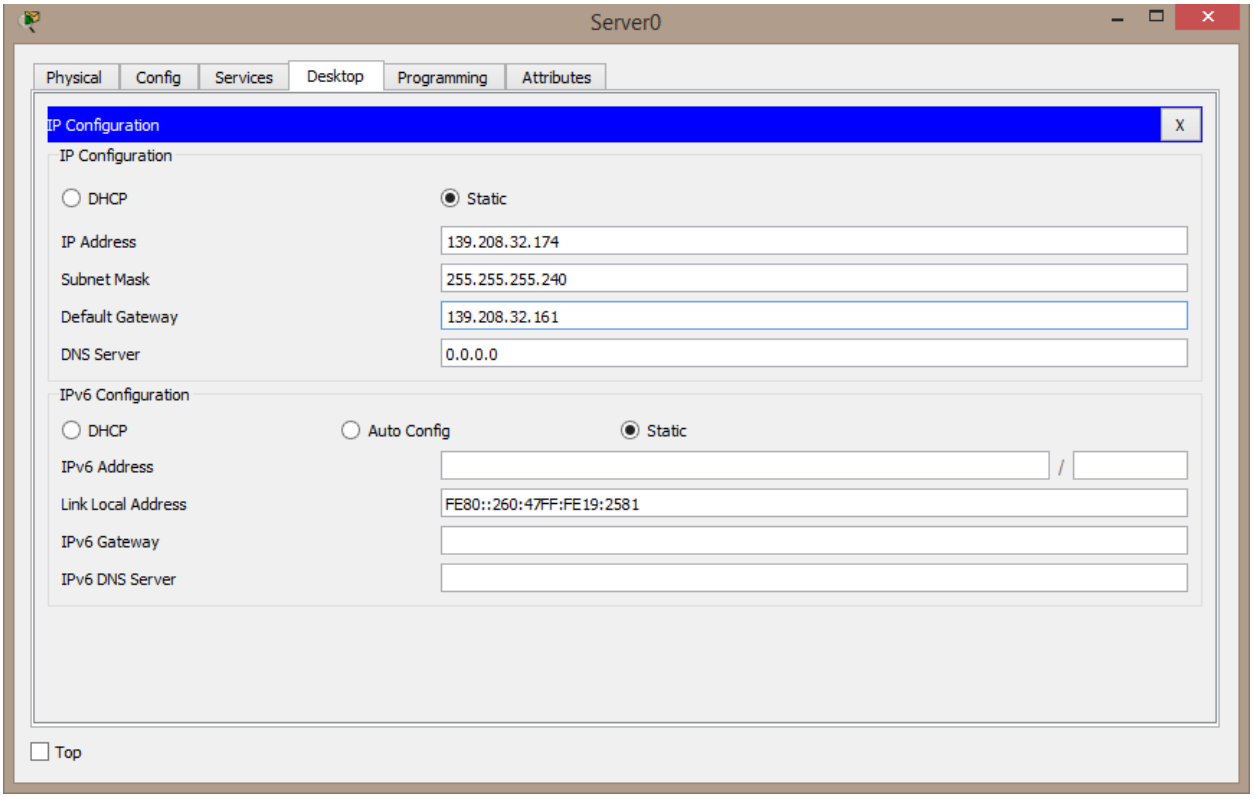
Subnet mask: 255.255.255.240;

IP Host: 139.208.32.174 pentru ca este Server, deci va avea IP-urile mari din range, si il alegem pe cel mai mare din R.A.

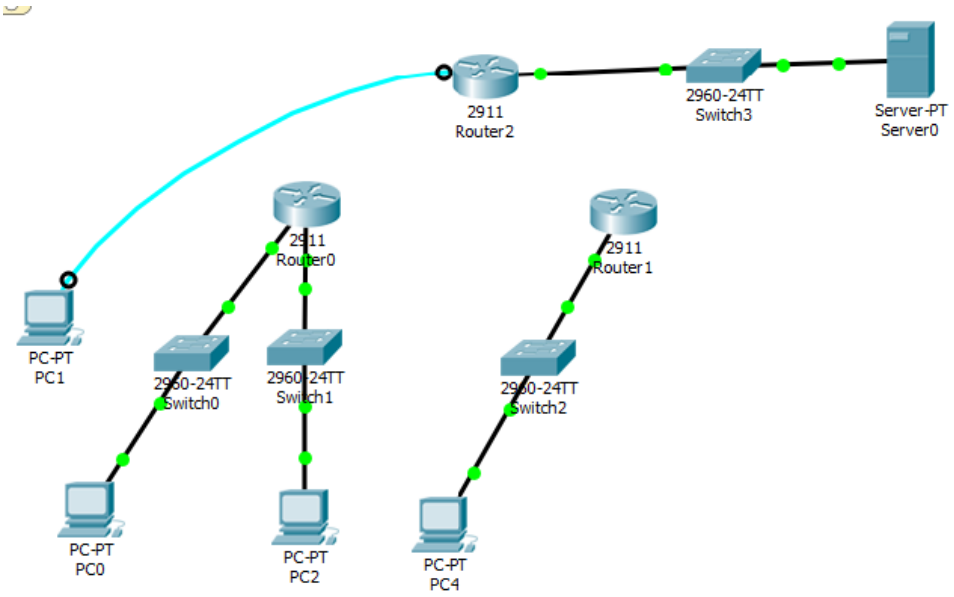
IP Switch: (pentru interface vlan) 139.208.32.162

IP Router: (pentru legatura Switch – Router) 139.208.32.161

(nu uitam sa schimbam prima placa de retea – cea de sus – si in cadrul Serverului)



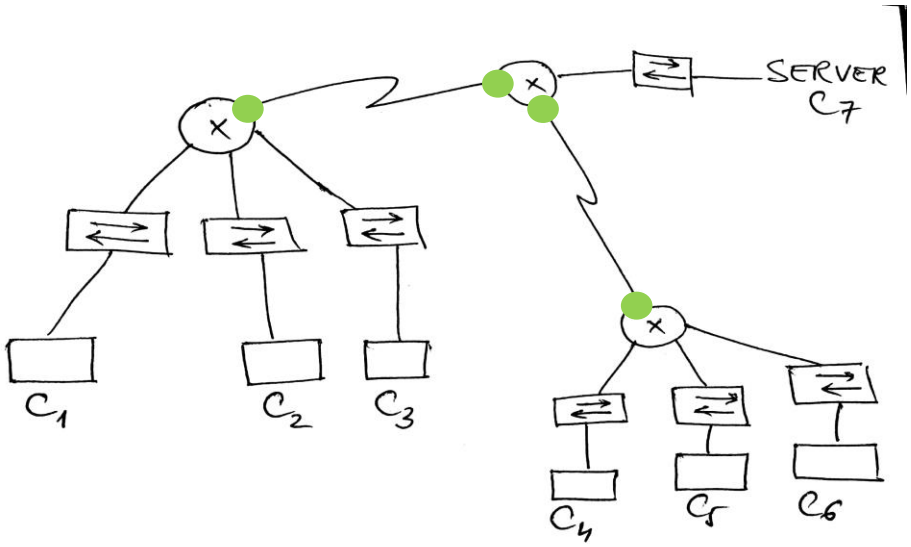
Reteaua pana in acest punct este:



si vom verifica ping-ul de pe **Server** spre **Router**:

```
Packet Tracer SERVER Command Line 1.0
C:\>
ping 139.208.32.161

Pinging 139.208.32.161 with 32 bytes of data:

Reply from 139.208.32.161: bytes=32 time=1ms TTL=255
Reply from 139.208.32.161: bytes=32 time<1ms TTL=255
Reply from 139.208.32.161: bytes=32 time<1ms TTL=255
Reply from 139.208.32.161: bytes=32 time<1ms TTL=255

Ping statistics for 139.208.32.161:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Acum, trebuie doar sa mai legam **Routerele** intre ele, conform schemei. Pentru asta, avem nevoie de inca 4 IP-uri, cate doua pentru fiecare capat (in bulinele verzi din schema):



Pentru a determina IP-urile, vom continua procedeul de la LAN-uri, si anume:

- Ultimul LAN calculat a fost LAN 7 care s-a oprit in Broadcast Address 139.208.32.175/28
- Avem nevoie de doua ori de un LAN 2 ($2 + 2 < 2^2$, deci subnet mask-ul va fi 32 – 2 = 30)
- Facem de doua ori procedeul standard: adaugam +1 la ultimul B.A. obtinut ca sa aflam noul N.A., determinam B.A. si R.A..

LAN 2 (primul)

N.A.	139.208.32.176/30
B.A.	139.208.32.179/30
R.A.	139.208.32.177 – 139.208.32.178/30

LAN 2 (al doilea)

N.A.	139.208.32.180/30
B.A.	139.208.32.183/30
R.A.	139.208.32.181 – 139.208.32.182/30

Acum, trebuie doar sa configuram interfetele in Routere folosind cele doua IP-uri obtinute in fiecare caz.

Pe primul Router vom configura interfata GigabitEthernet 0/2 cu ip-ul 139.208.32.181 si SubnetMask-ul specific lui 30, si anume 255.255.255.252.

```
INFO1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
INFO1(config)#interface gigabitethernet 0/2
INFO1(config-if)#description "Legatura realizata"
INFO1(config-if)#ip address 139.208.32.181 255.255.255.252
INFO1(config-if)#no shutdown
```

Analog in INFO3 (GigabitEthernet 0/1), cu IP-ul 139.208.32.182 si subnet mask-ul 255.255.255.252. Apoi, configuram tot in INFO3 (GigabitEthernet 0/2) cu 139.208.32.177 si subnet mask-ul 255.255.255.252, iar in INFO2 (GigabitEthernet 0/1) cu 139.208.32.178 si acelasi subnet mask.

Acum, reteaua arata astfel, si este functionala, conform schemei (fara C3, C5, C6):