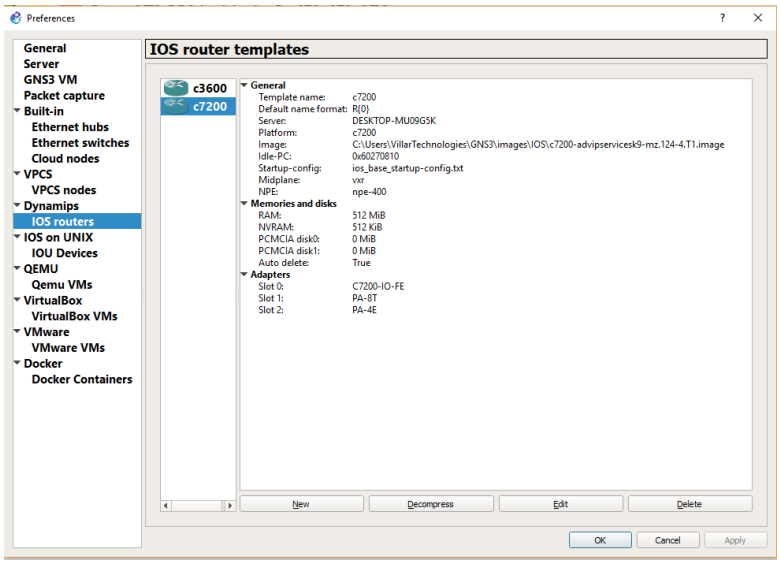
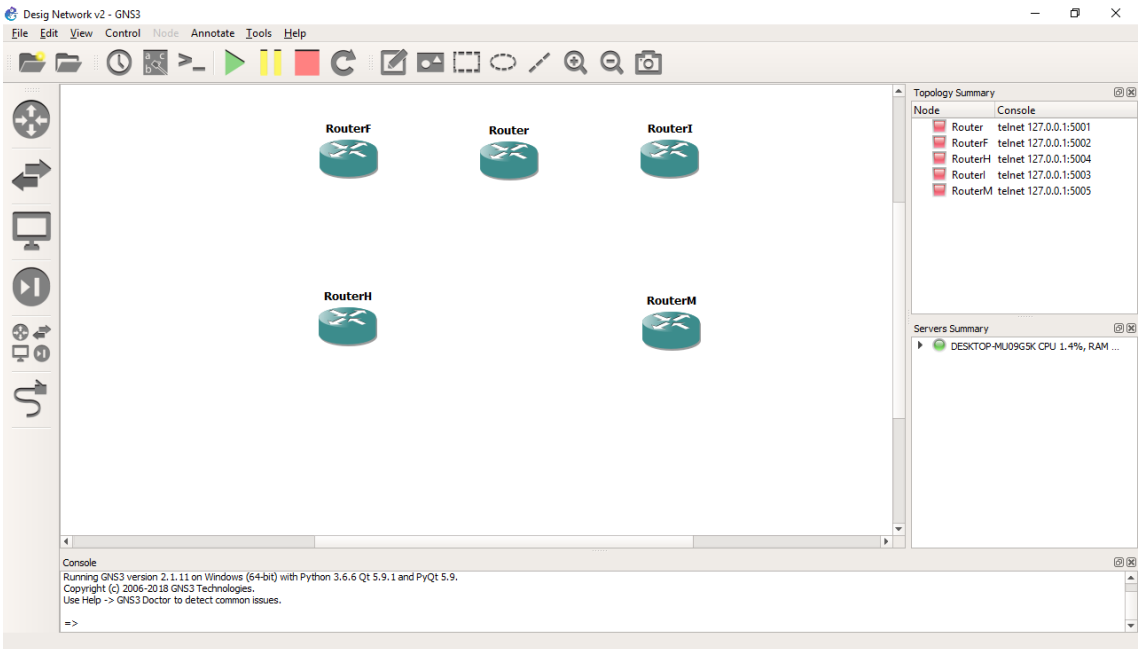
In this document, I am going to explain how create a network design. How first step, I install the GNS3 v2 from its official web site, download the ISO image belong to the router 7200 CISCO and import inside the GNS3.



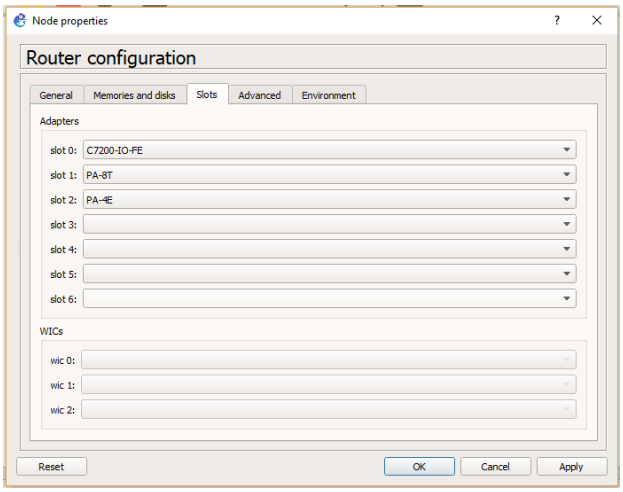
1. Import router c7200 to the GNS3 program GNS3

When the routers are downloaded, we can use it inside the workspace of the GNS3 for make the design.

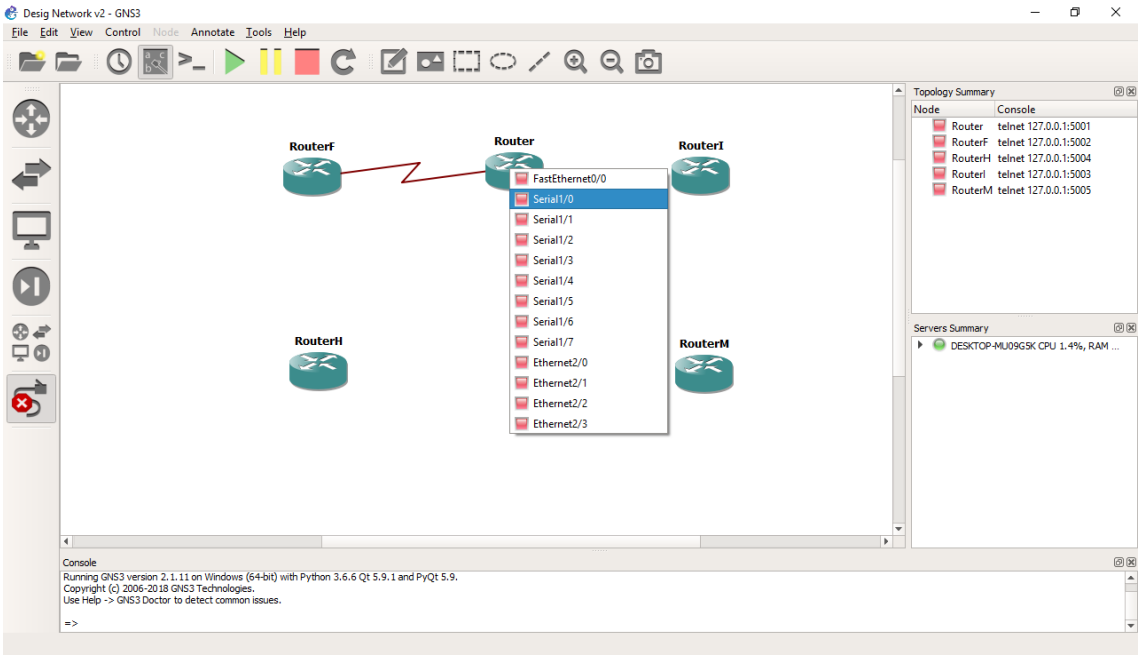


2. Router for use in the workspace

How the routers have to connect each other, we use a serial cable for join them so we configure the slots for this connection as like configure the Ethernet cable for connect the other devices.

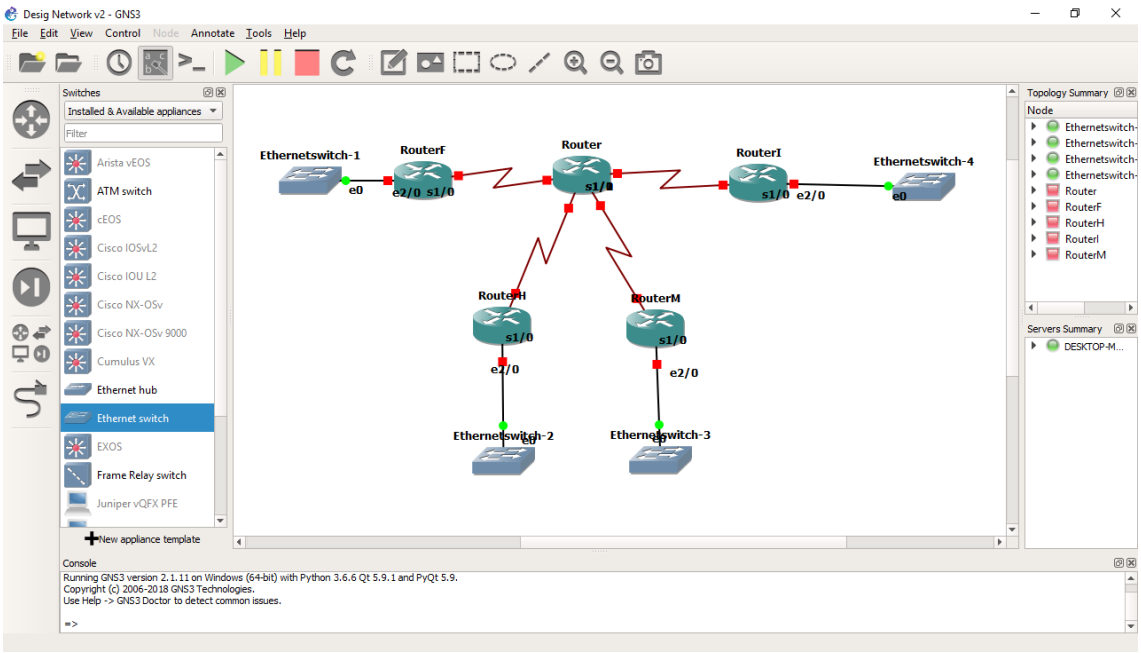


3. View of the router configuration with Ethernet and serial cable



4. Connection of the routers through the slots for serial cable

After of the configuration, we procedure to join the components necessaries for develop the design as switchs, PCs, servers and printers.

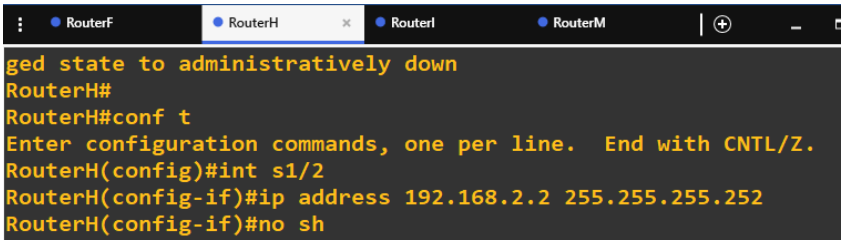


5. View connection with switchs through of ports ethernet

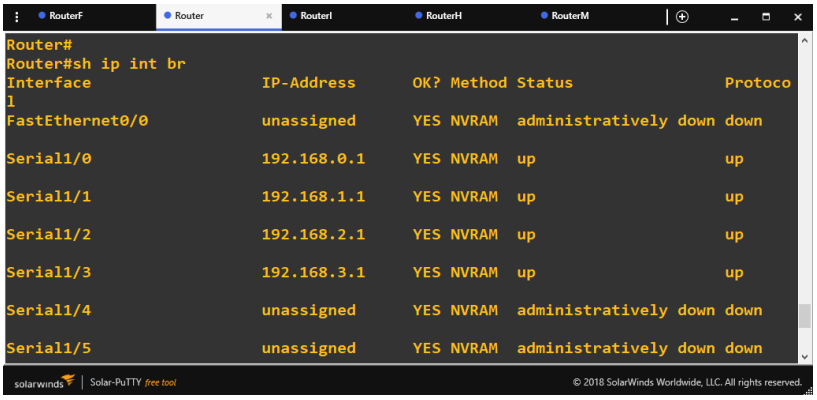
For make the connection existent between the routers of each department with the main router, we will configure an internal network who help to the transition of packages even the hosts request. So, we are going to use the next ip address represented in the table below for its communication.

Points	Network address
RouterF – Router (s1/0)	192.168.0.0/30
RouterI – Router (s1/1)	192.168.1.0/30
RouterH – Router (s1/2)	192.168.2.0/30
RouterM – Router (s1/3)	192.168.3.0/30

Table 1. IP address for the connection of the interfaces between the departments and the main router

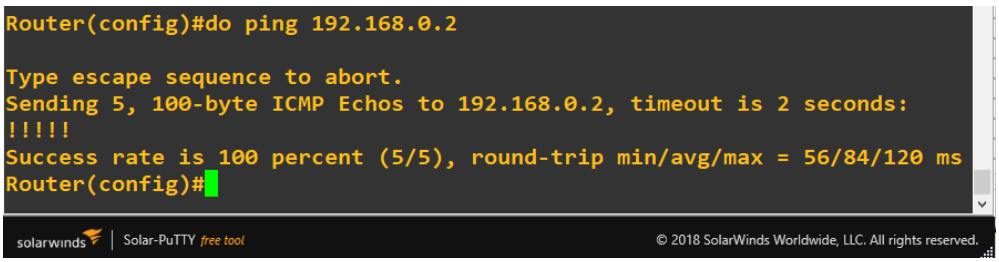


6. Command lines for configure the ip address in the interface of each department router



7. Command line for show the interfaces table of the main router

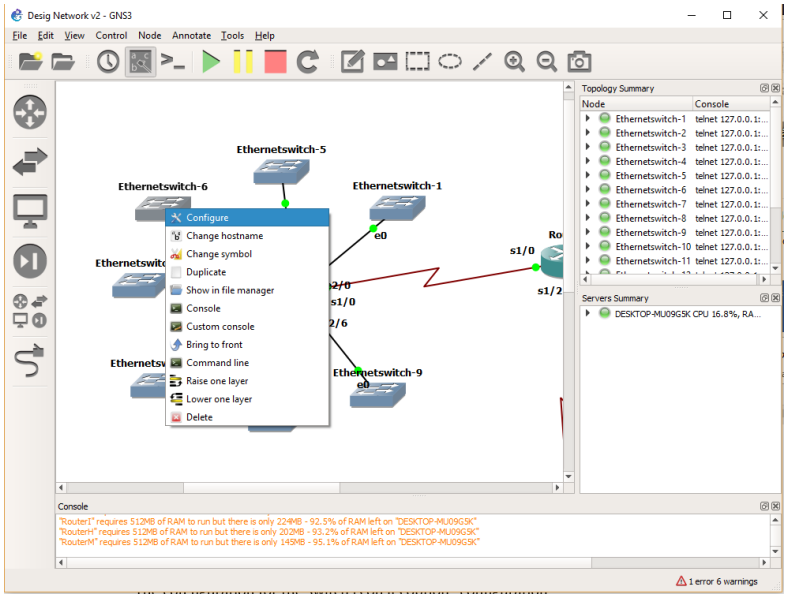
For check the connection between the devices, we make ping from a router until other and obtain a percent of success rate of communication.



8. Command line for check the connection between the routers obtain a 100 percent

Now we are going to configure the VLAN (Virtual Local Area Network) for create an independent logic network inside our physic network. This configuration will stay inside of the department router and the switches connected it.

The configuration for the switch is on its option “configure” to do right click over it. After, this show us the ports that will be connected to the hosts in our network.



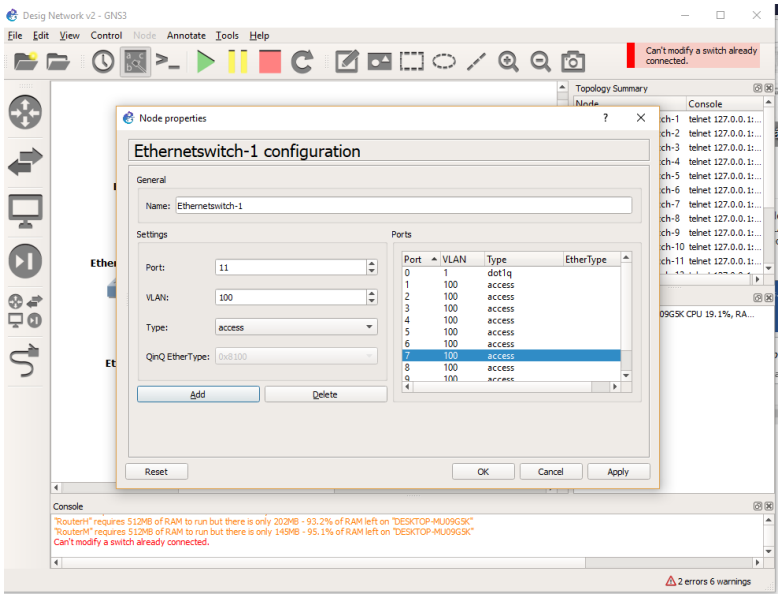
9. View option for the configuration

Each switch will be configured with the necessary number of ports, the first will be the type dot1Q that will allow sharing multiple networks between the same devices without having interference between them; This will connect to the department's router. The other ports will have a VLAN value depending on the department and as a type value it will be access.

The values belong to each department are the showed in the table next:

Department	VLAN number
Finance	100
Information Technology	101
Human Resources	102
Marketing	103

Table 2. number of VLAN for each department



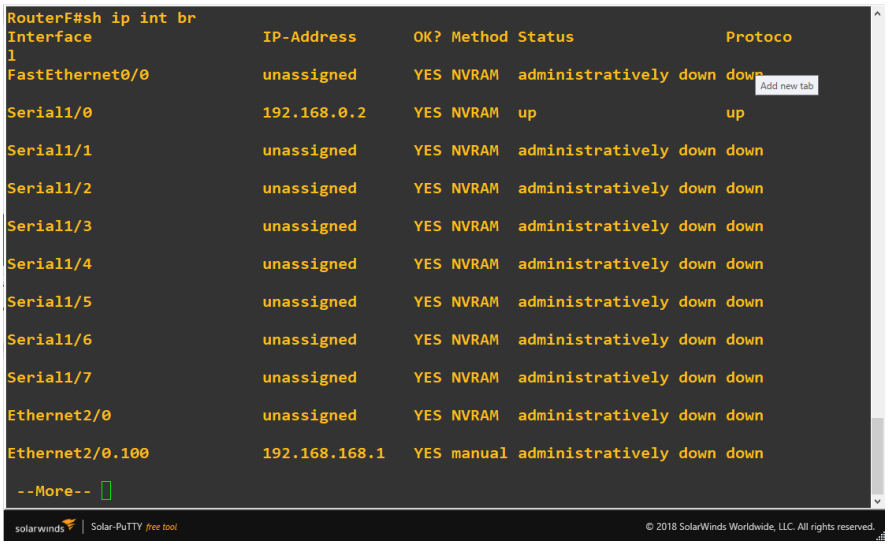
10. Configuration of the VLAN inside of the switch

Inside router console, execute the next command lines for configure the connection with the VLANs for the network:

```
RouterF(config-if)#int e2/0.100
RouterF(config-subif)#encapsulation dot1Q 100
RouterF(config-subif)#ip address 192.168.168.1 255.255.255.128
RouterF(config-subif)#no sh
RouterF(config-subif)#do wr
Building configuration...
[OK]
RouterF(config-subif)#
```


11. Command lines for configure the VLANs for our network

Next the typing the lines, we have the next table with the command line sh **ip int br**, there we can see which interface is assigned.



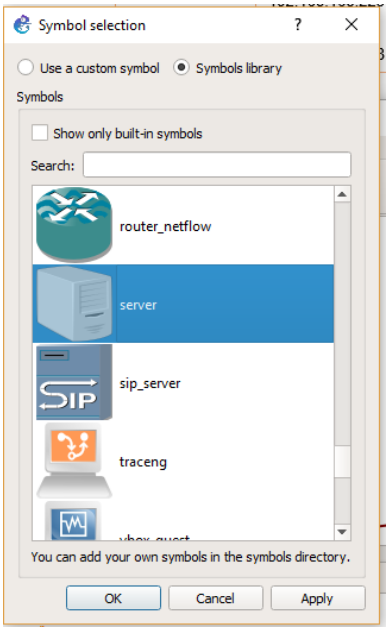
12. Command line for watch the table of the interfaces

The IP address used, was made through of the subneting with the IP private 192.168.168.0/26 using VLSM the next way.

Department	Requested host	Network address	Mask	Range usable IPs	Broadcast address
Finance	69 Hosts	192.168.168.0	255.255.255.128	192.168.168.1 - 192.168.168.126	192.168.168.127
IT	39 Hosts	192.168.168.128	255.255.255.192	192.168.168.129 - 192.168.168.190	192.168.168.191
HR	19 Hosts	192.168.168.192	255.255.255.224	192.168.168.193 - 192.168.168.222	192.168.168.223
Marketing	11 Hosts	192.168.168.224	255.255.255.240	192.168.168.225 - 192.168.168.238	192.168.168.239

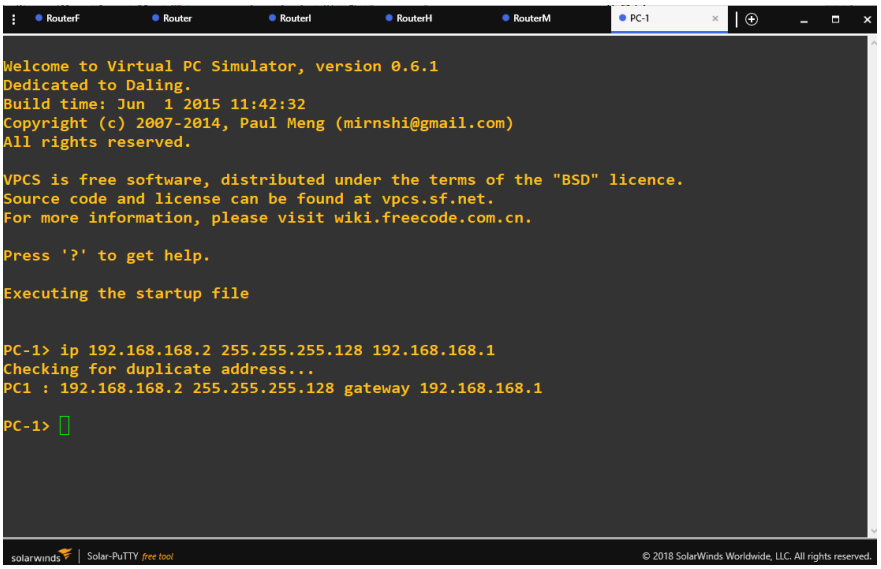
Table 3. The information on the IP address belonging to each network

Now for the assignment of the IPs, we put the hosts inside of the workspace and the connect them with a port of the switch. We can change its appearance doing right click over it and clicking on “change symbol”, and appear a window as the next:



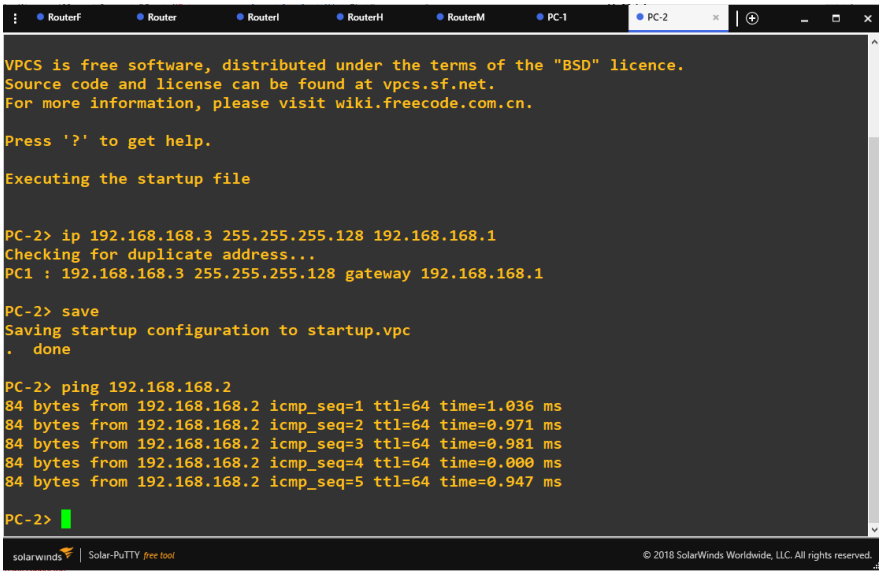
13. View of the window for change the symbol of the host

Inside each department will exist IP static belong to the router, the server and the printer, these will be assignment manually to the hosts (server and printer) of the next way and type save in the end for that it **save** the configuration.



14. Command line for assignment the ip address on the host

And doing ping to the other pc configured, we check that the communication is success.



15. Command lines doing ping to other host for check the communication

But as we have many hosts in our network, we can configure a method that we permit assign IP address to the all hosts automatically through DHCP (Dynamic Host Configuration Protocol). This will be configuring it inside the main router of each department with the next command lines:

```
RouterF#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RouterF(config)#ip dhcp pool FINANCE-POOL
RouterF(dhcp-config)#network 192.168.168.0 255.255.255.128
RouterF(dhcp-config)#default-router 192.168.168.1
RouterF(dhcp-config)#dns-server 130.140.150.160
RouterF(dhcp-config)#do wr
RouterF(dhcp-config)#
```

16. Command lines for configure DHCP inside the network

And with the command line, we can have excluded some IPs of the our DHCP for avoid collisions in the moment for assign the IP address in the hosts that have a static IP

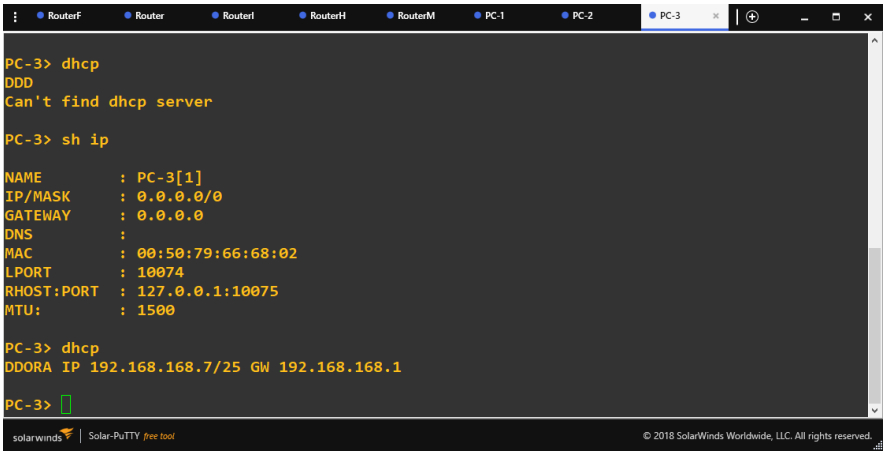
```
RouterF#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RouterF(config)#ip dhcp pool FINANCE-POOL
RouterF(dhcp-config)#network 192.168.168.0 255.255.255.128
RouterF(dhcp-config)#default-router 192.168.168.1
RouterF(dhcp-config)#dns-server 130.140.150.160
RouterF(dhcp-config)#do wr
RouterF(dhcp-config)#end
```

17. Command lines for configure a pool of DHCP

```
RouterF(config)#ip dhcp excluded-address 192.168.168.1 192.168.168.6
RouterF(config)#
```

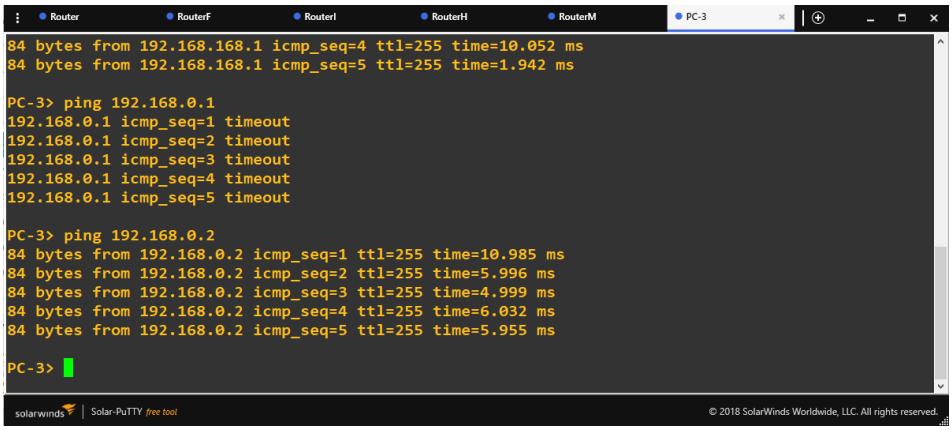
18. Command line for excluded IP address of the DHCP

For check this configuration, since a host console we can typing DHCP for assignment a IP address to the host



19. Command line for configure an IP address automatically in the host

If we make a ping to the main router, we are going to have an error of the communication due to that the router doesn't know where send it.



20. command lines doing ping to the routers

For avoid this, we configure static routes of the next command lines inside of the main router:

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip route 192.168.168.0 255.255.255.128 192.168.0.2
Router(config)#ip route 192.168.168.128 255.255.255.192 192.168.1.2
Router(config)#ip route 192.168.168.192 255.255.255.224 192.168.2.2
Router(config)#ip route 192.168.168.224 255.255.255.240 192.168.3.2
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
```

21. Command lines for configure static routes inside of the main router

```
RouterF(config-if)#ip route 0.0.0.0 0.0.0.0 192.168.0.1
RouterF(config)#do wr
```

22. Command lines for configure the static route inside of the router of the department

After the realized the configuration, we check that the routing is success doing ping to the gateway

```
Router   RouterF   RouterI   RouterH   RouterM   PC-3
192.168.0.1 icmp_seq=5 timeout

PC-3> ping 192.168.0.2
84 bytes from 192.168.0.2 icmp_seq=1 ttl=255 time=10.985 ms
84 bytes from 192.168.0.2 icmp_seq=2 ttl=255 time=5.996 ms
84 bytes from 192.168.0.2 icmp_seq=3 ttl=255 time=4.999 ms
84 bytes from 192.168.0.2 icmp_seq=4 ttl=255 time=6.032 ms
84 bytes from 192.168.0.2 icmp_seq=5 ttl=255 time=5.955 ms

PC-3> ping 192.168.0.1
84 bytes from 192.168.0.1 icmp_seq=1 ttl=254 time=54.995 ms
84 bytes from 192.168.0.1 icmp_seq=2 ttl=254 time=27.004 ms
84 bytes from 192.168.0.1 icmp_seq=3 ttl=254 time=22.047 ms
84 bytes from 192.168.0.1 icmp_seq=4 ttl=254 time=24.054 ms
84 bytes from 192.168.0.1 icmp_seq=5 ttl=254 time=24.956 ms

PC-3>
solarwinds | Solar-PuTTY free tool
© 2018 SolarWinds Worldwide, LLC. All rights reserved.
```

23. Command lines for check the success communication

Now for avoid the communication between the departments but having connection to the internet, we will create the access list inside of the router of the department of the next way:

```
RouterI(config)#ip access-list standard Technology
RouterI(config-std-nacl)#deny 192.168.168.0 0.0.0.127
RouterI(config-std-nacl)#deny 192.168.168.192 0.0.0.31
RouterI(config-std-nacl)#deny 192.168.168.224 0.0.0.15
RouterI(config-std-nacl)#permit host 192.168.1.1
RouterI(config-std-nacl)#permit any
RouterI(config-std-nacl)#
```

24. Command lines for create the access list

And we assignment the list in each port of the interfaces

```
RouterF(config)#int s1/0
RouterF(config-if)#ip access-group Finance in
RouterF(config-if)#int e2/0
RouterF(config-if)#ip access-group Finance in
RouterF(config-if)#do wr
```

25. Command lines for assign the access list

```
RouterM(config-if)#do sh access-list
Standard IP access list Marketing
    40 permit 192.168.3.1
    10 deny   192.168.168.0, wildcard bits 0.0.0.127
    20 deny   192.168.168.128, wildcard bits 0.0.0.63
    30 deny   192.168.168.192, wildcard bits 0.0.0.31
    50 permit any
RouterM(config-if)#
```

26. View of the access list configured

Now we can configure the DNS server our network of the next way:

```
Router(config)#ip dns server
Router(config)#$ary sysco.co.uk soa main.sysco.co.uk mail.sysco.co.uk
Router(config)#ip dns server
Router(config)#ip dns primary sysco.co.uk soa main.sysco.co.uk mail.sysco.co.uk
Router(config)#ip host sysco.co.uk ns 130.140.150.160
Router(config)#ip host main 130.140.150.160
Router(config)#
```

27. Command lines for configure the DNS server inside the main router

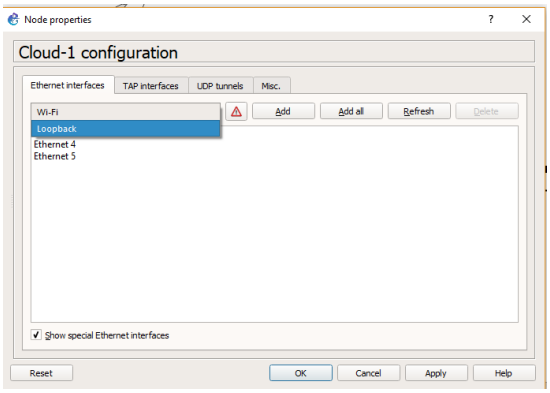
For each department router, the configuration is the next

```
RouterF(config)#ip name-server 130.140.150.160
RouterF(config)#ip domain-lookup
RouterF(config)#ip domain round-robin
RouterF(config)#
```

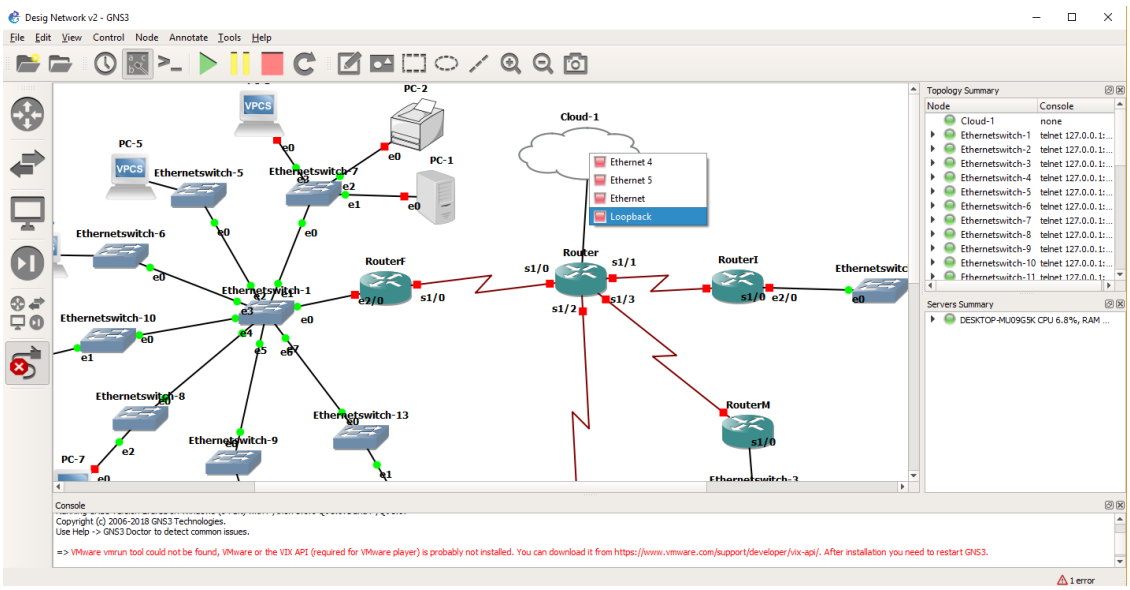
28. Command lines for configure the DNS inside the router of the department

For search an internet connection, we have to configure a loopback interface to be to provide of internet through our internet adapter. The configuration dependent of the operating system that we use.

For connect inside our network design, drag a cloud and we configure it selecting the interface of Loopback for the connection.



29. Window for configure the loopback interfaces in our cloud



30. Connection from the main router until the cloud through loopback interface

Next, we request a IP address external with the next command

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int e2/0
Router(config-if)#ip address dhcp
Router(config-if)#no sh
Router(config-if)#do wr
```

31. Request of the IP address for obtain access to internet

```
Router(config-if)#int loopback 0
Router(config-if)#ip address 130.140.150.160 255.255.255.192
Router(config-if)#no sh
Router(config-if)#do ping 130.140.150.160
```

32. Command lines for create a loopback interface inside the main router

And for the other devices obtain access to the internet, we will configure NAT (Network Address Translation) inside the main router defining which are the inside channel and the outside channel with the next command lines:

```
Router(config-if)#int s1/1
Router(config-if)#ip nat inside
Router(config-if)#int s1/2
Router(config-if)#ip nat inside
Router(config-if)#int s1/3
Router(config-if)#ip nat inside
Router(config-if)#int e2/0
Router(config-if)#ip nat outside
Router(config-if)#do wr
```

33. Command lines for configure the NAT inside the main router

```
Router(config)#access-list 100 permit ip any any
Router(config)#ip nat inside source list 100 interface ethernet 2/0 overload
Router(config)#
```

34. Command lines for create an access list for the outside interface

For the authentication, we use the PAP method between the routers of our WAN.

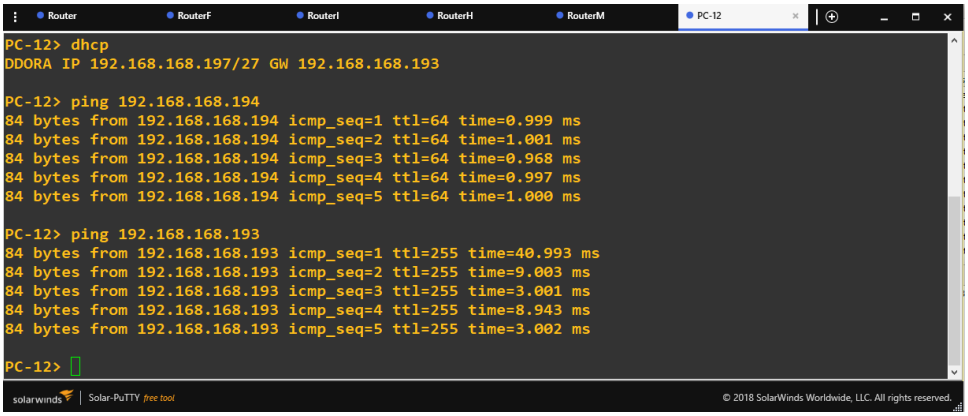
```
Router(config-if)#int s1/0
Router(config-if)#encapsulation ppp
Router(config-if)#no sh
Router(config-if)#ppp authentication pap
Router(config-if)#exit
Router(config)#username FINANCE password pass1
Router(config)#do wr
Building configuration...
```

35. Command lines for configure the methods of authentication inside of the main router

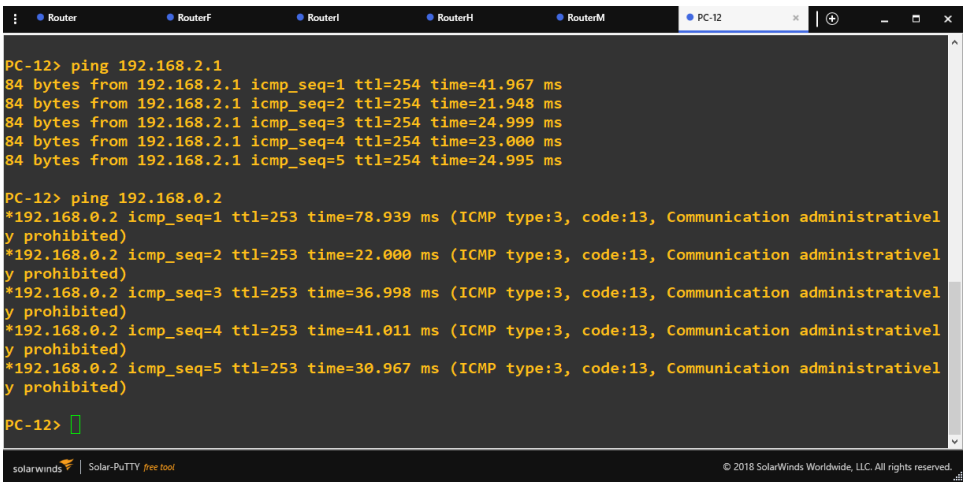
```
RouterF(config-if)#int s1/0
RouterF(config-if)#encapsulation ppp
RouterF(config-if)#no sh
RouterF(config-if)#ppp pap sent-username FINANCE password pass1
RouterF(config-if)#
```

36. Command lines for configure the methods of authentication inside of the routers secondary

In the follow images, we can see the communication of a host localized in the Human Resource Department.



37. Command lines for check the communication inside its network



38. Command lines for check the communication with other points in the network

REFERENCES

- gns3vault.com,(2018). GNS3 VAULT *Official Website*. [online] Available at: https://gns3vault.com /[Accessed Nov. 2018]
- gns3.com,(2018). *Documentation GNS3 Official Website.* [online] Available at: https://docs.gns3.com/[Accessed Nov. 2018]
- cisco.com, (2018). *Configure Commonly Used IP ACLs*. Available at: https://www.cisco.com/c/en/us/support/docs/ip/access-lists/26448-ACLsamples.html[Accessed Nov. 2018]
- gns3.com, (2018). *Connect GNS3 to the Internet (local server)*. Available at: https://docs.gns3.com/1vFs-KENh2uUFfb47Q2oeSersmEK4WahzWX-HrMIMd00/index.html [Accessed Nov. 2018]
- smartpctricks.com, (2014). *How to Calculate Idle PC Value in GNS3 Network Simulator 0.8.6?*. Available at: http://www.smartpctricks.com/2014/05/calculate-idle-pc-value-in-gns3.html[Accessed Nov. 2018]