P05: Networking with Routers

Q1: Understand the elements on the Layer 3

A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. Data sent through the internet, such as a web page or email, is in the form of data packets. A packet is typically forwarded from one router to another router through the networks that constitute an internetwork (e.g. the Internet) until it reaches its destination node.

A router is connected to two or more data lines from different IP networks.[b] When a data packet comes in on one of the lines, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey.

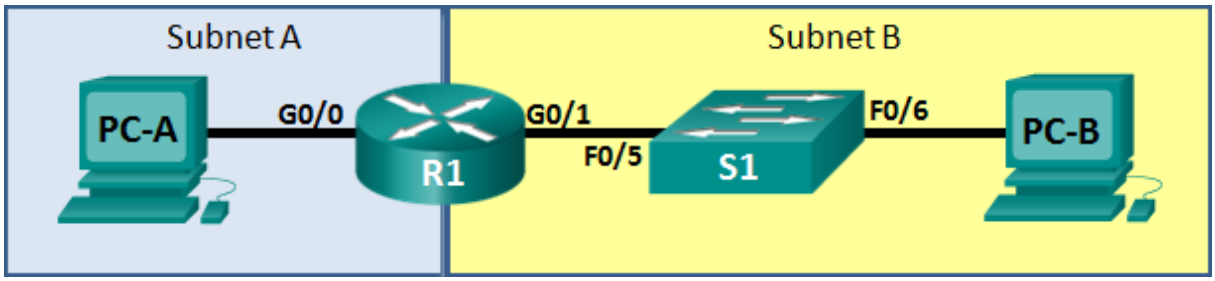
The most familiar type of IP routers are home and small office routers that simply forward IP packets between the home computers and the Internet. More sophisticated routers, such as enterprise routers, connect large business or ISP networks up to the powerful core routers that forward data at high speed along the optical fiber lines of the Internet backbone.

Q2: Classless Inter-Domain Routing (CIDR)

Determine the network and broadcast addresses and number of host bits and hosts for the given IPv4 addresses and prefixes in the following table:

IPv4 Address/Prefix	Network Address	Broadcast Address	Total Number of Host Bits	Total Number of Hosts
192.168.100.25/28	192.168.100.16	192.168.100.31	4	14
172.30.10.130/30				
10.1.113.75/19				
198.133.219.250/24				
128.107.14.191/22				
172.16.104.99/27				

Q3: Variable Length Subnet Masking (VLSM)



Refer to the network diagram above to answer the following questions.

Given an IP address and mask of 192.168.10.0/24 (address / mask), design an IP addressing scheme that satisfies the following requirements. Network address/mask and the number of hosts for Subnets A and B will be provided as below:

Subnet	Number of Hosts
Subnet A	10
Subnet B	Between 40 to 50

Assume that the 0th subnet is used. Complete the following tables.

Subnet A	
Specification	**Student Input**
Number of bits in the subnet	4
New IP mask (binary)	1111111.1111111.1111111.11110000
New IP mask (decimal)	255.255.255.240
Maximum number of usable subnets (including the 0th subnet)	16
Number of usable hosts per subnet	14
IP Subnet *(one of maximum usable subnets)*	192.168.10.64
First IP Host address	192.168.10.65
Last IP Host address	192.168.10.78

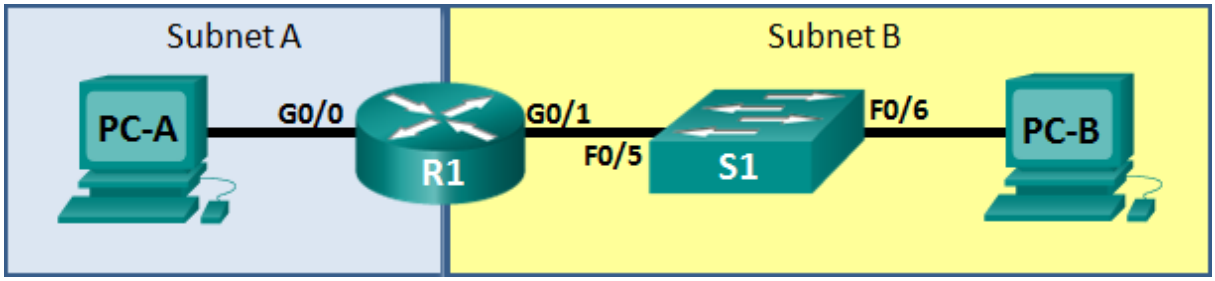
Subnet B	
Specification	**Student Input**
Number of bits in the subnet	2
New IP mask (binary)	11111111.11111111.11111111.11000000
New IP mask (decimal)	255.255.255.192

Maximum number of usable subnets (including the 0th subnet)	4
Number of usable hosts per subnet	62
IP Subnet *(one of maximum usable subnets)*	192.168.10.0
First IP Host address	192.168.10.1
Last IP Host address	192.168.10.62

Host computers will use the first IP address in the subnet. The network router will use the LAST network host address. The switch will use the second to the last network host address. Write down the IP address information for each device.

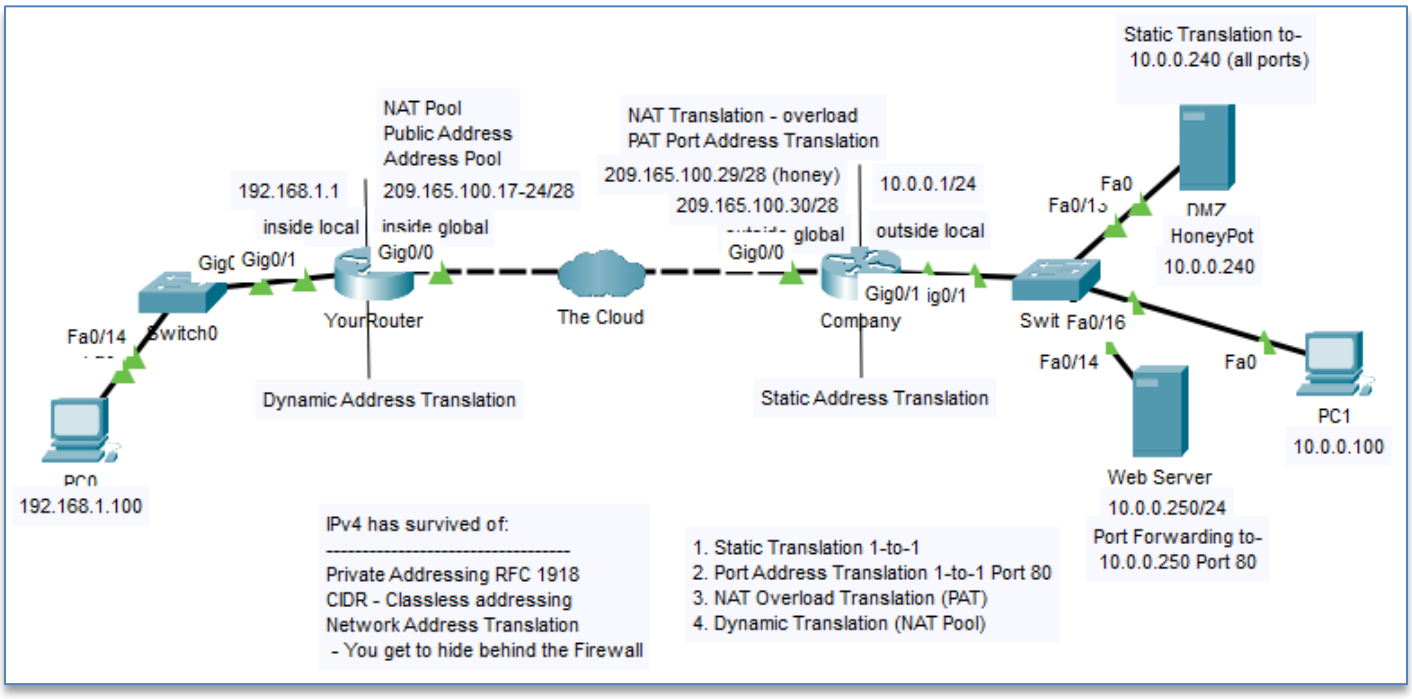
Device	IP address	Subnet Mask	Gateway
PC-A	192.168.10.65	255.255.255.240	192.168.10.78
R1-G0/0	192.168.10.78	255.255.255.240	N/A
R1-G0/1	192.168.10.62	255.255.255.192	N/A
S1	192.168.10.61	255.255.255.192	N/A
PC-B	192.168.10.1	255.255.255.192	192.168.10.62

Once the tables above are completed, implement and configure the folllowing network accordingly.



Q4: Network Address Translation

- Open **PTLab 05.4.pka** and implement the network shown below:



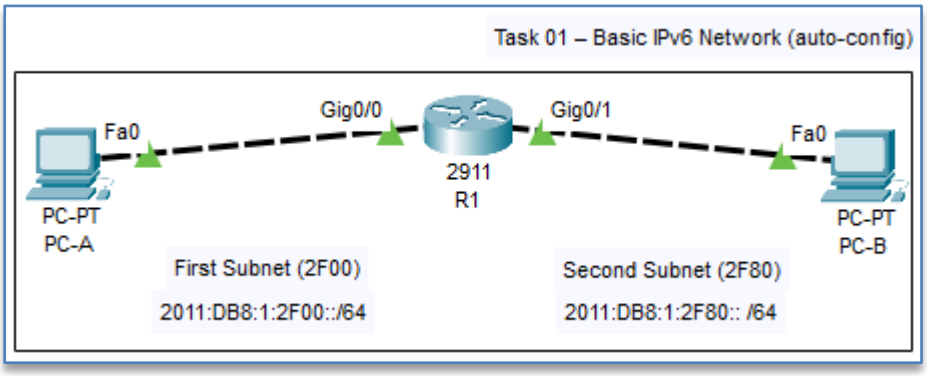
You may have to refer to P05 reference materials on Blackboard to complete this activity.

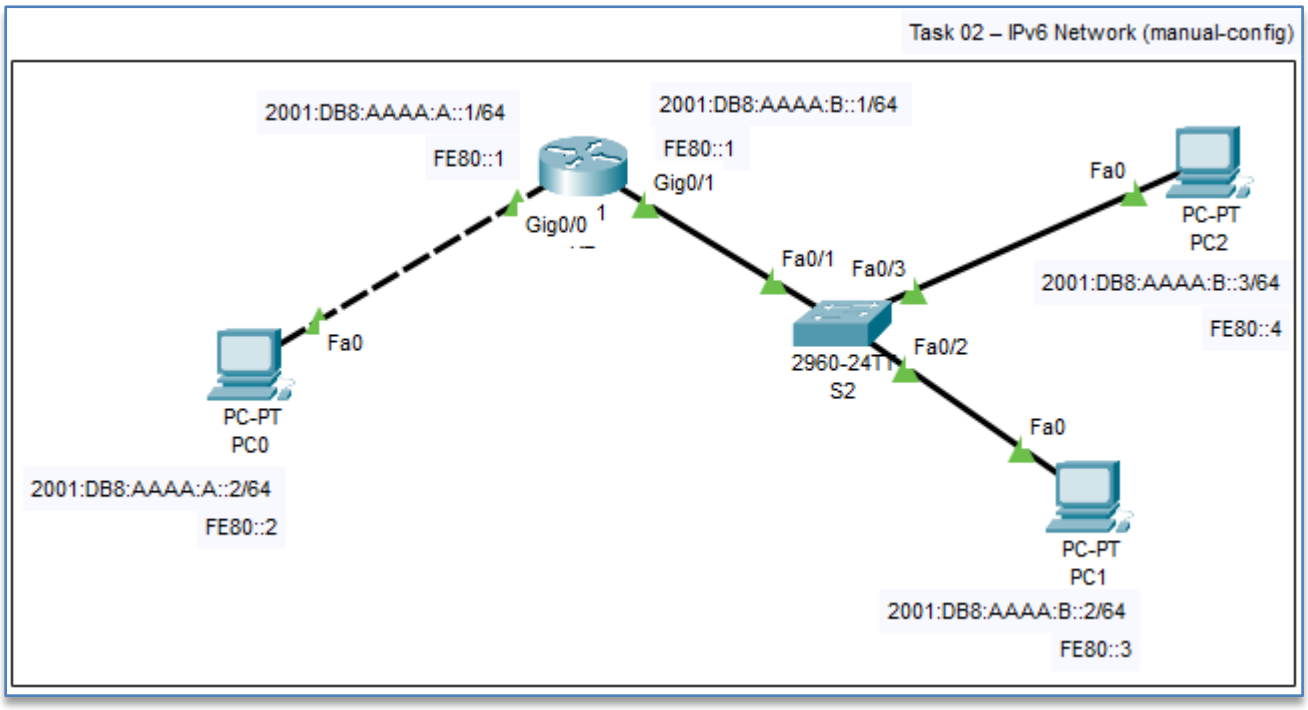
You are required to implement all four methods shown below:

1. Static Translation 1-to-1
2. Port Address Translation 1-to-1 Port 80
3. NAT Overload Translation (PAT)
4. Dynamic Translation (NAT Pool)

Q5: IPv6 Networking

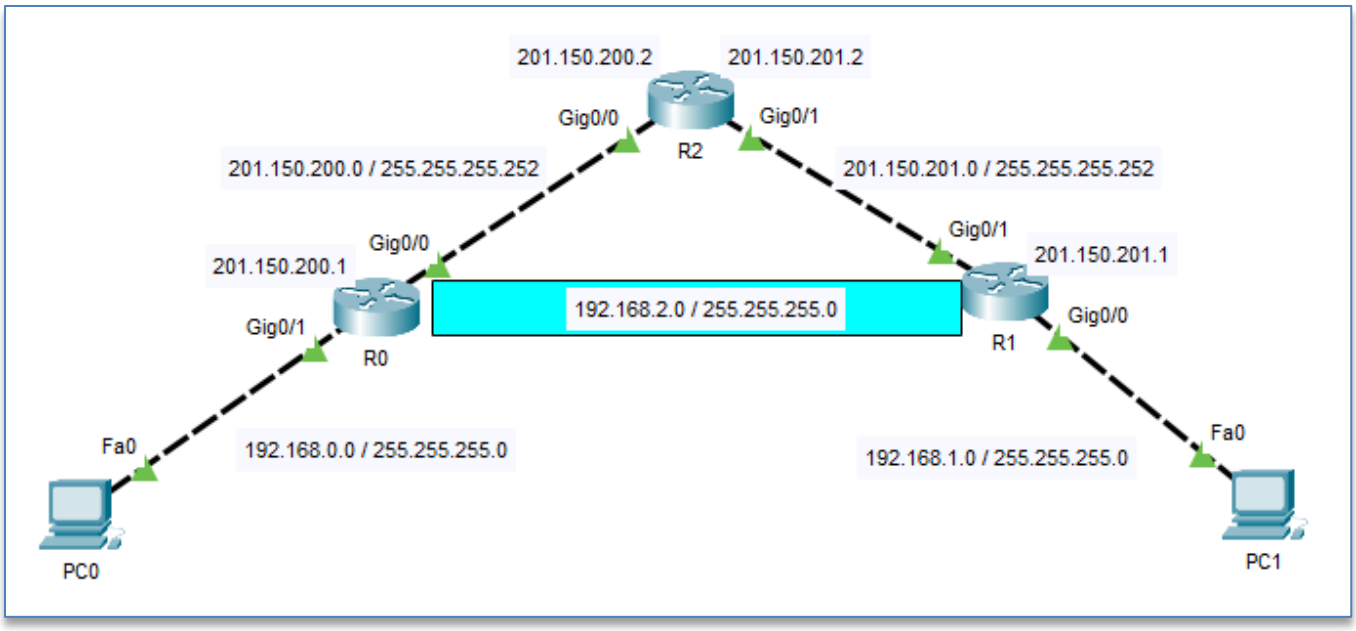
- Open **PTLab 05.5.pka** and implement the networks shown below:





Q6: Generic Routing Encapsulation (GRE) Tunnels for VPN – Virtual Private Network

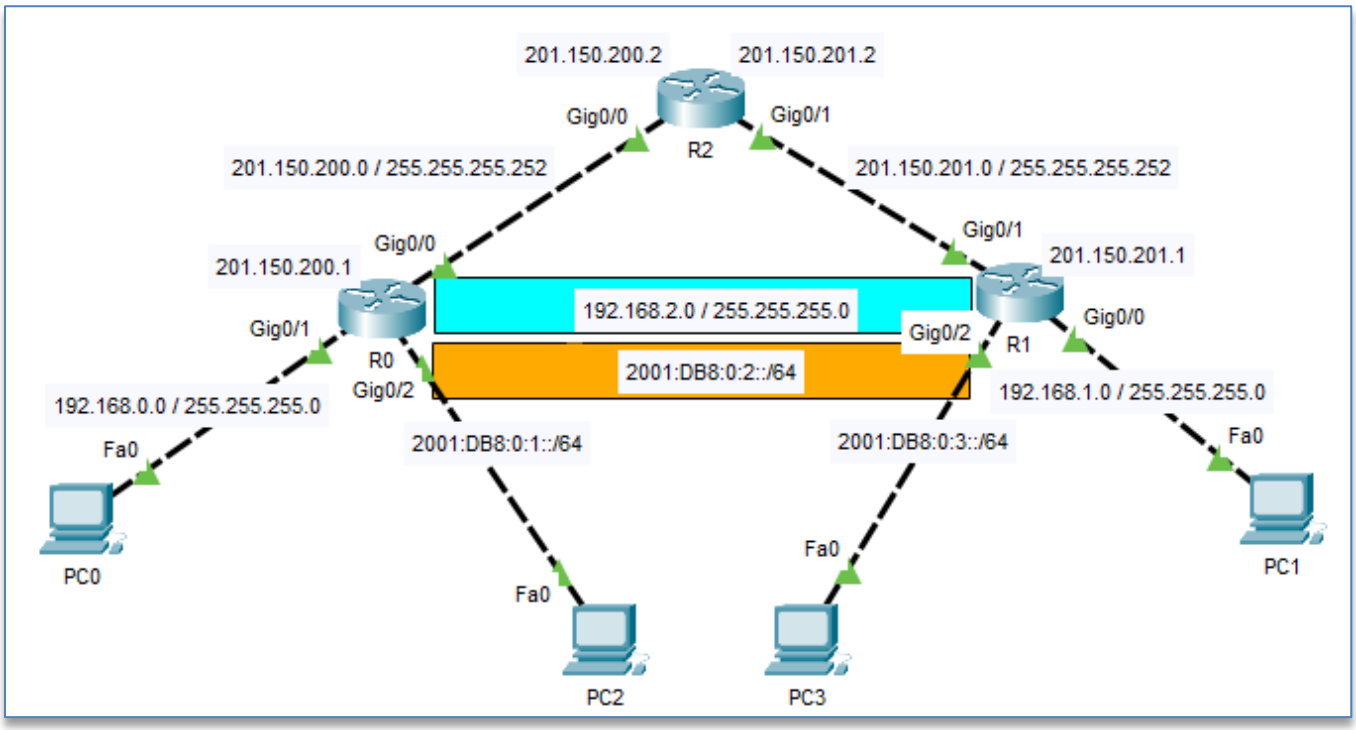
- Open **PTLab 05.6.pka** and implement the network shown below:



Q7: Generic Routing Encapsulation for IPv6 to IPv4 Address Transition (Manual Tunnel)

- Open **PTLab 05.7.pka** and implement the network shown below:

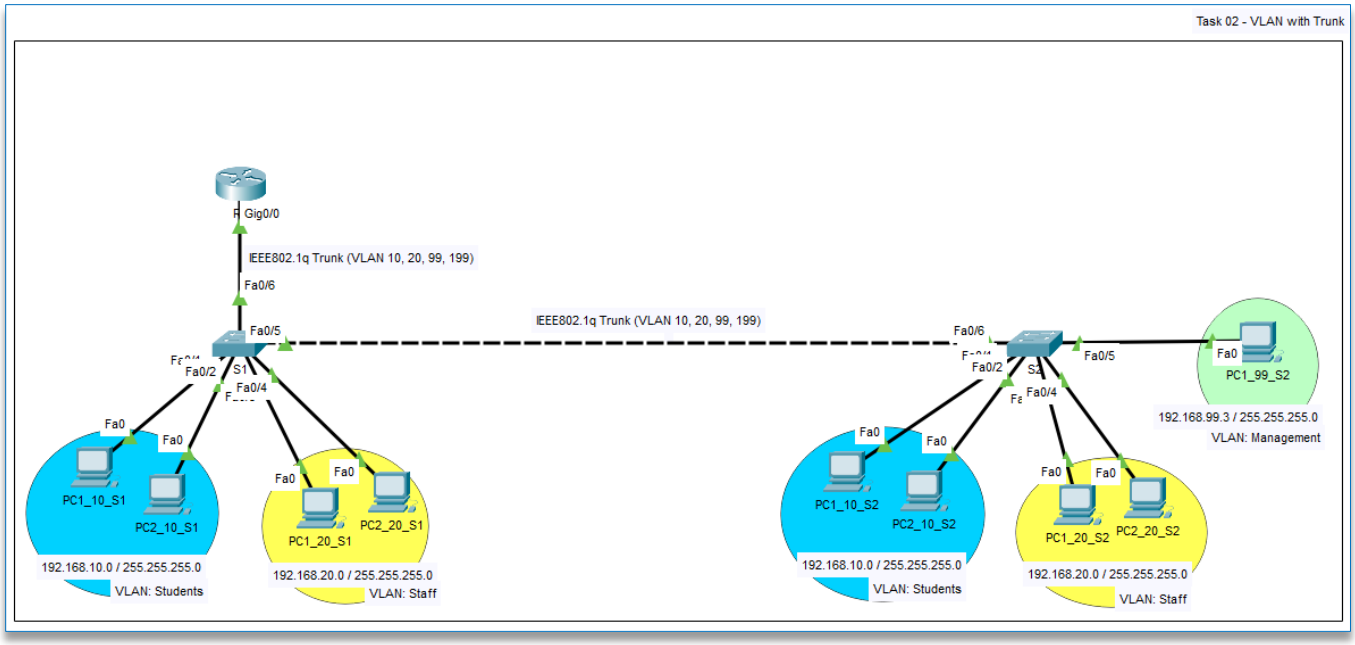
Please note that this activity is an extension of the previous question (Q6).



- Note that PT does not support IPv6 to IPv4 automatic tunnel method (6in4), but GNS3 Simulation Tool. Please refer to P05 Reference Materials on Blackboard for an example with GNS3 Simulation Tool to implement dynamic tunneling (6in4, ISATAP) and observe the difference between manual and dynamic tunneling.

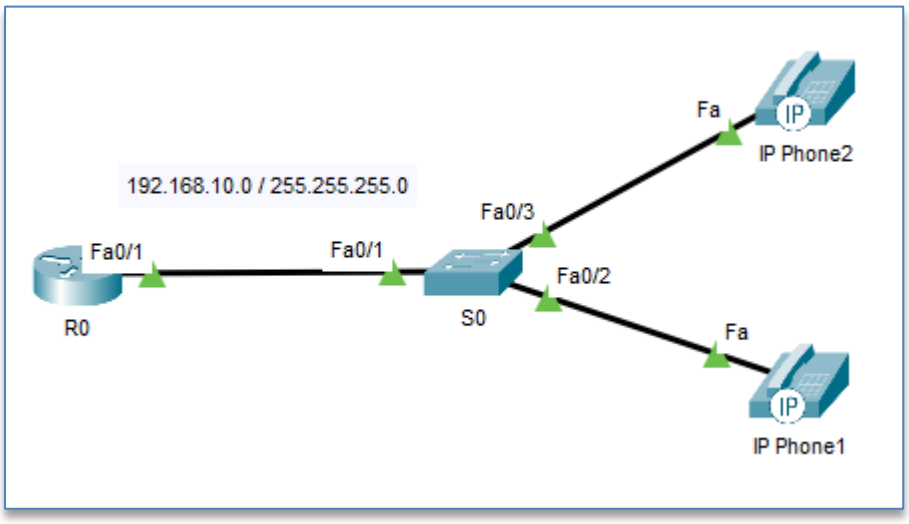
Q8: Inter VLAN Routing

- Open **PTLab 05.8.pka** and implement the network shown below:



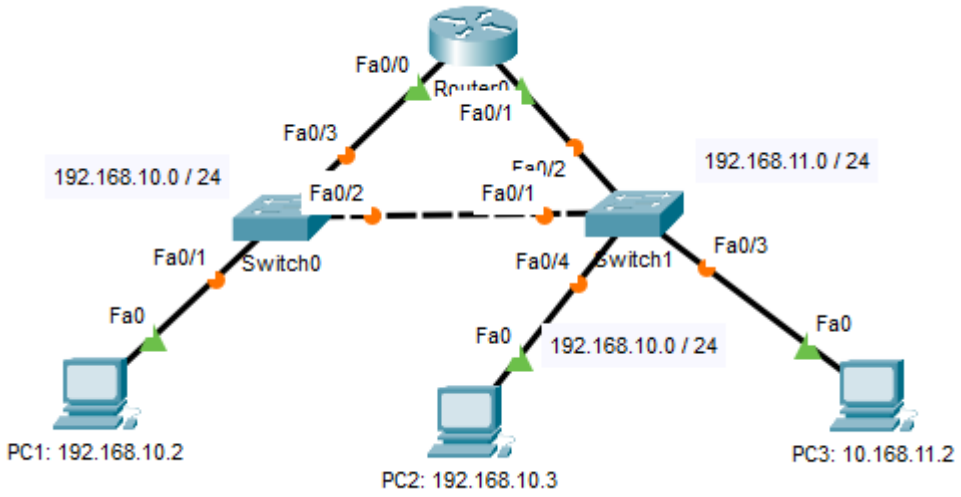
Q9: Voice Over IP (VOIP)

- Open **PTLab 05.9.pka** and implement the network shown below:



Q10: Try me! Questions

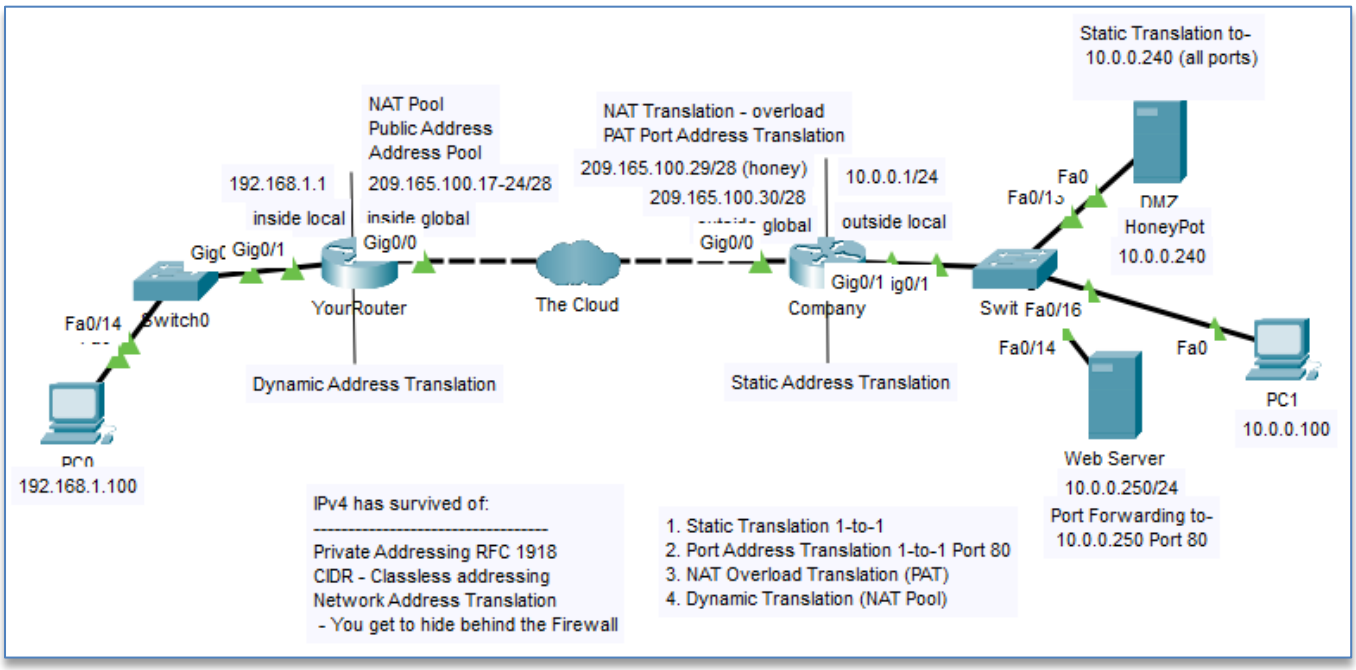
1. Is the following network valid? Does it has routing loops ?



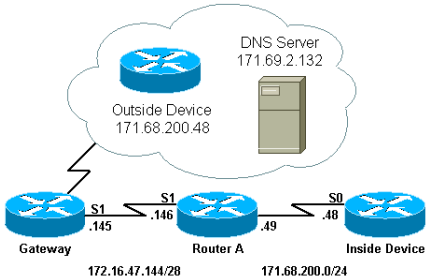
   a. Can PC1 ping PC2? If yes, which path will it take (via the router, or via the switches)? Why?

   b. Can PC1 ping PC3? If yes, which path will it take (via the router, or via the switches)? Why?

2. In Q4, when NAT is enabled at both ends, why does ICMP/ping fail from PC0 to PC1?



3. Configure NAT on "Router A" for the following network to access the Outside Device from the Inside Device. Note that the Outside Device resides in a network which is basically the same as Inside Device's network (refer to the reference material on Blackboard for NAT in Overlapping Networks).



4. In Q5, Task 02 – IPv6 Network (manual-config), assume that the local link address for Router R0 (Gig0/0, Gig0/1) interfaces are configured but not the global unicast addresses.
   a. Try to send an ICMP packet (using the ping command) from PC1 to PC0. Why does it fail?
   b. Try to send an ICMP packet (using the ping command) from PC1 to PC2. Why is it successful?
5. In Q6, why does it fail if you send a ICMP packet from R2 to PC1 or R2 to PC0?
6. In Q7, can we configure a single tunnel that can work with both IPv4 and IPv6 traffic? In other words, can we configure a IPv4 and a IPv6 gateway address on the same tunnel instead of having two tunnels, one for IPv4 traffic and other for IPv6 traffic as shown in the Q7 activity?
7. In Q7, why it is not possible to send data (ICMP packets):
   a. PC0 to PC2?
   b. PC0 to PC3?
8. In Q8, connect two PCs to the Native VLAN of S1, S2 respectively **(PC1 – 192.168.199.2**, **PC2 – 192.168.199.3)**.
   a. Send an ICMP message from PC1_10_S1 to PC1 which is on the Native VLAN. Is it successful? If not, explain why?
   b. Can a PC which is not on Management VLAN (VLAN 99) Telnet into S1 or S2? Explain why?
9. In Q8, add a switching module (HWIC-4ESW) to Router 2911 (Fa0/0/0, Fa0/0/1, Fa0/0/2, Fa0/0/3) Why it is **not possible** to define sub interfaces on those ports?
   a. Hint: Observer the configuration of those interfaces via the router; Can an IP address be assigned as the default gateway address? Connect two PCs (both in 10.0.0.0 / 255.255.255.0 network) to two of those ports (Fa) on the switch and see whether they can communicate with each other.
   b. Hint: Connect another two PCs (one in 10.0.0.0 / 255.255.255.0 network and other in 10.0.1.0 / 255.255.255.0 network) to other two ports (Fa) and see whether they can communicate with each other. Any suggestions to fix the communication in this case?

Summary

1. Understand the elements on Layer 3
2. Classless Inter Domain Routing (CIDR)
3. Variable Length Subnet Masking (VLSM)
4. Network Address Translation (NAT)
5. IPv6 Networking
6. GRE for VPN
7. GRE for IPv6 in IPv4 – Manual Tunneling
8. InterVLAN Routing
9. Voice Over IP (VoIP)
10. **Try me! Questions**