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NET463
Lab #1 –NAT
ASSIGNMENT DOCUMENT
Must be done on Packet Tracer
Version 2: Updated network Diagram with correct address, corrected AS number

Lab Scenario:

In this lab you will demonstrate how NAT translates IP addresses. As discussed in lecture, NAT translates non-routable private, internal addresses into routable, public addresses. NAT has an added benefit of providing a degree of privacy and security to a network because it hides internal IP addresses from outside networks. In this Lab, you will configure both a static NAT and NAT overload (aka PAT). Also, HSRP enables gateway router redundancy – a function that is critical in business operations.

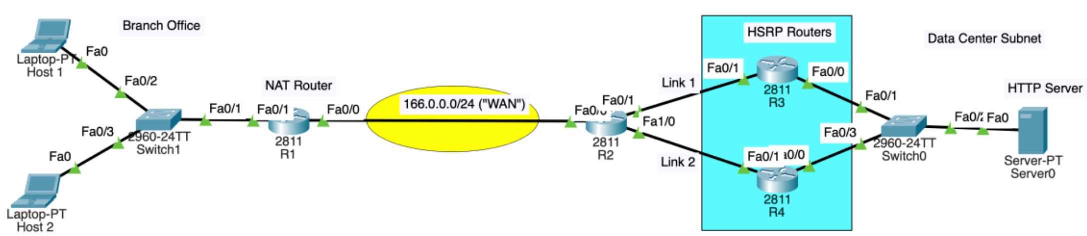


Figure 1: Lab #1 Network Diagram

Learning Objectives

- Configure dynamic NAT *Overload*
- Configure HRSP
- Configure default routes
- Configure EIGRP routing protocol (basic)
- Configure an HTTP server in Packet Tracer
- Test connectivity and debug using *pings*

Lab Procedure:

Configure hostnames, IP addresses, HTTP server

1. Configure hostname prompt on each router and end device to the appropriate name shown in the network diagram. NOTE: The device name of device (routers and end devices) must be set to include your initials at the end. For example, if the lab includes routers R1 and R2 and hosts Host1 and Host2

and your initials are "AB", you MUST set the names of these device to R1-AB, R2-AB, Host1-AB and Host2-AB. Prompts in ALL of your screen captures must include your prompt with your initials.

2. Assign IPv4 addresses to all router interfaces as defined in the IPv4 address assignment table.

IPv4 Address Assignments

Network	Subnet ID
Branch Office	192.168.8.0/24
WAN	166.0.0.0/24
Data Center subnet	110.0.0.0/24
Link 1	177.1.0.0/24
Link 2	177.2.0.0/24

3. Configure the HTTP server to return "<*your name*> Spring 2024 Lab #1!" as a response to an HTTP request

Configure static routes and routing protocols

4. Create default routes in R1, R2, R3, and R4 routers.
5. Configure EIGRP in R2,R3 and R4 to advertise link1, link2, and the Data Center subnet. Use the AS=**463** in our ***router eigrp*** *<AS number>* command. Use ***network*** commands to advertise the networks.

```
R1(config)#router eigrp 463
R1(config-router)#network <subnet id> <wild-card>
```

6. All end devices and router interfaces should now be able to successfully ping from one another.

Configure NAT overloading

7. Configure NAT overloading in router R1. Create a named standard Access Control List (ACL). To define the internal addresses that are translated to public addresses in the NAT process, create a named standard ACL called R1NAT. This list is used in the NAT configuration steps that follow.

```
R1(config)#ip access-list standard R1NAT
R1(config-std-nacl)#permit 192.168.8.0 0.0.0.255
```

8. Configure dynamic NAT to allow any host in subnet 192.168.8.0/24 to access the Internet at the same time. Configure NAT with *overload* to accommodate the additional hosts. NAT overload, also called *Port Address Translation (PAT)*, uses port numbers to distinguish packets from different hosts that are assigned the same public IP address
9. Configure the interfaces on R1 to apply NAT. In interface configuration mode on R1, configure each of the interfaces using the **`ip nat {inside | outside}`** command.

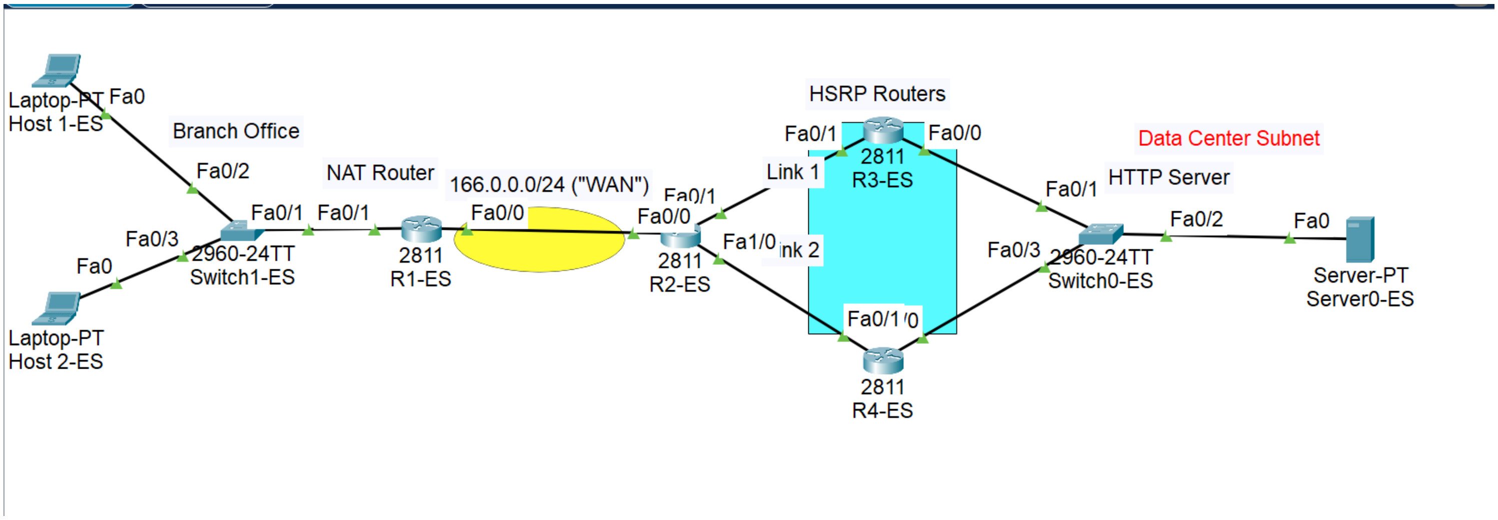
Configure HRSP

1. Configure R3 and R4 routers that are serving as GW routers for the DC subnet with HSRPv1 (for IPv4). This will enable default router redundancy for the subnet. Configure HSRP with the settings below.

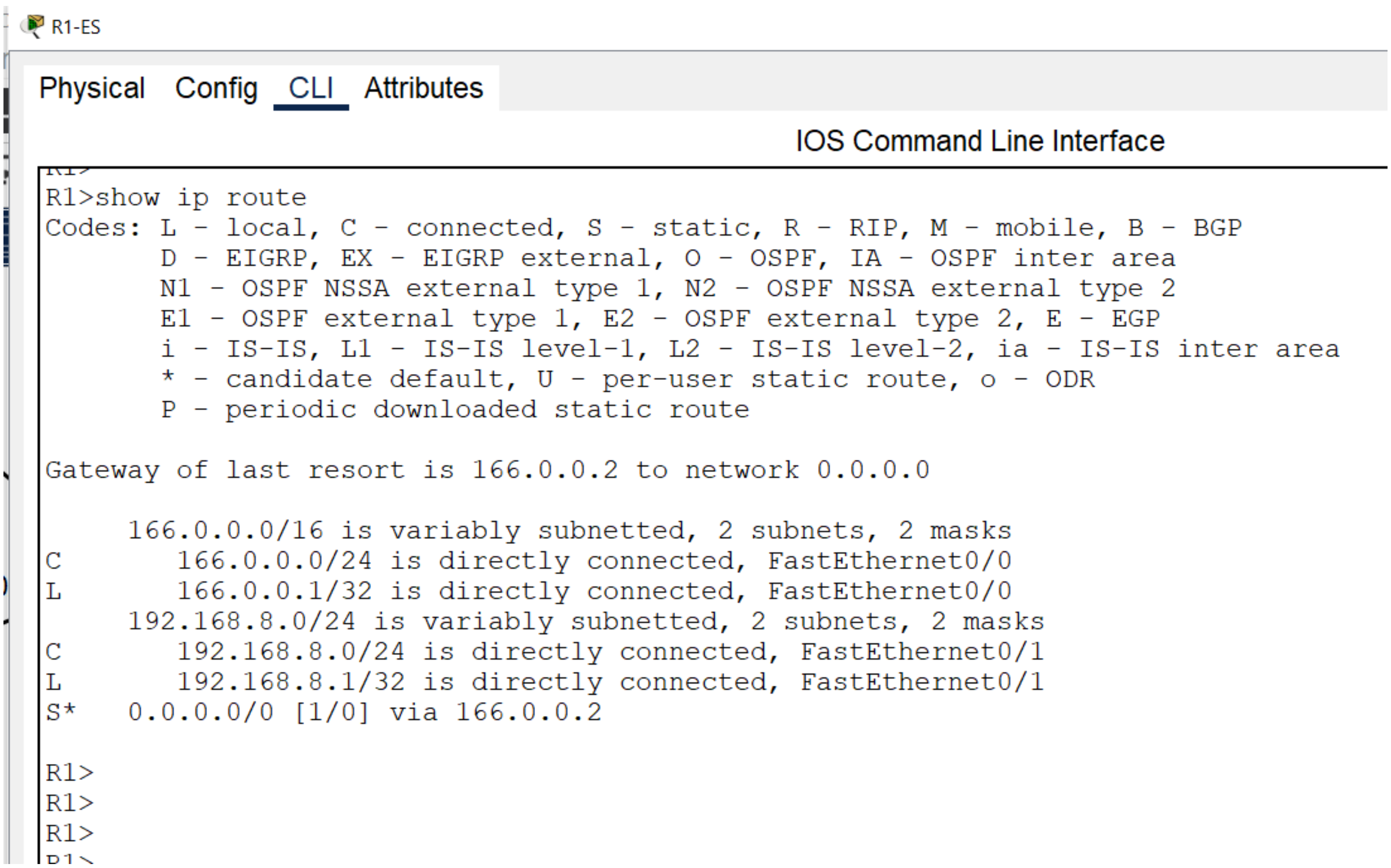
Network	Active Router	Standby Router	Preempt
DC subnet	R3	R4	YES

Lab Report / Questions (100pts):

1. (5%) demonstrated in your screen shots that you used your initials for the host names <u>and</u> router names as specified in step 1 of the lab procedure.



2. (5%) Enter the command ***show ip route*** for routers R1, R2 and paste the **screenshots** below.



```
R1-ES
Physical  Config  CLI  Attributes
IOS Command Line Interface

R1>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 166.0.0.2 to network 0.0.0.0

     166.0.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       166.0.0.0/24 is directly connected, FastEthernet0/0
L       166.0.0.1/32 is directly connected, FastEthernet0/0
     192.168.8.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.8.0/24 is directly connected, FastEthernet0/1
L       192.168.8.1/32 is directly connected, FastEthernet0/1
S*   0.0.0.0/0 [1/0] via 166.0.0.2

R1>
R1>
R1>
```

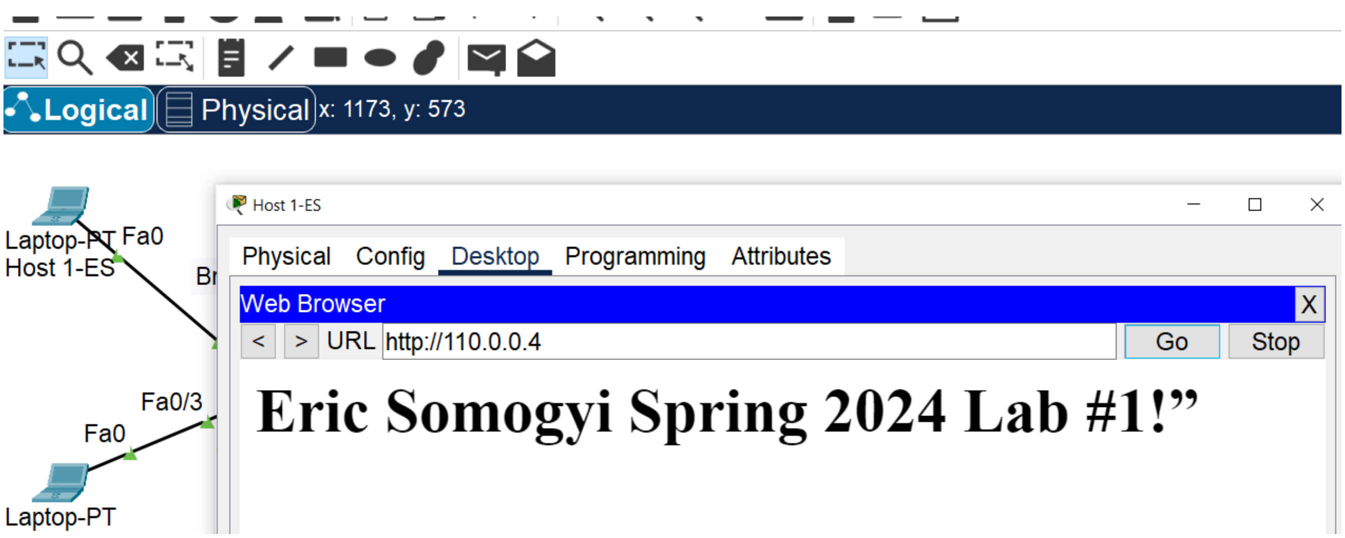
R2-ES

Physical Config CLI Attributes

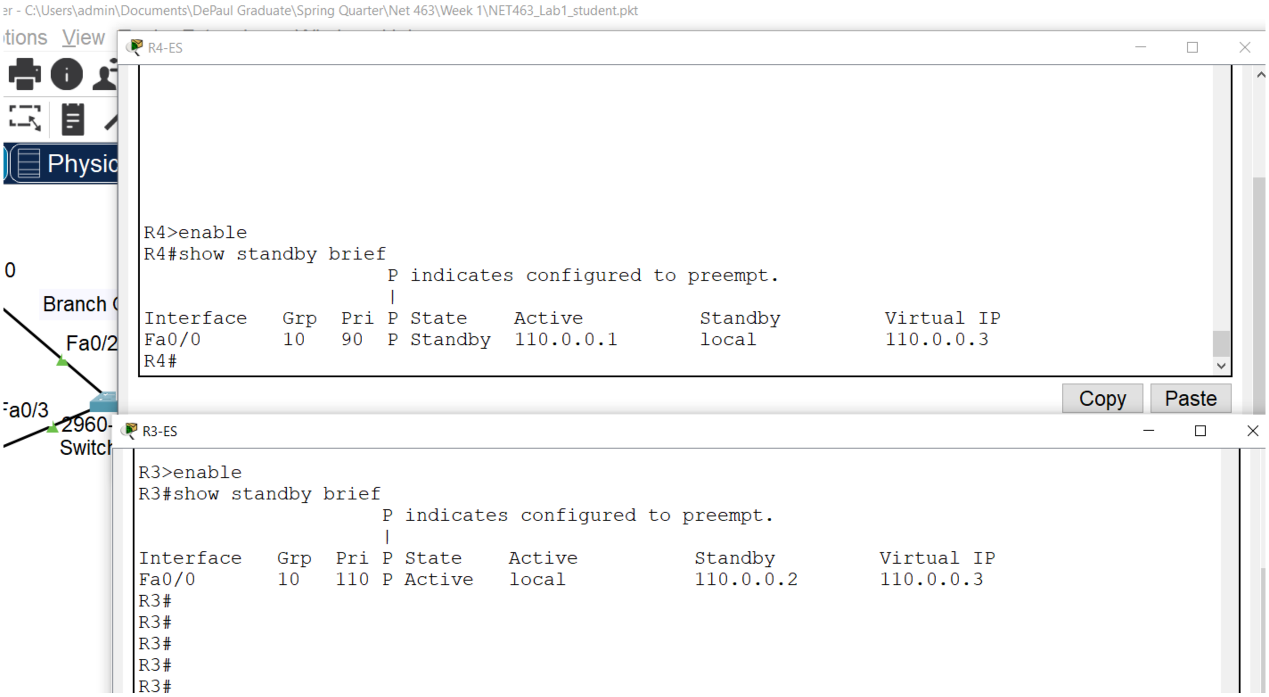
IOS Command Line Interface

```
R2>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 166.0.0.1 to network 0.0.0.0

     110.0.0.0/24 is subnetted, 1 subnets
D       110.0.0.0/24 [90/30720] via 177.1.0.2, 00:05:55, FastEthernet0/1
                     [90/30720] via 177.2.0.2, 00:05:49, FastEthernet1/0
     166.0.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       166.0.0.0/24 is directly connected, FastEthernet0/0
L       166.0.0.2/32 is directly connected, FastEthernet0/0
     177.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       177.1.0.0/24 is directly connected, FastEthernet0/1
L       177.1.0.1/32 is directly connected, FastEthernet0/1
     177.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       177.2.0.0/24 is directly connected, FastEthernet1/0
L       177.2.0.1/32 is directly connected, FastEthernet1/0
S*   0.0.0.0/0 [1/0] via 166.0.0.1
```

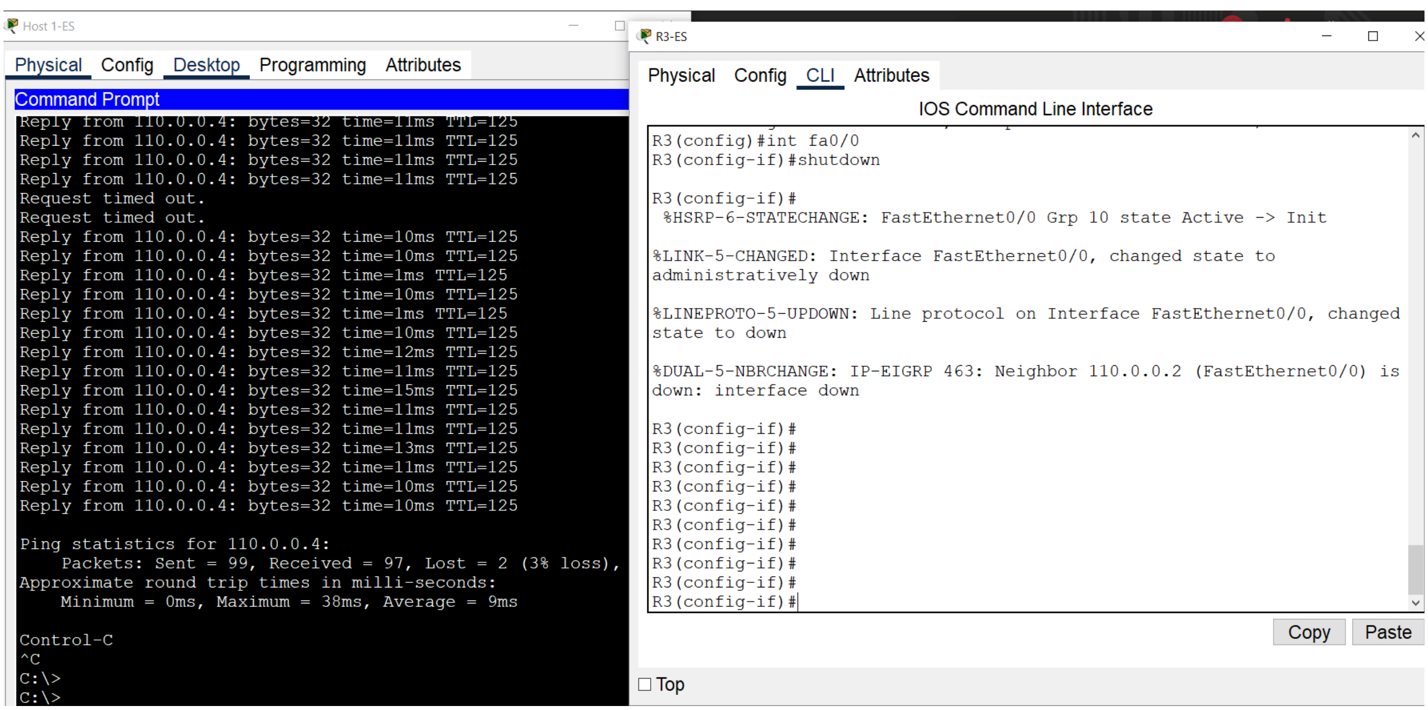
3. (10%) From host 1, perform an HTTP query to the HTTP server. This should be successful. Paste a **screenshot** of the HTTP response below.



4. (10 pts) Execute a ***show standby brief*** on R3 and R4 and **paste results** here:



5. (10 pts) On Host 1, enter a ***ping -t*** to the web server *ipv4 address.* The ping with the "-t" option should continuously ping. While this ping is executing, go to R3 and perform a shutdown on the port that is connected to the DC subnet. You should find that the ping's will stop being successful for several minutes and then return successfully. Take a screen shot on the host 1 command prompt of showing this ping behavior and **paste results** here.



6. (5 pts) Execute a ***show standby brief*** on R3 and R4 <u>while the port is still in shutdown</u> and **paste results** here:

R3-ES

Physical Config CLI Attributes

IOS Command Line Interface

```
R3#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        110.0.0.1       YES manual administratively down down
FastEthernet0/1        177.1.0.2       YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R3#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       10   110 P Init     unknown         unknown         110.0.0.3
R3#
R3#
```

R4-ES

```
R4>enable
R4#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       10   90  P Active   local           unknown         110.0.0.3
R4#
R4#
R4#
```

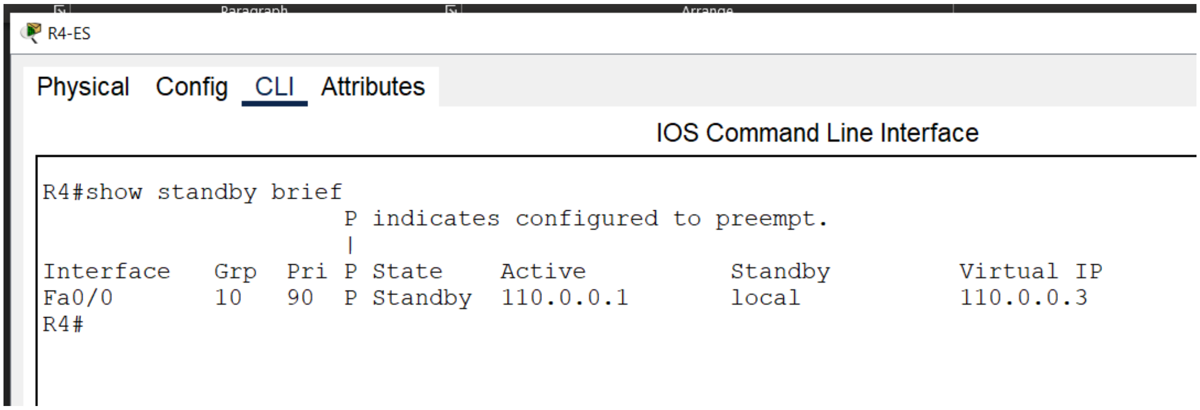
7. (5 pts) Explain the reason in several CLEAR sentences the cause of WHY the behavior of the *ping's* disappearing and then re-appearing resulting from the actions of the port shutdown.

   Answer: The reason the ping's timeout and disappear for a few seconds and then reappear is because that is during the time that the router EIGRP 463 feature on R2 was engaged due to the packets not flowing through R3 since the shutdown was initiated. In the EIGRP routing protocol, it's dynamic autonomous system was engaged and eventually found another best path to the destination ip address which ended up being through data link 2 which was through Router 4.

8. (5 pts) Remove the port shutdown on R3 and execute a ***show standby brief*** on both R3 and R4 and **paste results** here.

```
R3(config)#int fa0/0
R3(config-if)#no shutdown

R3(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

R3(config-if)#exit
R3(config)#
%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 10 state Speak -> Standby

%HSRP-6-STATECHANGE: FastEthernet0/0 Grp 10 state Standby -> Active

%DUAL-5-NBRCHANGE: IP-EIGRP 463: Neighbor 110.0.0.2 (FastEthernet0/0) is up: new adjacency
```

```
R3>enable
R3#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       10   110 P Active   local           110.0.0.2       110.0.0.3
R3#
```


R4-ES

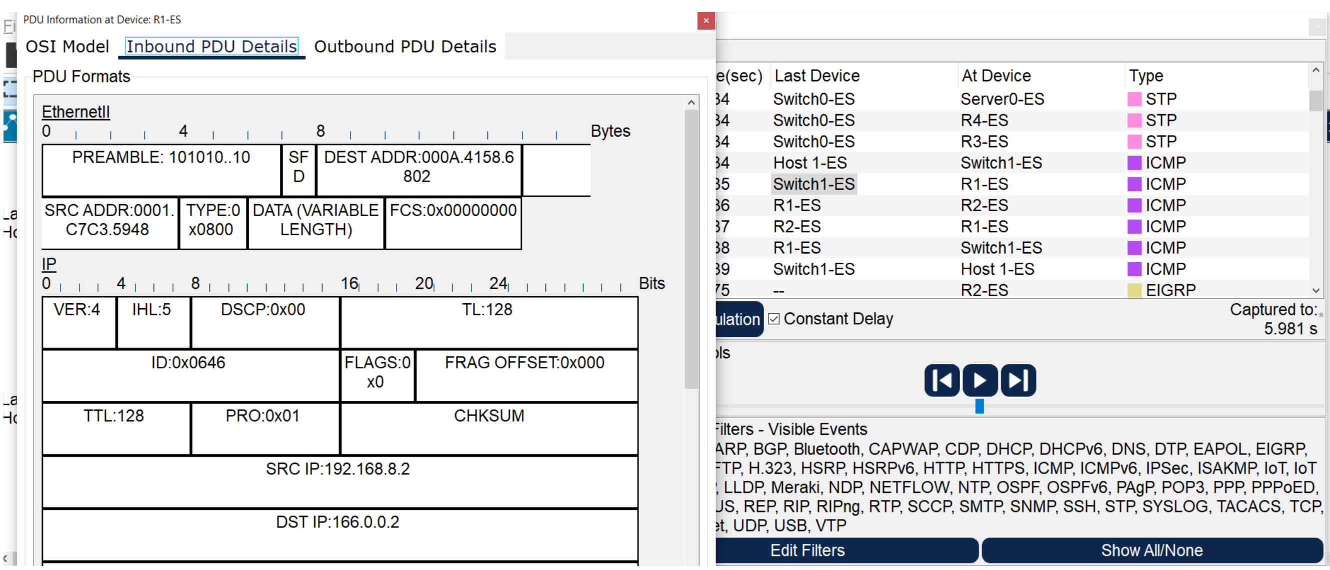
Physical Config CLI Attributes

IOS Command Line Interface

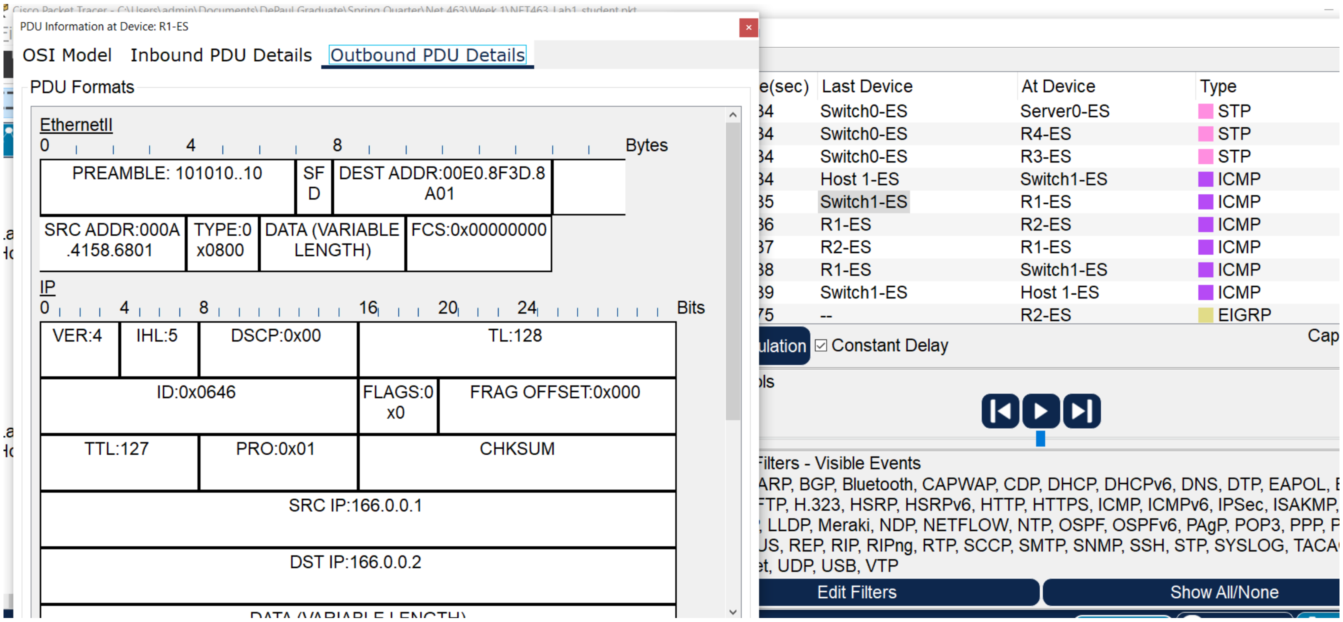
```
R4#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Fa0/0       10   90  P Standby  110.0.0.1       local           110.0.0.3
R4#
```

NAT Overload procedure and questions:

9. (15%) You should now be able to ***ping*** from any inside host to the HTTP Server **(**USE the IP address of the R2 router**)** To see the effects of NAT on a specific packet, enter *Simulation mode* in Packet Tracer and observe the packet that originates from a **ping** on Host 1. Click the colored information box associated with that packet as it is passed from Host 1 to R1. By clicking Inbound PDU Details, you should see that the source address is IP address that you assigned. Include a **screenshot** of the results and paste here.

i. 

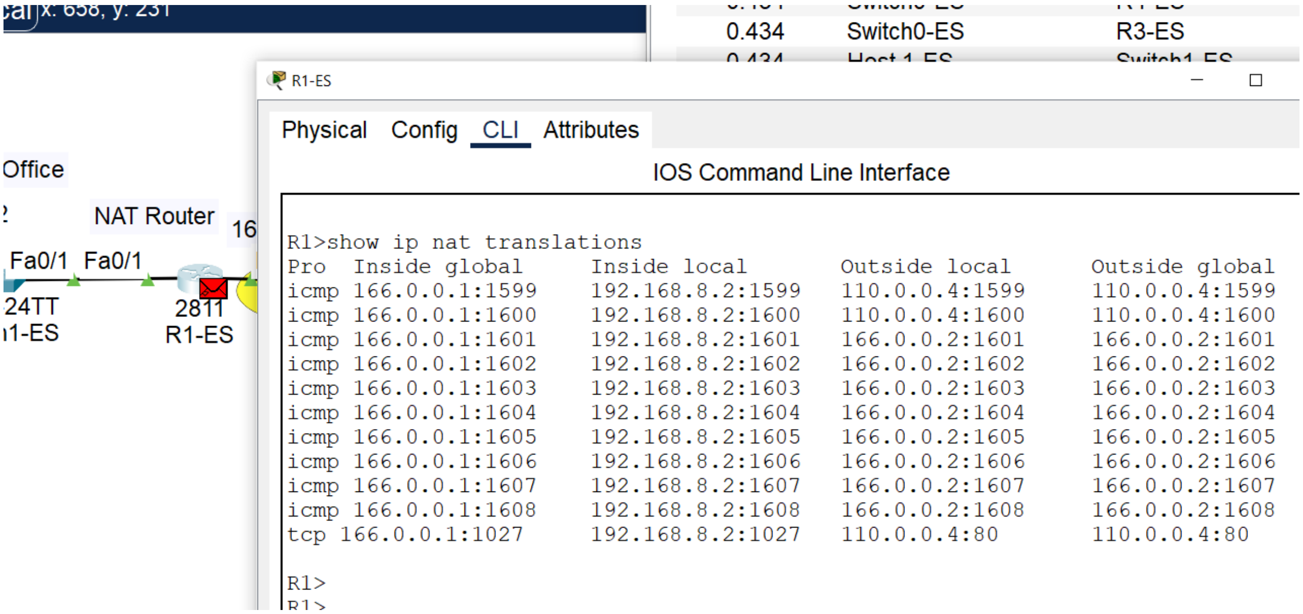
b. By clicking Outbound PDU Details or R1, you should see that the source address has been translated to the inside global IP address. Include a **screenshot** of the results and paste here.



10. (10%) Based on your above explanation, discuss **<u>why</u>** such a method presents challenges with ***Ping packets*** and how this is generally resolved (hint: think about how Ping packets are encapsulated, that is, are they encapsulated in UDP or TCP?).

    a. Answer: Ping packets use the ICMP protocol. The ICMP protocol operates at the Layer 3 level but it also assists in Layer 4 when delivering error messages and operational information. Also, ICMP packets don't use port numbers or establish a connection like in UDP or TCP. In layer 3, the ping packets include the ICMP headers and data is incapsulated with the IP datagram. In Layer 2, then the ICMP packet is encapsulated into a frame specific to the data link layer protocol. Then in Layer 1, the data is encapsulated and then transmitted over the physical medium of the wire. This collectively becomes challenging because when a device is accessing the internet from NAT through a singular ip address this requires different techniques for the ping packets to be delivered/responded to from the internal to external networks and it is necessary for data to be translated to the correct format so all the layers work together to read and accomplish the command.

11. (10%) On router R1, display the PAT translation table by entering the command ***show ip nat translations*** and include a screenshot of the results and paste here.



12. (10%) For the PAT address translation in router R1, provide an IP address example for each the following:

inside local address: Answer: 192.168.8.2:1600

inside global address: Answer: 166.0.0.1:1600

outside global address: Answer: 166.0.0.2:1601