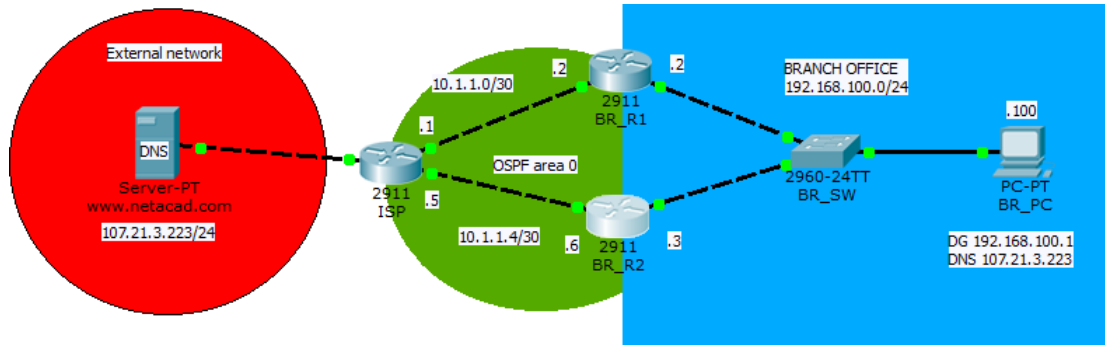


# Configuring basic HSRP (Hot Standby Router Protocol)

## Topology Diagram



## Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
ISP	Gi0/0	10.1.1.1	255.255.255.252	N/A
	Gi0/1	10.1.1.5	255.255.255.252	N/A
	Gi0/2	107.21.3.1	255.255.255.0	N/A
BR_R1	Gi0/0	192.168.100.2	255.255.255.0	N/A
	Gi0/1	10.1.1.2	255.255.255.252	N/A
BR_R2	Gi0/0	192.168.100.3	255.255.255.0	N/A
	Gi0/1	10.1.1.6	255.255.255.252	N/A
BR_PC	NIC	192.168.100.100	255.255.255.0	192.168.100.1
Server	NIC	107.21.3.223	255.255.255.0	107.21.3.1

## Learning Objectives

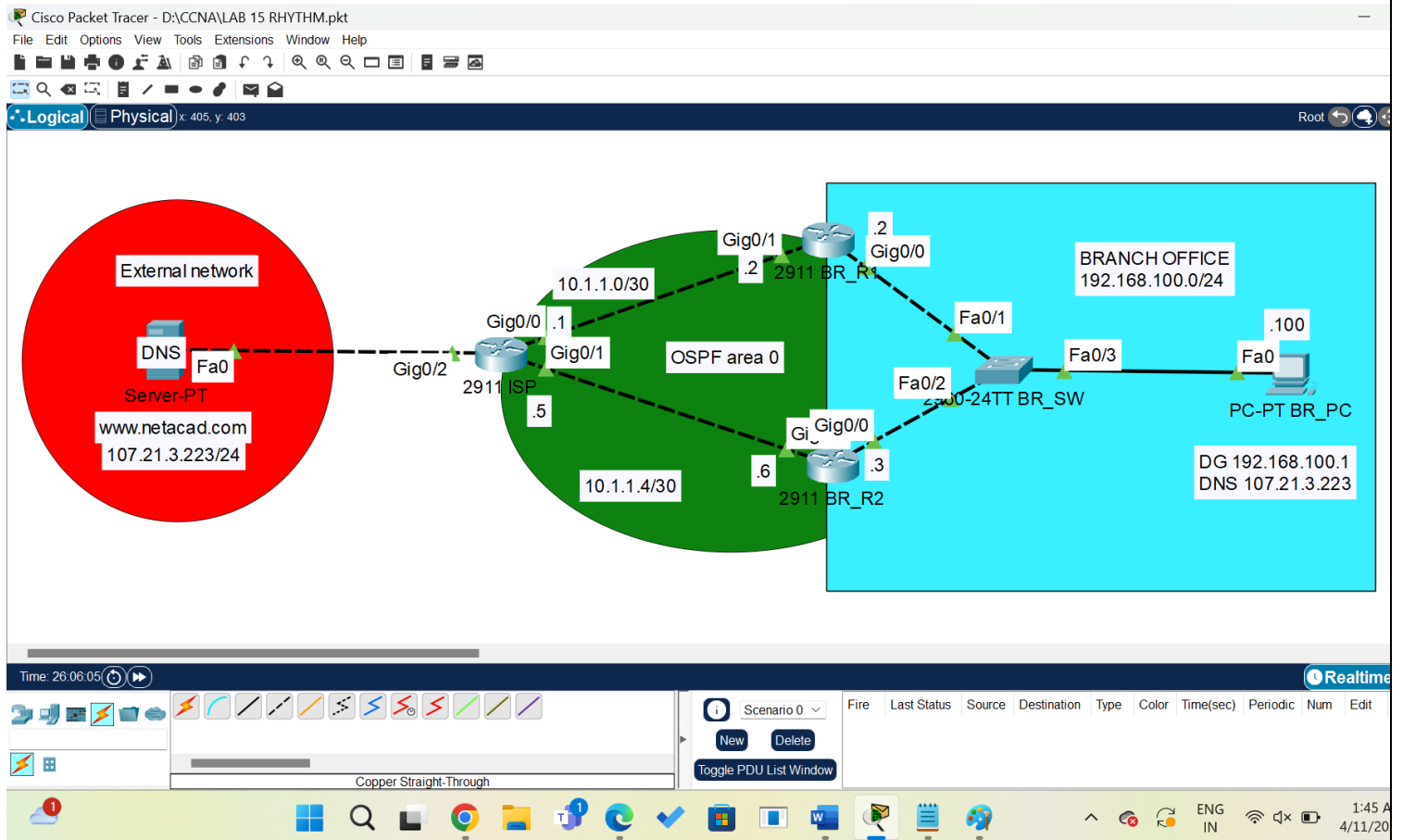
- Configure STP
- Configure OSPF routing and verify functionality
- Configure HSRP and verify functionality
- Configure Ethernet interface on host PC and test failover

## Introduction

In this activity, you will perform basic STP and OSPF configuration before activating HSRP on the Branch routers. ISP, BR\_R1, BR\_R2 have already been preconfigured with hostnames and IP addresses. The DNS/Web server has also been preconfigured.

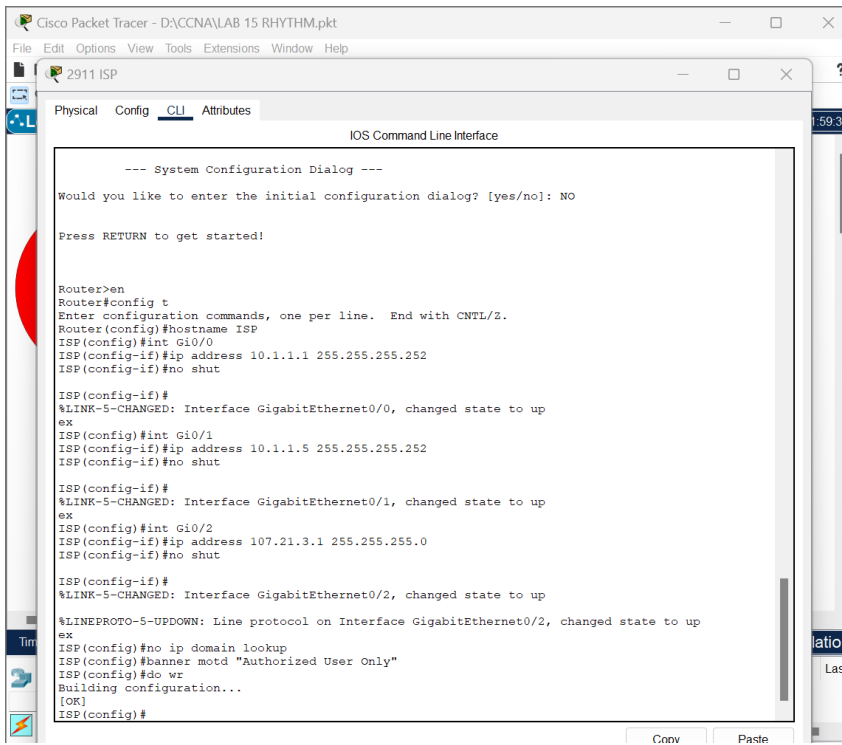
## SOLUTION

### TOPOLOGY DIAGRAM AS PER TABLE



## Basic Network Configuration:

### ISP



```
Cisco Packet Tracer - D:\CCNA\LAB 15 RHYTHM.pkt
File Edit Options View Tools Extensions Window Help

2911 ISP
Physical Config CLI Attributes

IOS Command Line Interface

--- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: NO

Press RETURN to get started!

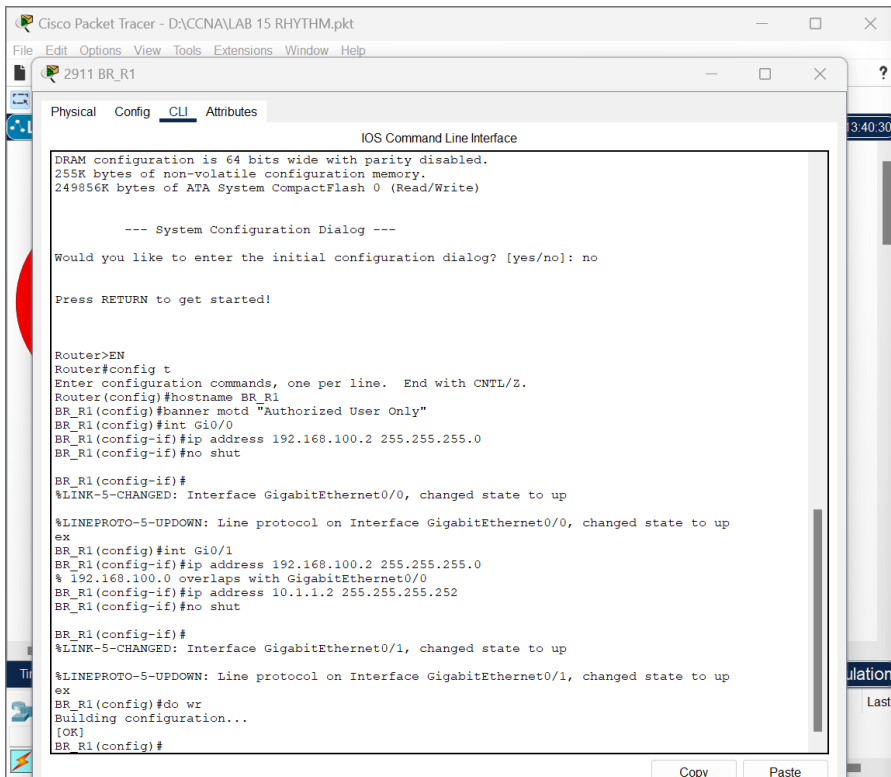
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname ISP
ISP(config)#int Gi0/0
ISP(config-if)#ip address 10.1.1.1 255.255.255.252
ISP(config-if)#no shut

ISP(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
ex
ISP(config)#int Gi0/1
ISP(config-if)#ip address 10.1.1.5 255.255.255.252
ISP(config-if)#no shut

ISP(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up
ex
ISP(config)#int Gi0/2
ISP(config-if)#ip address 107.21.3.1 255.255.255.0
ISP(config-if)#no shut

ISP(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
ex
ISP(config)#no ip domain lookup
ISP(config)#banner motd "Authorized User Only"
ISP(config)#do wr
Building configuration...
[OK]
ISP(config)#
```

### BR\_R1



```
Cisco Packet Tracer - D:\CCNA\LAB 15 RHYTHM.pkt
File Edit Options View Tools Extensions Window Help

2911 BR_R1
Physical Config CLI Attributes

IOS Command Line Interface

DRAM configuration is 64 bits wide with parity disabled.
255K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

--- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

Router>EN
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname BR_R1
BR_R1(config)#banner motd "Authorized User Only"
BR_R1(config)#int Gi0/0
BR_R1(config-if)#ip address 192.168.100.2 255.255.255.0
BR_R1(config-if)#no shut

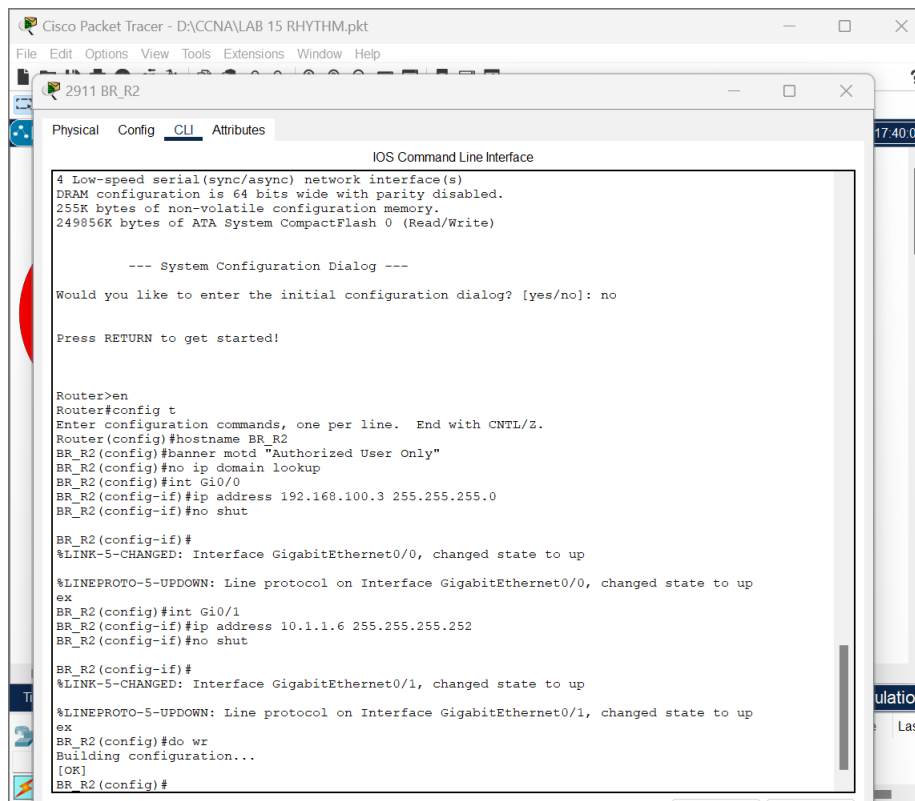
BR_R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
ex
BR_R1(config)#int Gi0/1
BR_R1(config-if)#ip address 192.168.100.2 255.255.255.0
% 192.168.100.0 overlaps with GigabitEthernet0/0
BR_R1(config-if)#ip address 10.1.1.2 255.255.255.252
BR_R1(config-if)#no shut

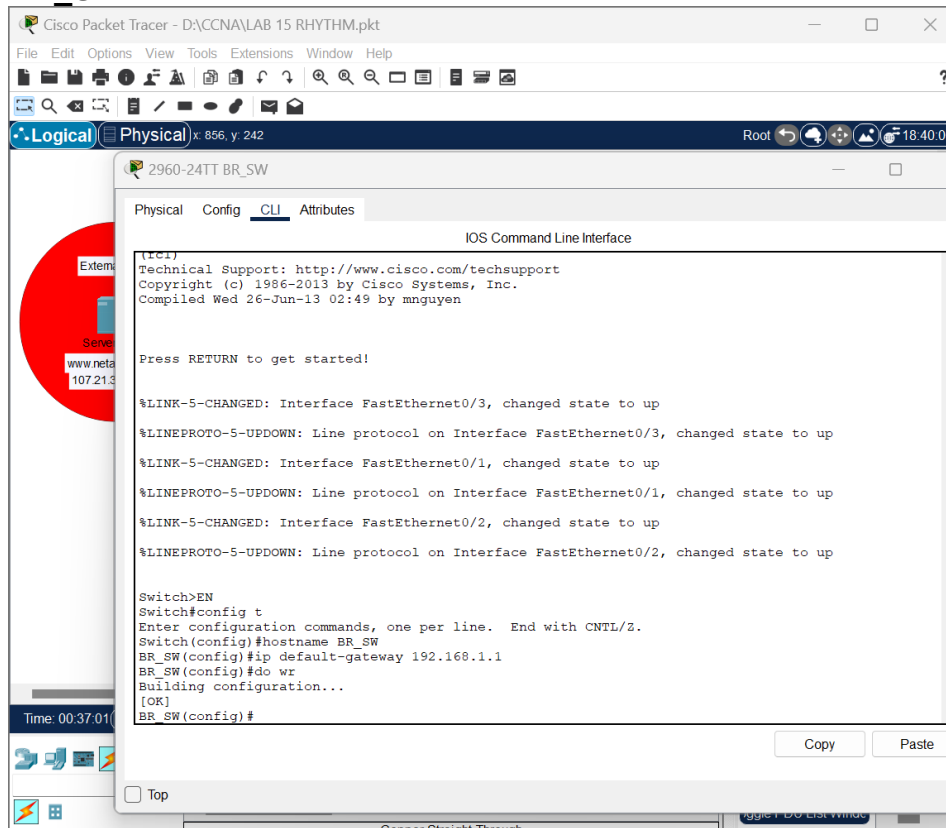
BR_R1(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
ex
BR_R1(config)#do wr
Building configuration...
[OK]
BR_R1(config)#
```

## BR\_R2



## BR\_SW



## PC-PT BR\_PC

The network diagram shows a red circle representing the 'External network' connected to a green circle representing the 'Internal network'. The red circle contains a 'Server-PT' with IP 107.21.3.223/24. The green circle contains a 'PC-PT BR\_PC' with IP 10.1.1.4/30. The two networks are connected via a 'Gig0/2' interface on the red circle and a 'Gig0/1' interface on the green circle. The PC configuration window is open, showing the 'IP Configuration' tab. The 'Interface' is 'FastEthernet0'. The 'IP Configuration' section has 'Static' selected. The 'IPv4 Address' is '192.168.100.100', 'Subnet Mask' is '255.255.255.0', 'Default Gateway' is '192.168.100.1', and 'DNS Server' is '0.0.0.0'. The 'IPv6 Configuration' section has 'Static' selected. The 'IPv6 Address' is 'FE80::2D0:97FF:FE12:B59A', 'Link Local Address' is 'FE80::2D0:97FF:FE12:B59A', 'Default Gateway' is empty, and 'DNS Server' is empty. The '802.1X' section has 'Use 802.1X Security' unchecked, 'Authentication' set to 'MD5', 'Username' is empty, and 'Password' is empty.

Physical Config Desktop Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.168.100.100

Subnet Mask 255.255.255.0

Default Gateway 192.168.100.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::2D0:97FF:FE12:B59A

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

☐ Top

## SERVER-PT

The network diagram is identical to the one above, showing the 'External network' (red circle) and 'Internal network' (green circle) connected via 'Gig0/2' and 'Gig0/1' interfaces. The 'Server-PT' has IP 107.21.3.223/24 and the 'PC-PT BR\_PC' has IP 10.1.1.4/30. The Server-PT configuration window is open, showing the 'IP Configuration' tab. The 'Interface' is 'FastEthernet0'. The 'IP Configuration' section has 'Static' selected. The 'IPv4 Address' is '107.21.3.223', 'Subnet Mask' is '255.255.255.0', 'Default Gateway' is '107.21.3.1', and 'DNS Server' is '0.0.0.0'. The 'IPv6 Configuration' section has 'Static' selected. The 'IPv6 Address' is 'FE80::250:FFF:FE47:E51B', 'Link Local Address' is 'FE80::250:FFF:FE47:E51B', 'Default Gateway' is empty, and 'DNS Server' is empty. The '802.1X' section has 'Use 802.1X Security' unchecked, 'Authentication' set to 'MD5', 'Username' is empty, and 'Password' is empty.

Physical Config Services Desktop Programming Attributes

IP Configuration

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 107.21.3.223

Subnet Mask 255.255.255.0

Default Gateway 107.21.3.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::250:FFF:FE47:E51B

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

☐ Top

Cisco Packet Tracer - D:\CCNA\LAB 15 RHYTHM.pkt
File Edit Options View Tools Extensions Window Help
Logical Physical x: 742, y: 99
External network
Server-PT
www.netacad.com
107.21.3.223/24
Fa0
Gig0/2
2911 BR
Gig0/1
10.1.1.0/30
2911 BR\_R1
Gig0/0
10.1.1.4/30
2911 BR\_R2
Gig0/1
OSPF area 0
Gig0/0
Time: 25:10:53
Conner Straitht-Through

Server-PT
Physical Config Services Desktop Programming Attributes
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
IoT
VM Management
Radius EAP
DNS
DNS Service
On Off
Resource Records
Name
Type A Record
Address
Add Save Remove

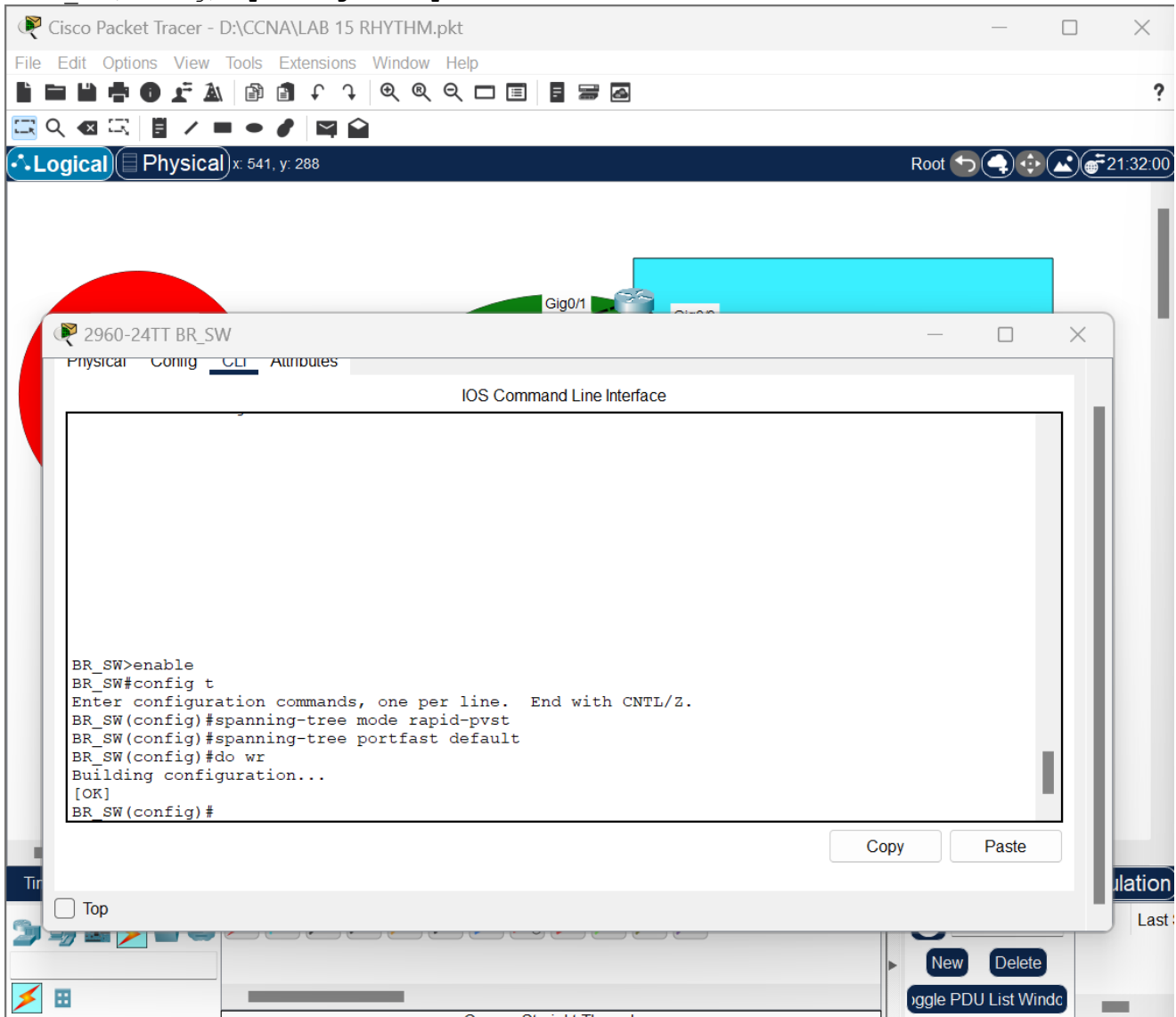
No.	Name	Type	Detail
0	www.netacad.com	A Record	107.21.3.223

DNS Cache

## Task 1: Configure STP

Configure BR\_SW to support Rapid-PVST+ and Port Fast. This will guarantee quicker failover of HSRP:

```
BR_SW>enable
BR_SW#config term
BR_SW(config)#spanning-tree mode rapid-pvst
BR_SW(config)#spanning-tree portfast default
```



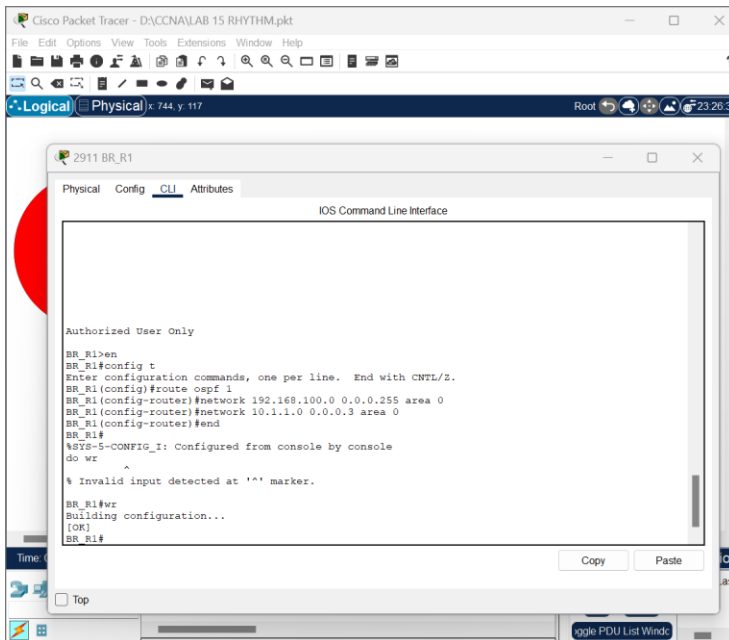
Your completion result should be 8%. If not, check for missing configuration statements.

## Task 2: Configure OSPF routing

Configure OSPF on ISP, BR\_R1 and BR\_R2. Assign all interfaces to Area 0, except for Gi0/2 on ISP. ISP will advertise a default route to BR\_R1 and BR\_R2.

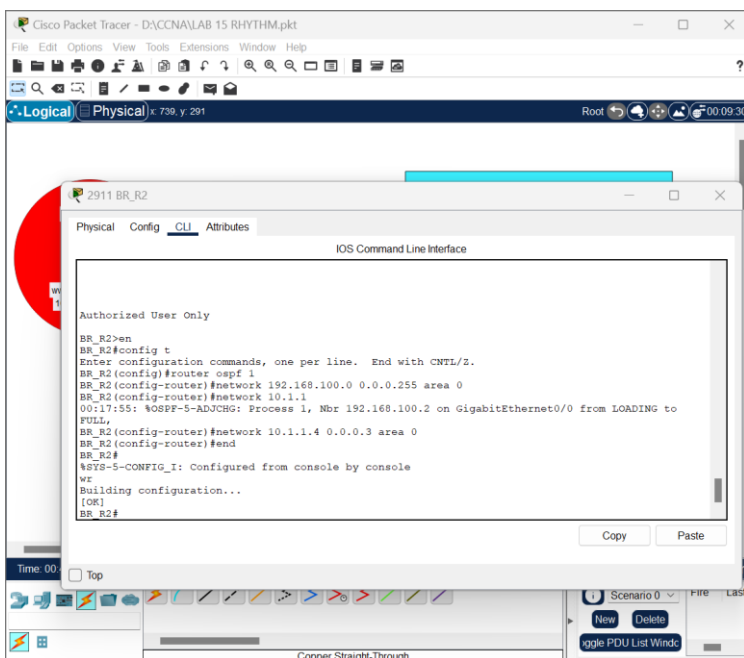
### Step 1. Enable OSPF on BR\_R1

```
BR_R1(config)#router ospf 1  
BR_R1(config-router)#network 192.168.100.0 0.0.0.255 area 0  
BR_R1(config-router)#network 10.1.1.0 0.0.0.3 area 0  
BR_R1(config-router)#end
```



### Step 2. Enable OSPF on BR\_R2

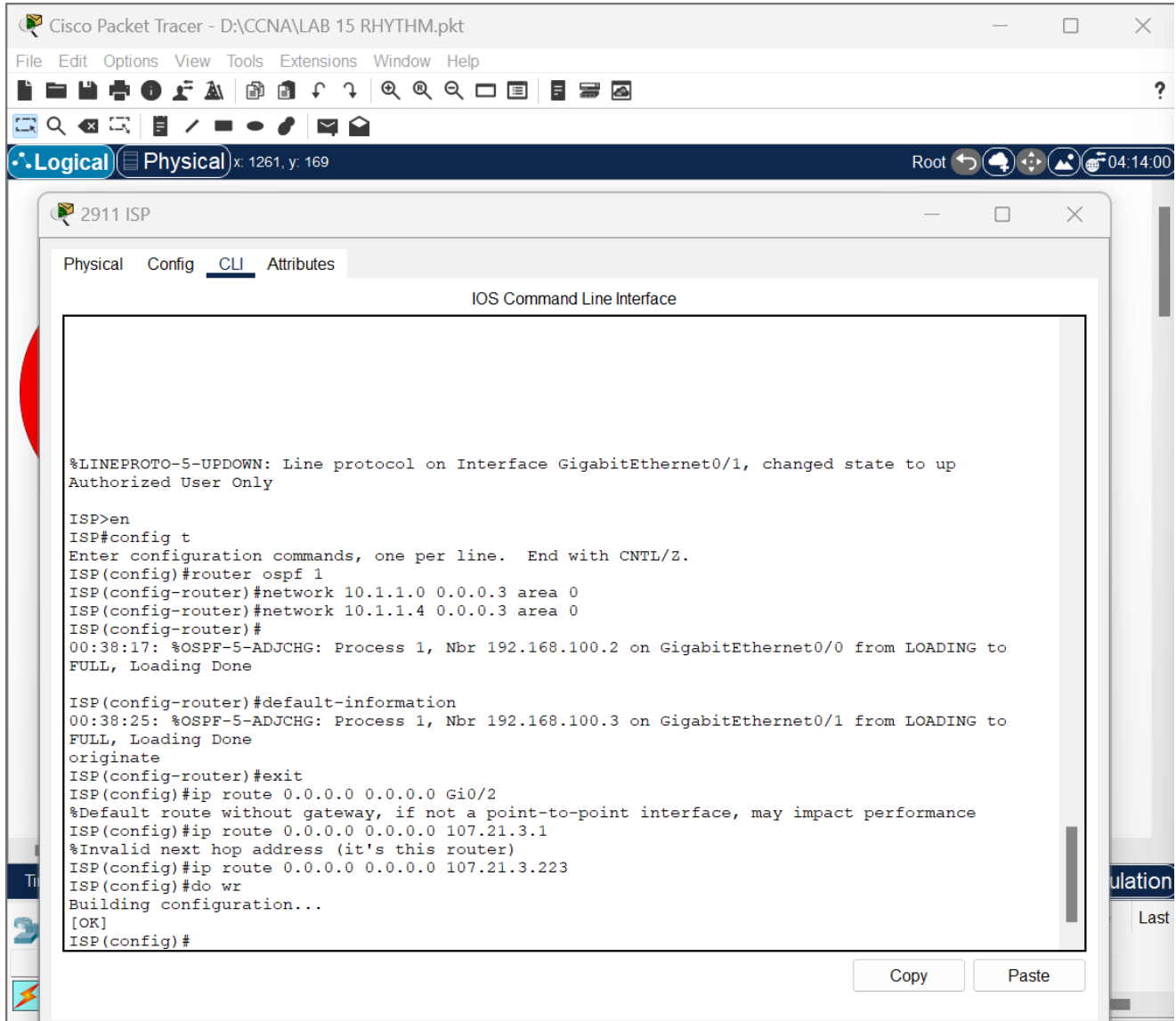
```
BR_R2(config)#router ospf 1  
BR_R2(config-router)#network 192.168.100.0 0.0.0.255 area 0  
BR_R2(config-router)#network 10.1.1.4 0.0.0.3 area 0  
BR_R2(config-router)#end
```





### Step 3. Enable OSPF on ISP

```
ISP(config)#router ospf 1
ISP(config-router)#network 10.1.1.0 0.0.0.3 area 0
ISP(config-router)#network 10.1.1.4 0.0.0.3 area 0
ISP(config-router)#default-information originate
ISP(config-router)#exit
ISP(config)#ip route 0.0.0.0 0.0.0.0 Gi0/2
```



#### Step 4. Verify routing

Use the **show ip route** command on BR\_R1 and BR\_R2 to verify that OSPF is operating correctly. Both routers should be receiving a default route (type O\*E2) from ISP.

BR\_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

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is 10.1.1.1 to network 0.0.0.0

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks

C 10.1.1.0/30 is directly connected, GigabitEthernet0/1

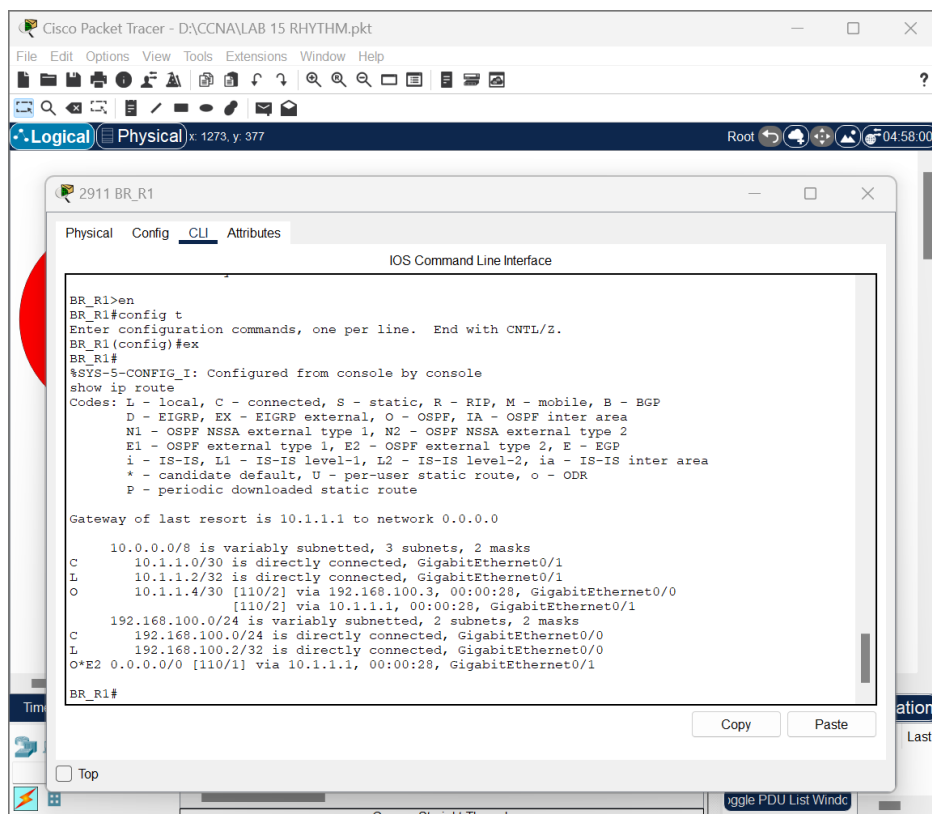
L 10.1.1.2/32 is directly connected, GigabitEthernet0/1

O 10.1.1.4/30 [110/2] via 192.168.100.3, 00:17:05, GigabitEthernet0/0  
[110/2] via 10.1.1.1, 00:17:05, GigabitEthernet0/1 192.168.100.0/24 is  
variably subnetted, 2 subnets, 2 masks

C 192.168.100.0/24 is directly connected, GigabitEthernet0/0

L 192.168.100.2/32 is directly connected, GigabitEthernet0/0

O\*E2 0.0.0.0/0 [110/1] via 10.1.1.1, 00:17:05, GigabitEthernet0/1



Your completion result should be 56%. If not, check for missing configuration statements.

### Task 3: Configure HSRP

Configure HSRP group 1 on BR\_R1 and BR\_R2 using 192.168.100.1 as the standby virtual IP address. By default, Packet Tracer supports HSRP version 2. BR\_R1 will be configured as the Active HSRP default-gateway and BR\_R2 will be configured as Standby. Preemption is configured on both routers.

#### Step 1. Enable HSRP on BR\_R1

```
BR_R1(config)#interface gi0/0
BR_R1(config-if)#standby 1 ip 192.168.100.1
BR_R1(config-if)#standby 1 preempt
```

The screenshot shows the Cisco Packet Tracer interface with a network diagram in the background. In the foreground, the CLI window for router 2911 BR\_R1 is open, displaying the following text:

```
Gateway of last resort is 10.1.1.1 to network 0.0.0.0

  10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.1.1.0/30 is directly connected, GigabitEthernet0/1
L       10.1.1.2/32 is directly connected, GigabitEthernet0/1
O       10.1.1.4/30 [110/2] via 192.168.100.3, 00:00:28, GigabitEthernet0/0
        [110/2] via 10.1.1.1, 00:00:28, GigabitEthernet0/1
  192.168.100.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.100.0/24 is directly connected, GigabitEthernet0/0
L       192.168.100.2/32 is directly connected, GigabitEthernet0/0
O*E2   0.0.0.0/0 [110/1] via 10.1.1.1, 00:00:28, GigabitEthernet0/1

BR_R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
BR_R1(config)#interface Gi0/0
BR_R1(config-if)#standby 1 ip 192.168.100.1
BR_R1(config-if)#standby 1 preempt
BR_R1(config-if)#
%HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1 state Speak -> Standby
%HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1 state Standby -> Active
```

At the bottom of the CLI window, there are 'Copy' and 'Paste' buttons. The background network diagram shows a red circular cloud labeled 'External network' connected to a green router labeled 'Gig0/1', which is connected to a blue router labeled 'Gig0/0'.

## Step 2. Enable HSRP on BR\_R2

```
BR_R2(config)#interface gi0/0
BR_R2 (config-if)#standby 1 ip 192.168.100.1
BR_R2 (config-if)#standby 1 priority 95
BR_R2 (config-if)#standby 1 preempt
```

The screenshot displays the Cisco Packet Tracer interface. The main window shows the 'Physical' tab selected, with a red circle highlighting the 'CLI' tab of the '2911 BR\_R2' device. The CLI window shows the following commands and output:

```
Authorized User Only

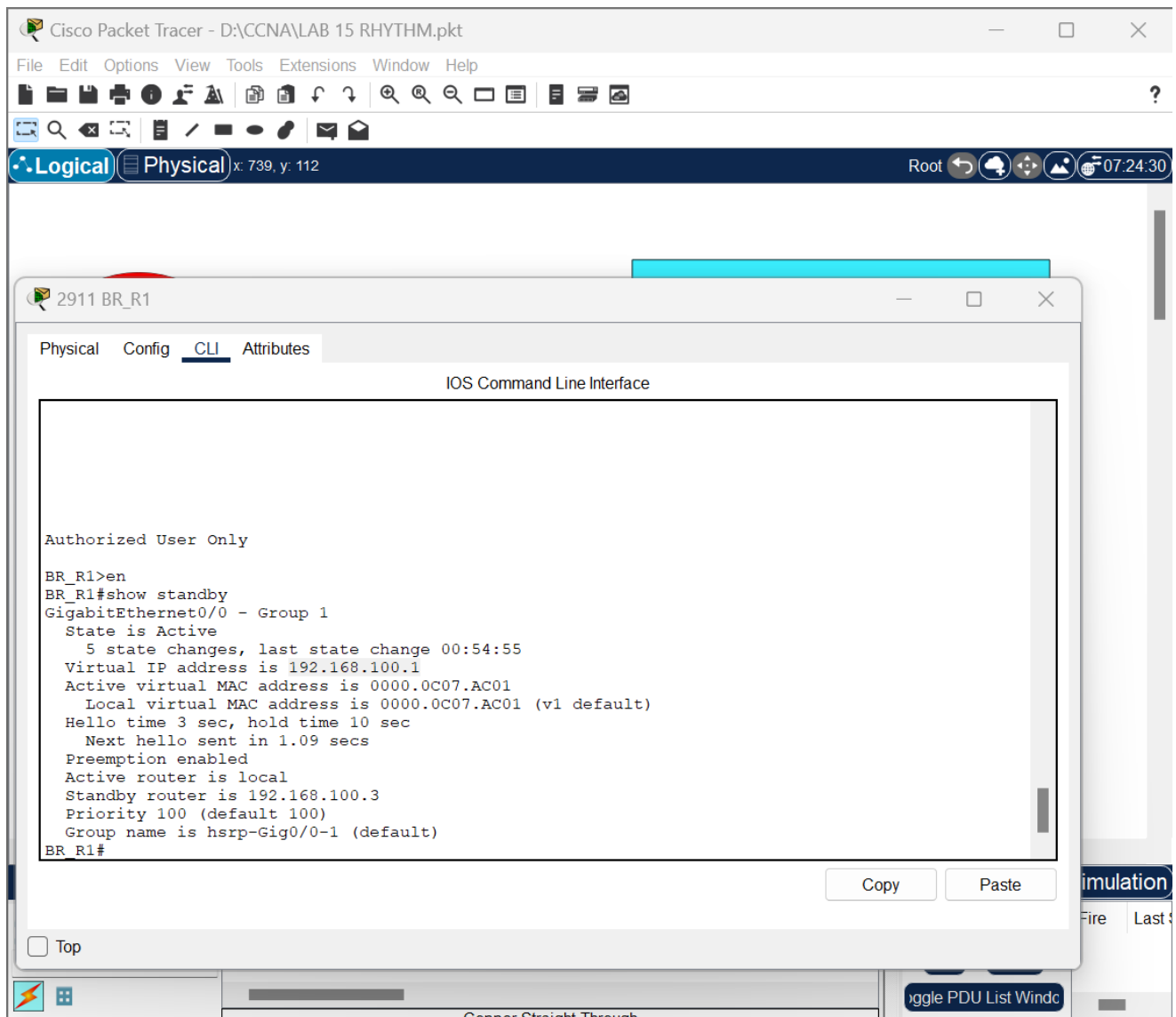
BR_R2>en
BR_R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
BR_R2(config)#int Gi0/0
BR_R2(config-if)#standby 1 ip 192.168.100.1
BR_R2(config-if)#standby 1 priority 95
BR_R2(config-if)#standby 1 preempt
BR_R2(config-if)#
%HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1 state Speak -> Standby
```

Below the CLI window, the 'Top' checkbox is visible. The bottom status bar shows the time as 25:00:04 and the simulation mode as 'Realtime'. The bottom toolbar includes icons for various tools, and the bottom right corner shows the 'Scenario 0' dropdown and 'New' and 'Delete' buttons.

### Step 3. Verify HSRP

After a few moments, use the **show standby** and **show standby brief** commands on BR\_R1 and BR\_R2 to verify that HSRP is operating correctly. BR\_R1 should be the Active router and BR\_R2 should be Standby.

BR\_R1#**show standby**



GigabitEthernet0/0 - Group 1 (version 2)

State is **Active**

5 state changes, last state change 00:00:19

Virtual IP address is **192.168.100.1**

Active virtual MAC address is 0000.0C9F.F001

Local virtual MAC address is 0000.0C9F.F001 (v2 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.314 secs

Preemption enabled

Active router is local

Standby router is 192.168.100.3  
Priority 100 (default 100)  
Group name is hsrp-Gig0/0-1 (default)

BR\_R1#show standby brief

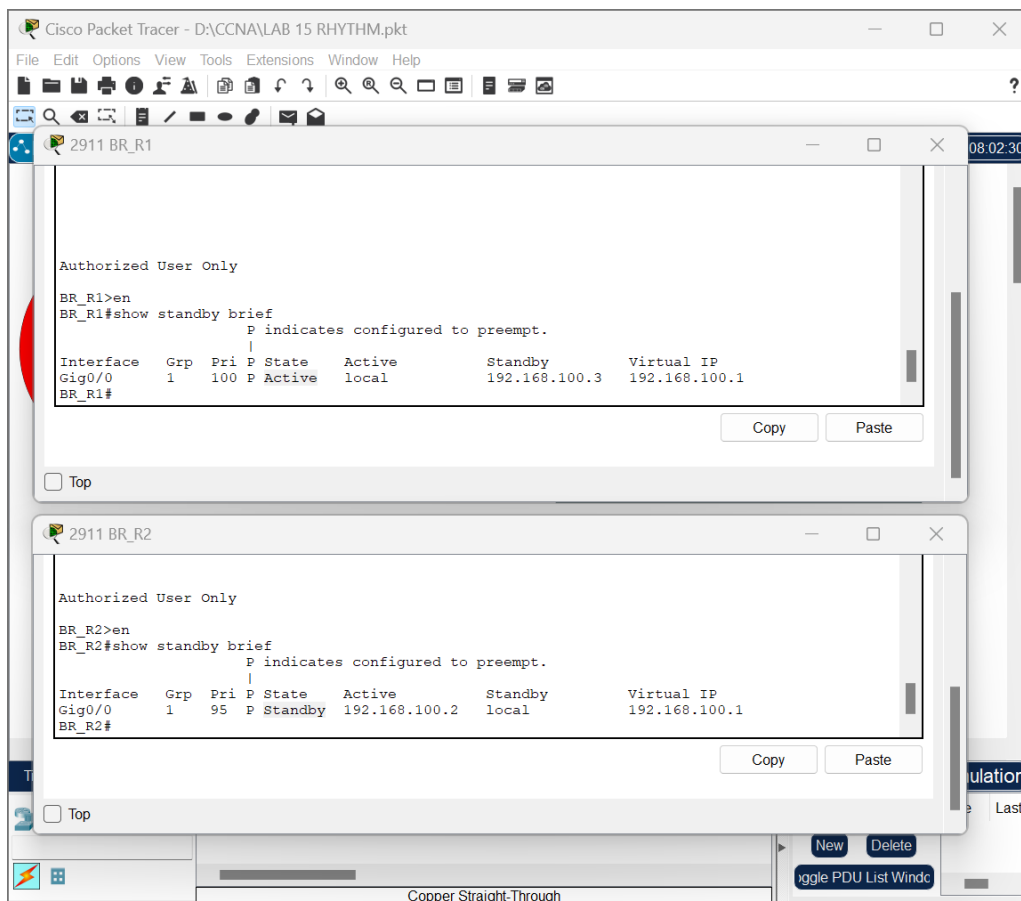
P indicates configured to preempt.  
|

Interface	Grp	Pri	P	State	Active	Standby	Virtual IP
Gig0/0	1	100	P	Active	local	192.168.100.3	192.168.100.1

BR\_R2#sh standby brief

P indicates configured to preempt.  
|

Interface	Grp	Pri	P	State	Active	Standby	Virtual IP
Gig0/0	1	95	P	Standby	192.168.100.2	local	192.168.100.1

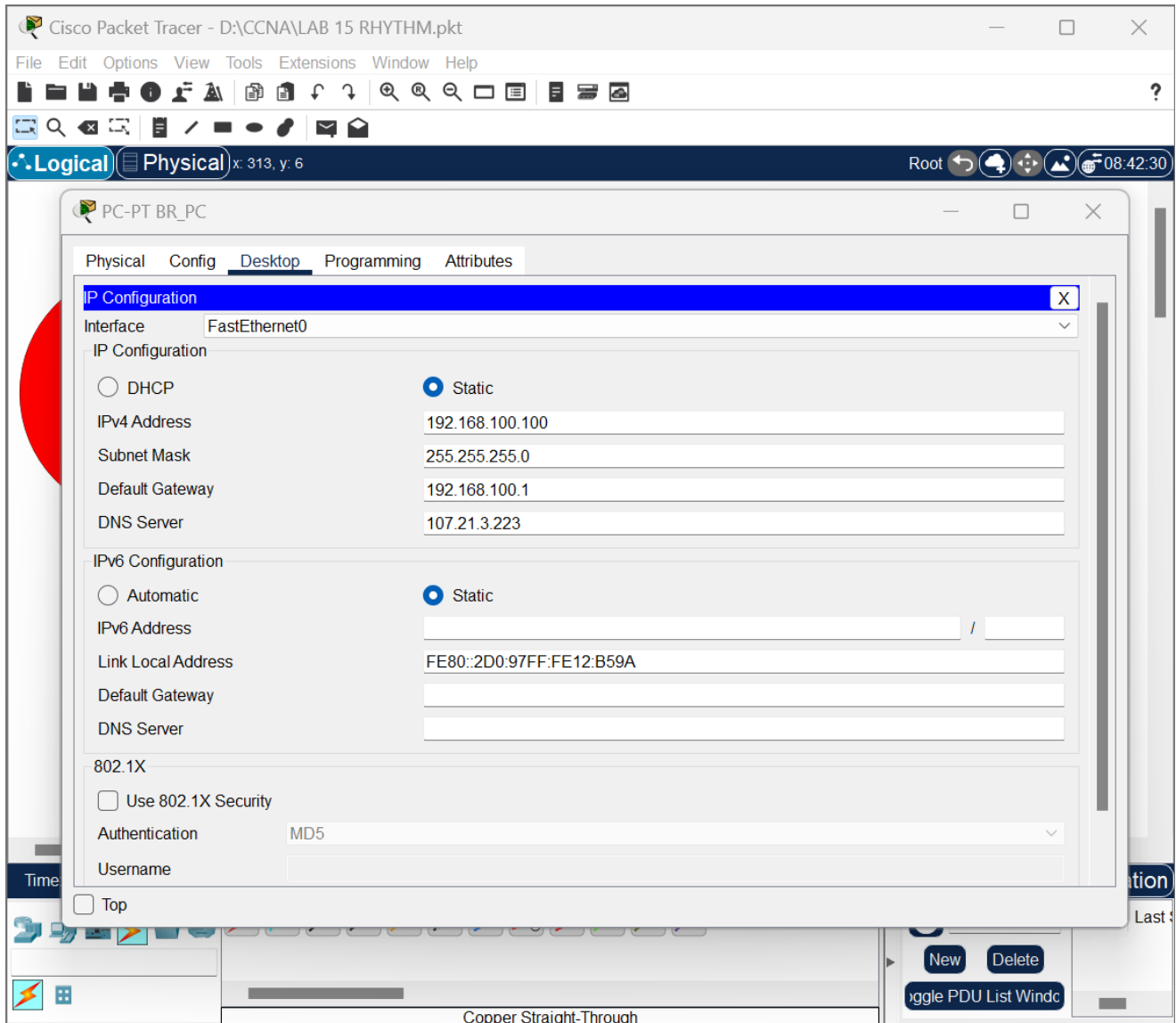


Your completion result should be 82%. If not, check for missing configuration statements.

## Task 4: Configure Ethernet interface on host PC and test HSRP failover functionality

### Step 1. Configure host PC

Configure the NIC on BR\_PC according to the information in the table. Also configure BR\_PC to use **107.21.3.223** as its DNS server.



### Step 2. Test connectivity using Ping

Use a command prompt on BR\_PC to Ping the server using the URL <http://www.netacad.com>

```
PC>ping www.netacad.com
```

```
Pinging 107.21.3.223 with 32 bytes of data:
```

```
Reply from 107.21.3.223: bytes=32 time=13ms TTL=126
```

```
Reply from 107.21.3.223: bytes=32 time=1ms TTL=126
```

```
Reply from 107.21.3.223: bytes=32 time=0ms TTL=126
```

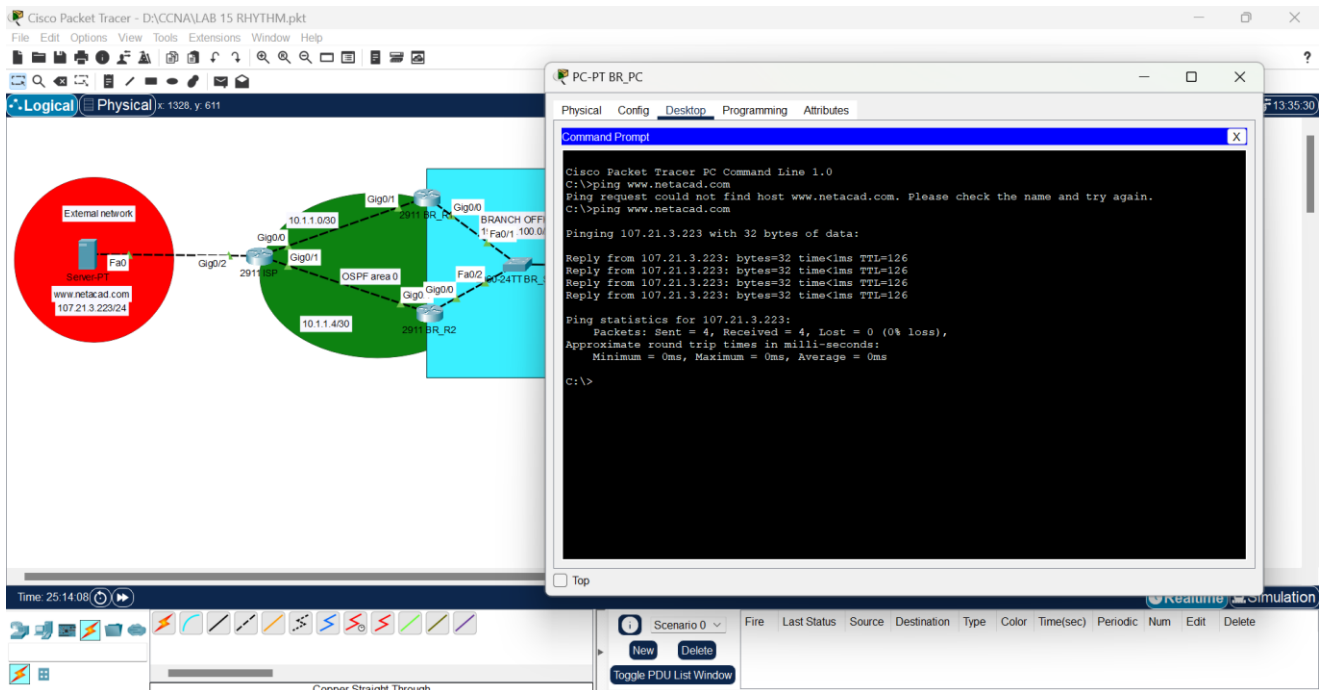
```
Reply from 107.21.3.223: bytes=32 time=1ms TTL=126
```

Ping statistics for 107.21.3.223:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

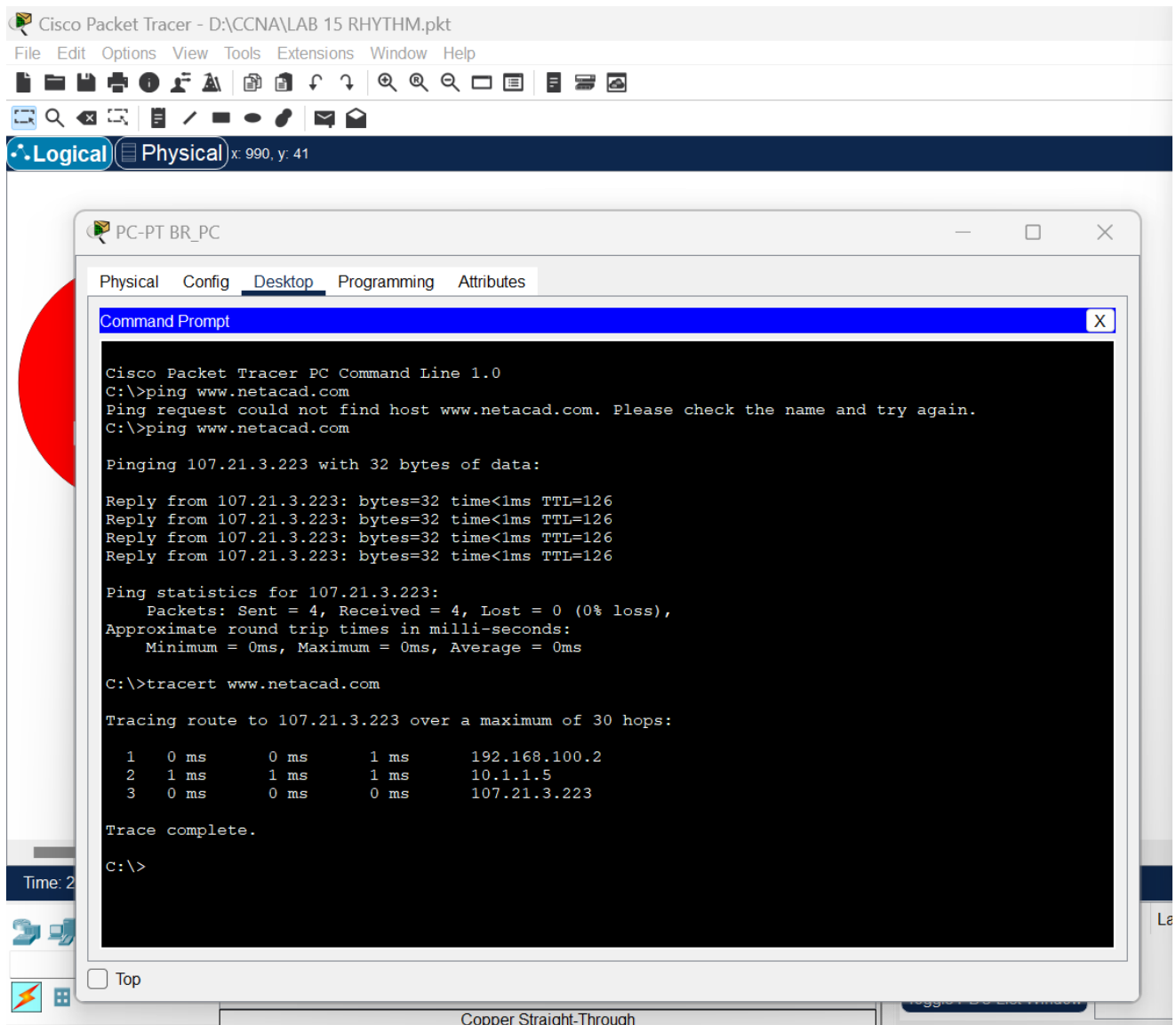
Minimum = 0ms, Maximum = 13ms, Average = 3ms





### Step 3. Test connectivity using Tracert

Use a command prompt to trace the physical path taken from BR\_PC to the Server. Confirm that the first hop is the physical address of BR\_R1 Gi0/0 interface (192.168.100.2)



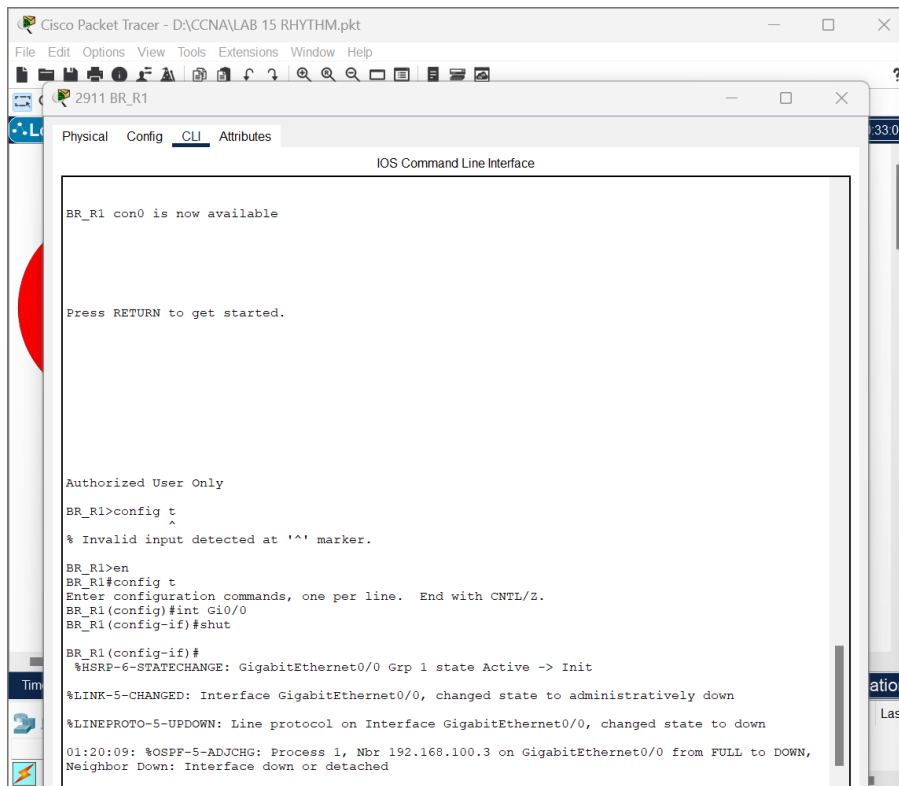
PC>**tracert www.netacad.com**

Tracing route to 107.21.3.223 over a maximum of 30 hops:

1	1 ms	0 ms	1 ms	192.168.100.2
2	1 ms	0 ms	0 ms	10.1.1.5
3	0 ms	1 ms	0 ms	107.21.3.223

Trace complete.

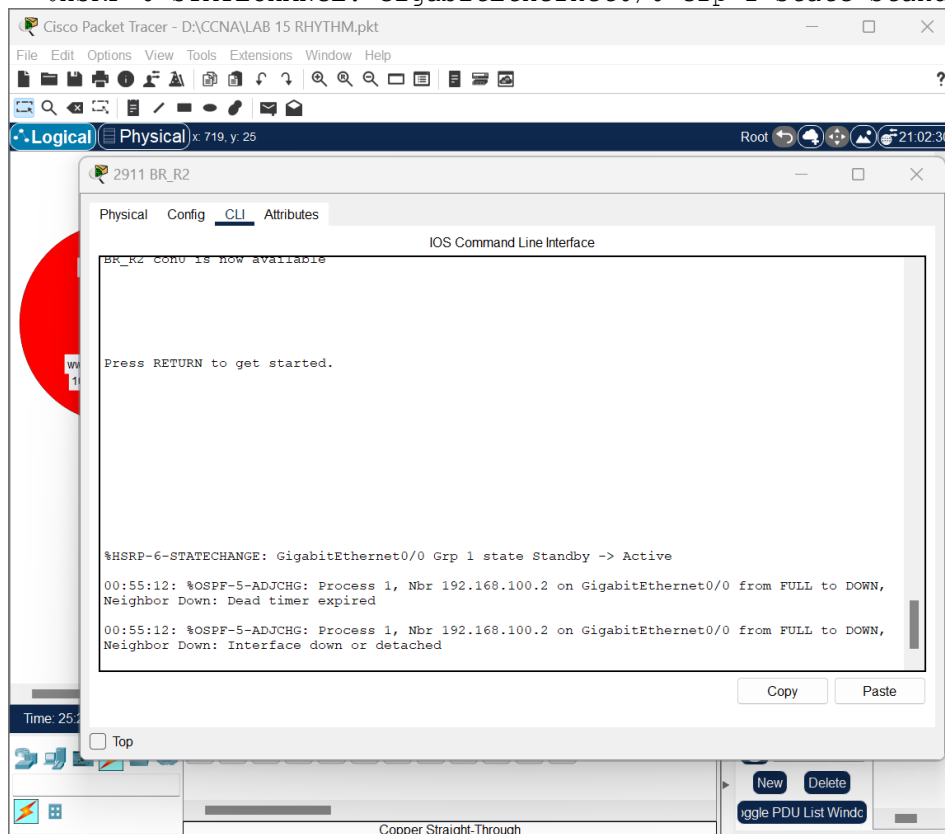




Notice that BR\_R2 becomes the new Active router.

BR\_R2#

%HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1 state Standby -> Active



Notice what occurs on BR\_PC. A change in physical gateway has occurred, but this is transparent to the host PC. It is possible for one or two pings to drop depending on how quickly BR\_R2's hold time expires. The default hold time for HSRP is 10 seconds.

```
Reply from 107.21.3.223: bytes=32 time=0ms TTL=126
```

```
Reply from 107.21.3.223: bytes=32 time=0ms TTL=126
```

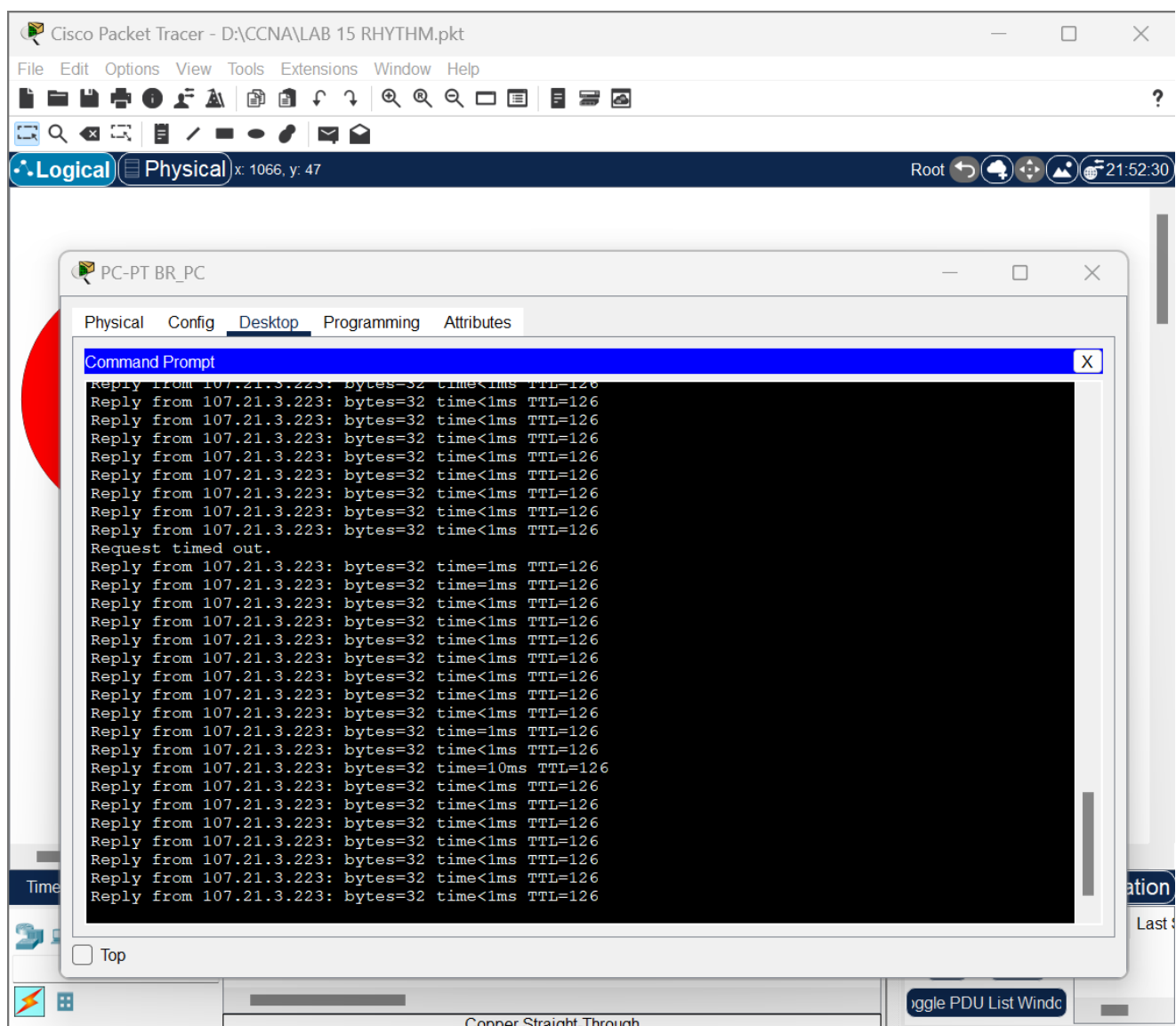
```
Reply from 107.21.3.223: bytes=32 time=0ms TTL=126
```

```
Request timed out.
```

```
Reply from 107.21.3.223: bytes=32 time=1ms TTL=126
```

```
Reply from 107.21.3.223: bytes=32 time=1ms TTL=126
```

```
Reply from 107.21.3.223: bytes=32 time=1ms TTL=126
```



Your completion result should be 100%. If not, check for missing configuration statements.

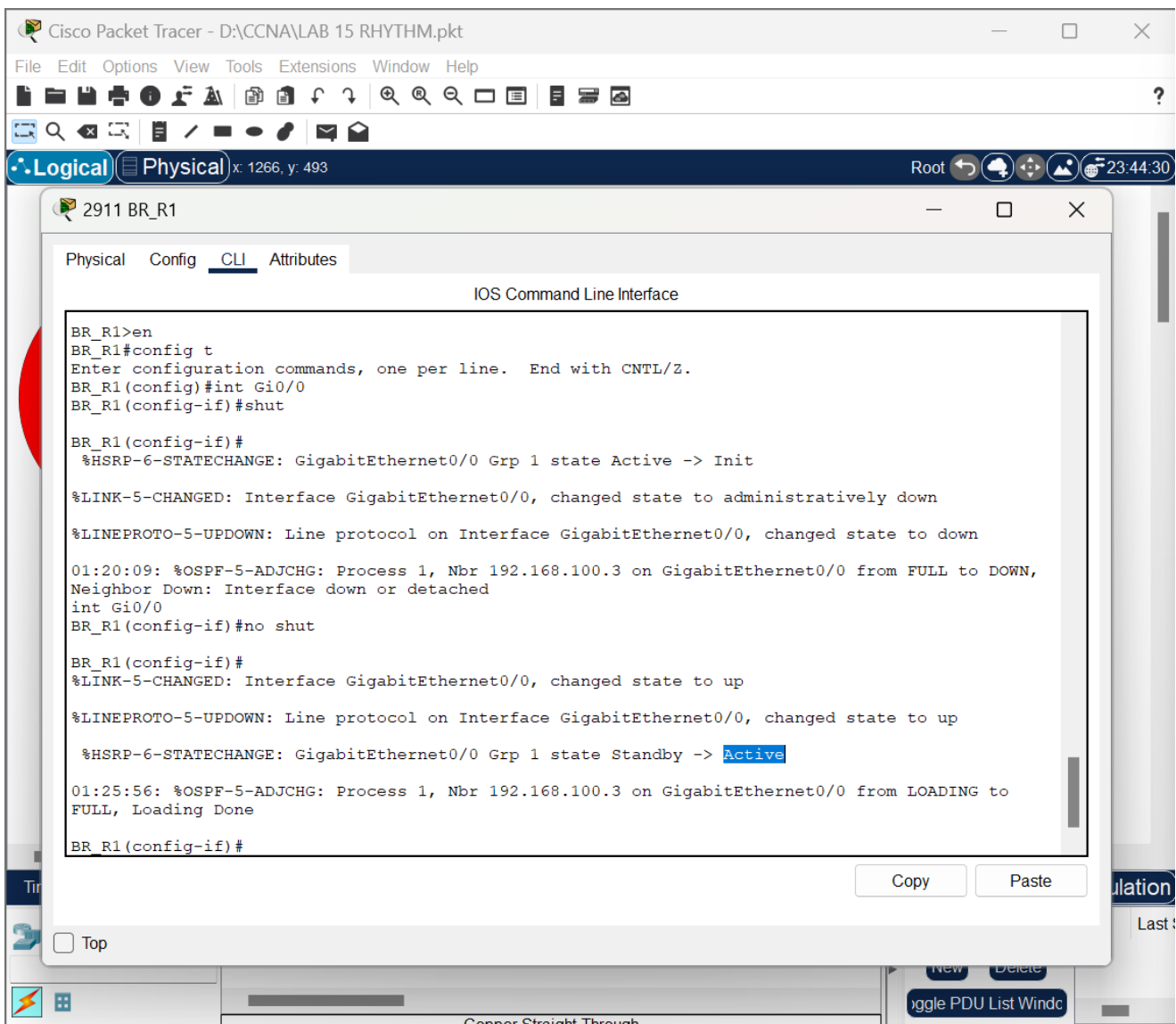
## Task 5: Verify HSRP packet exchange

### Step 1. Activate BR\_R1 Gi0/0 interface to allow the router to reclaim the Active status

```
BR_R1#config term
BR_R1 (config) #interface gi0/0
BR_R1 (config-if) #no shutdown
BR_R1 (config-if) #

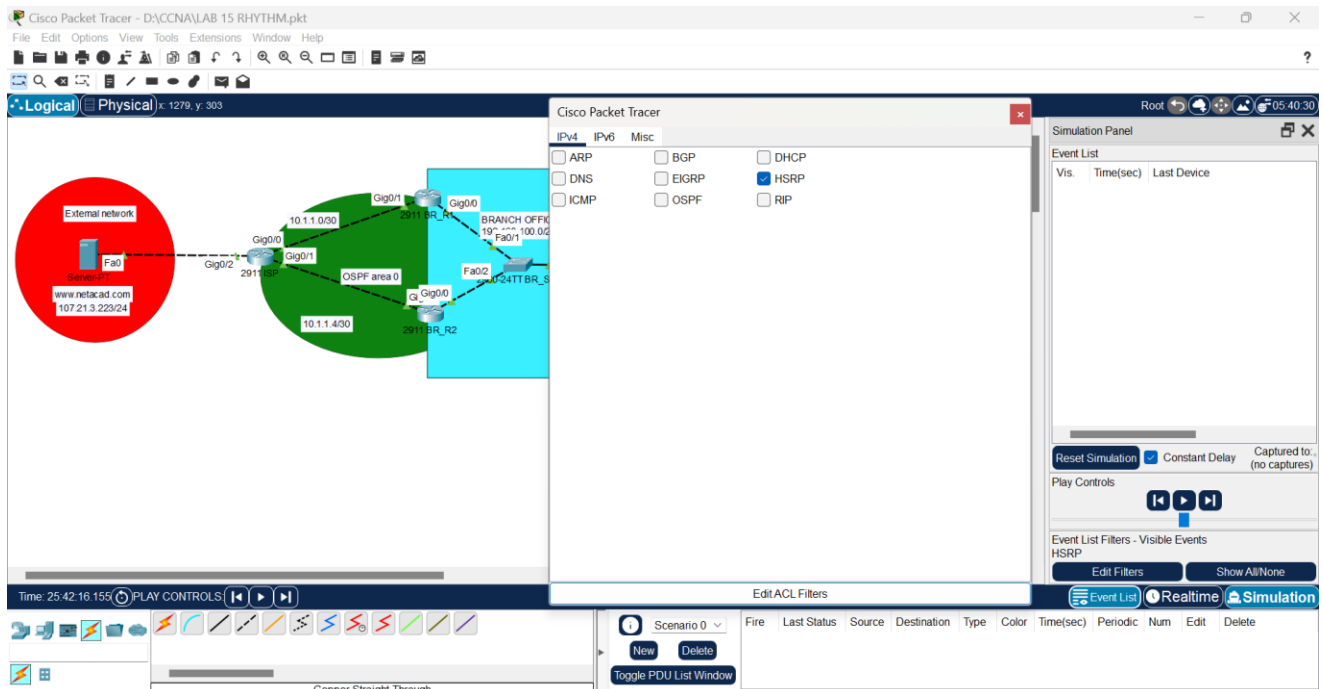
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed
state to up

%HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1 state Standby -> Active
BR_R1 (config-if) #
```

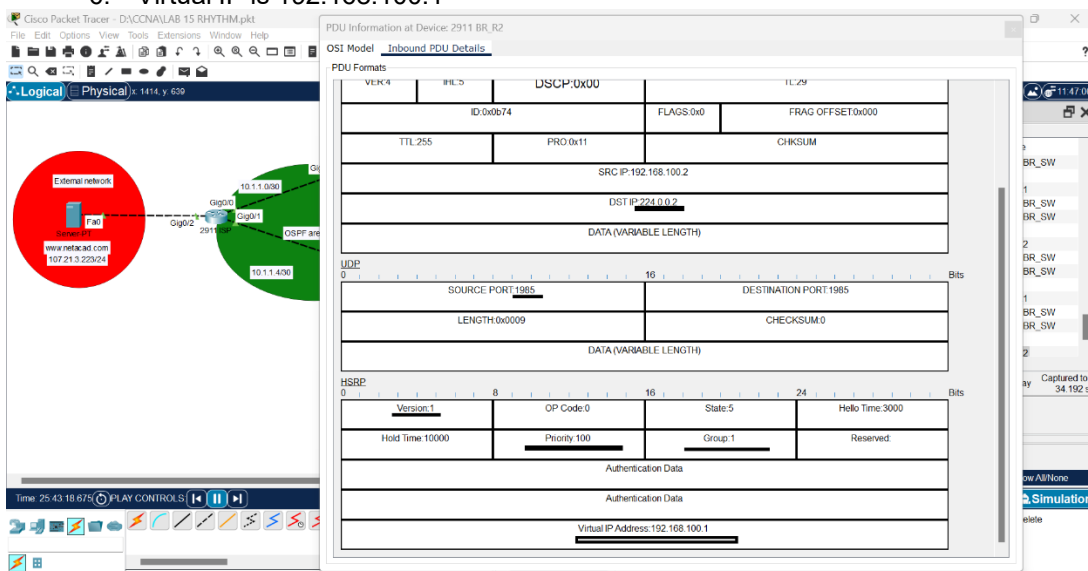


## Step 2. Use Simulation mode to view HSRP Hello packets

Enter Simulation mode. Select only HSRP in the filter window. Click Auto Capture / Play to see the multicast HSRP Hello packets being sent and received by both BR\_R1 and BR\_R2. Confirm the following by observing the PDU details of some of the packets:



1. Destination IP address is 224.0.0.2 instead of 224.0.0.102
2. UDP port is 1985
3. HSRP version is 1 instead of 0x2
4. Priority is either 100 or 95 depending on Hello viewed.
5. Group number is 1
6. Virtual IP is 192.168.100.1



### Step 3. Use Simulation mode to view ICMP packet flow from BR\_PC to Netacad server

Create a complex PDU. Use 192.168.100.100 as the source IP address. Use 107.21.3.223 as the destination IP address. Use a sequence number of 1 and configure a one-shot time of 5 seconds. Use the Capture/Forward button to view the ICMP packet flow to and from the Netacad server, **via the BR\_R1 router**.

Time: 25:45:07.660 PLAY CONTROLS

Scenario 0

New Delete

Toggle PDU List Window

Cooper Straight-Through

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
Visible	1.168	2911 BR_R1

Reset Simulation Constant Delay Captured to: 1.169 s

Play Controls

Event List Filters - Visible Events

HSRP

Edit Filters Show All/None

Event List Realtime Simulation

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC-P...	107.21.3.223	ICMP		5.000	N	0	(edit)	(delete)

Delete the cable between BR\_R1 and BR\_SW. Run the simulation again and view the packets flow to and from the server **via BR\_R2** after it has become the new Active HSRP router.

Time: 25:45:25.640 PLAY CONTROLS

Scenario 0

New Delete

Toggle PDU List Window

Cooper Straight-Through

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	2.480	
	2.481	2911 BR_R2
	2.482	2960-24TT BR_SW
	5.070	
	5.071	2911 BR_R2
	5.072	2960-24TT BR_SW
Visible	7.983	

Reset Simulation Constant Delay Captured to: 7.983 s

Play Controls

Event List Filters - Visible Events

HSRP

Edit Filters Show All/None

Event List Realtime Simulation

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC-P...	107.21.3.223	ICMP		5.000	N	0	(edit)	(delete)