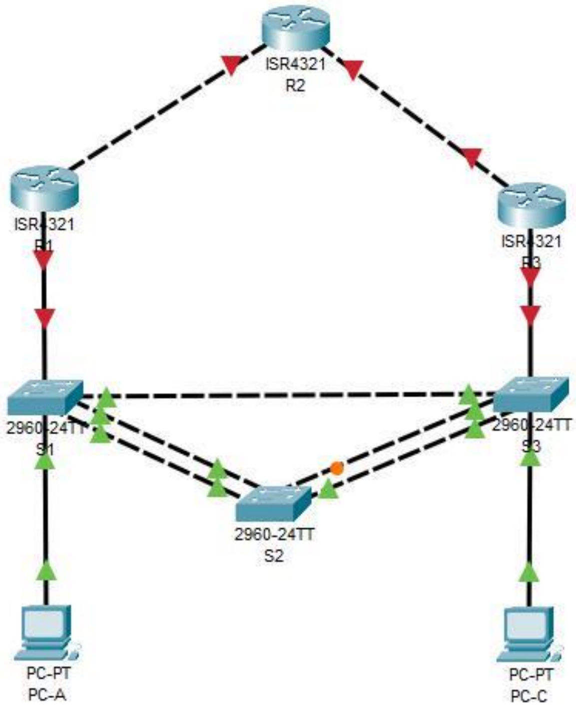
## CCNA SRWE Lab 2 Instruction Deadline: 12.2.2021

## Name: Rubaiya Kabir Pranti

# Spanning Tree Protocols

# EtherChannel

# HSRP Redundancy



## NP Course NP Chapter 9

## SRWE Modules 5 - 9:

## Redundant Networks Exam

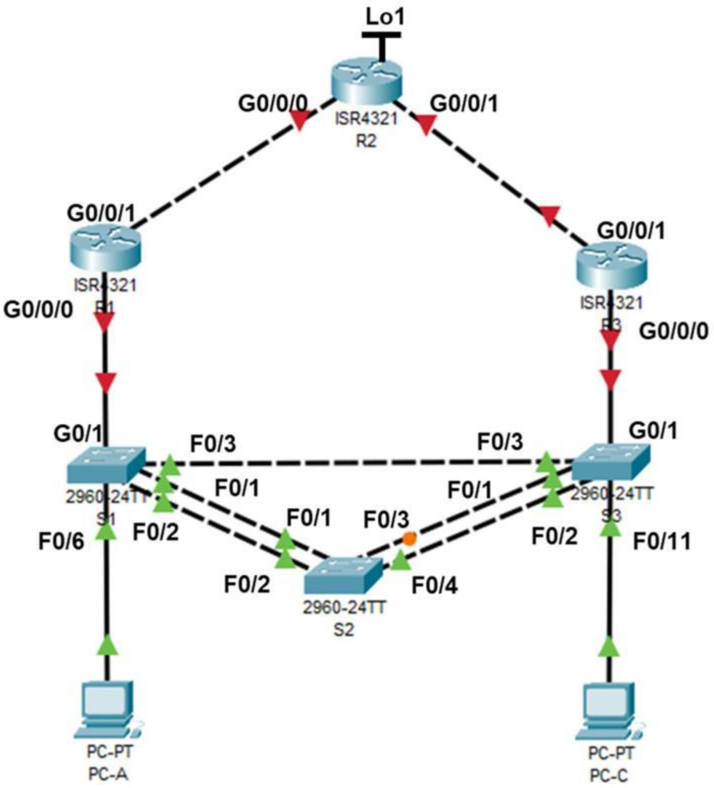
## Available and Reliable Networks Exam

## Answers and Solutions

Write your answers in **red color**. You may use the comment capabilities of the free Adobe reader.

# Task 1 – Examine STP protocols

## Packet Tracer Topology



## Addressing Table

| Device | Interface | IP Address | Subnet Mask | Default Gateway |
|---|---|---|---|---|
| R1 | G0/0/0 | 192.168.10.1 | 255.255.255.0 | N/A |
| | G0/0/1 | 10.1.1.1 | 255.255.255.252 | N/A |
| R2 | G0/0/0 | 10.1.1.2 | 255.255.255.252 | N/A |
| | G0/0/1 | 10.2.2.2 | 255.255.255.252 | N/A |
| | Lo1 (loopback) | 209.165.200.225 | 255.255.255.224 | N/A |
| R3 | G0/0/0 | 192.168.10.3 | 255.255.255.0 | N/A |
| | G0/0/1 | 10.2.2.1 | 255.255.255.252 | N/A |
| S1 | VLAN 99 | 192.168.99.11 | 255.255.255.0 | 192.168.99.1 |
| S2 | VLAN 99 | 192.168.99.12 | 255.255.255.0 | 192.168.99.1 |
| S3 | VLAN 99 | 192.168.99.13 | 255.255.255.0 | 192.168.99.1 |
| PC-A | NIC | 192.168.10.11 | 255.255.255.0 | 192.168.10.1 |
| PC-C | NIC | 192.168.10.33 | 255.255.255.0 | 192.168.10.3 (!) |

### VLAN Assignments

| VLAN | Name |
|---|---|
| 10 | User |
| 99 | Management |

## Part 1: Set Up Network Topology and Initialize Devices

### Step 1: Build topology in Packet Tracer.

**COVID-19 Version:** Build topology in **Packet Tracer**. Use and re-label the following devices:

a. Build the network with ISR4321 router, 2960 switches, and PCs in Packet Tracer. Rename the devices.

b. Cable the network according to the topology with straight-through TP cables and cross-over cables .

c. We will use the CLI window of the network devices directly for configurations.

d. Configure IP address, net mask and default gateway for PC-A, and PC-C.

### Step 2: Configure some basic settings for switches S1, S2 and S3.

Double-click network devices and use the CLI window. When network device is booting up, skip any automatic configuration.

For Switch S1, S2, and S3, perform the following tasks:

a. Disable DNS lookup.

b. Configure device name

c. Assign **class** as the privileged EXEC encrypted password.

a) Assign **cisco** as the console password, enable login, configure **logging synchronous** to prevent console messages from interrupting.

d. Configure password encryption

e. Save your running configuration in the startup configuration.

## Part 2: Configure VLANs and Trunks

### Step 1: VLANs and Access Ports

a. **Create** VLAN 10 (name User) and VLAN 99 (name Management) on all of the switches.

b. Configure **access ports** with VLAN 10:

**-**switch S1 port F0/6 and switch S3 port F0/11

### Step 2: Trunk ports and native VLAN 99.

a. For all ports interconnecting switches, S1 (F0/1, F0/2, F0/3), S2 (F0/1, F0/2, F0/3, F0/4), S3 (F0/1, F0/2, F0/3) enable and configure trunk ports

- assign native VLAN 99
- allow all configured VLANs

### Step 3: Management Interface SVI.

a. Configure the SVI VLAN 99 and apply the IP addresses from Addressing Table on all switches.

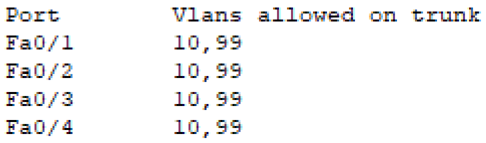
b. Add the Default Gateway 192.168.99.1 to all switches.

### Step 4: Verify configurations and connectivity.

a. Use the **show vlan brief** command on S1. Which Port is assigned to VLAN 10? **user**

b. Use the **show interfaces trunk** command on S2.

- Which ports are trunk ports? **f0/1-f0/4**
- Which VLANs are allowed on all trunks?



```
Port        Vlans allowed on trunk
Fa0/1       10,99
Fa0/2       10,99
Fa0/3       10,99
Fa0/4       10,99
```

c. Configure PC-A and PC-C.

By pinging, verify connectivity from PC-A to PC-C. Connectivity is given (y/n)? **no**

## Part 3: Set Root Bridge and Examine PVST+ Convergence

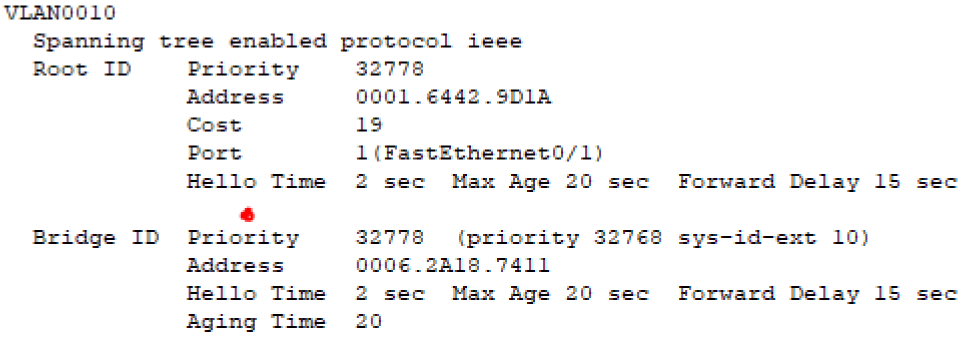
### Step 1: Determine the current root bridge.

**Note**: There are three instances of the spanning tree on each switch. The default STP configuration on Cisco switches is PVST+, which creates a separate spanning tree instance for each VLAN (VLAN 1 and any user-configured VLANs).

Use the command **show spanning-tree** on all three switches to determine the answers to the following questions:

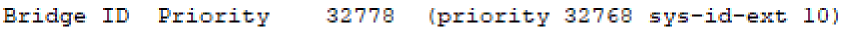
Record the bridge priority for **VLAN 10** in switch S1, S2, and S3:

S1



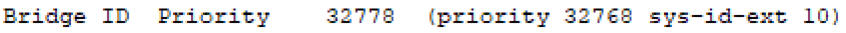
```
VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    32778
             Address     0001.6442.9D1A
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
             Address     0006.2A18.7411
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
```

S2



```
Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
```

S3



```
Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
```

Which switch is the root bridge for **VLAN10**? **S2**

Why was this switch elected as the root bridge for **VLAN10**? **S2 is the central switch to allow minimum path to others.**

### Step 2: Primary and secondary root bridge for all existing VLANs.

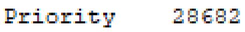
Having a root bridge (switch) elected by MAC address may lead to a suboptimal configuration. In this lab, you will configure switch S2 as the root bridge and S1 as the secondary root bridge.

a. Configure switch S2 to be the **primary root bridge** for VLAN 10.

b. Configure switch S1 to be the **secondary root bridge** for VLAN 10.

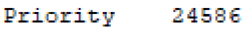
c. Use the **show spanning-tree vlan 10** command to answer the following questions:

What is the bridge priority of S1 for VLAN 10 now?



```
Priority    28682
```

What is the bridge priority of S2 for VLAN 10 now? **This bridge is the root**



```
Priority    24586
```

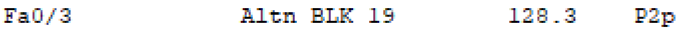
According to STP algorithm, which interfaces in the lab network should be blocked in the VLAN 10 spanning-tree (record switch name and interfaces, (Sx Fa0/y)):
**S1 Fa0/2**
**S2 none**

Check by **show spanning-tree vlan 10** which interfaces in the network are in blocking state in VLAN 10:

### Step 3: Change the Layer 2 topology and examine PVST+ convergence.

To examine PVST+ convergence, you will create a Layer 2 topology change.

a. Record (**show spanning-tree vlan 10**) the state of interface F0/3 in VLAN 10 at switch S3:

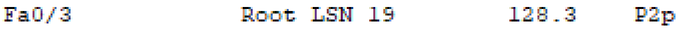


```
Fa0/3           Altn BLK 19        128.3    P2p
```

b. Create a topology change in VLAN 10 by disabling interface range **F0/1-2** on S3.

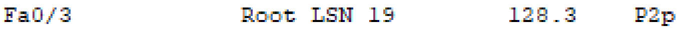
```
S3(config)#interface range f0/12
S3(config-if)#shutdown
```

c. Name the port states of PVST+ (Per VLAN-STP), which interface **F0/3** should walk through during network convergence:



```
Fa0/3           Root LSN 19        128.3    P2p
```

Record (**show spanning-tree vlan 10**) the state of interface F0/3 in VLAN 10 at switch S3 again:



```
Fa0/3           Root LSN 19        128.3    P2p
```

d. **(Skipped)** In **non-COVID-19** times, you would use debugging of spanning-tree (**S3#debug spanning- tree**) to record the convergence time with real switches.

Using the time stamp from the first and last STP debug message, calculate the time in seconds that it took for the network to converge. **Hint**: The debug timestamp format is **date hh.mm.ss:msec**.

**Result: ~ 30 sec.**

## Part 4: Rapid PVST+ plus PortFast and BPDUGuard

### Step 1: Rapid PVST+.

a. Configure all switches S1, S2, and S3, for using Rapid PVST+.

### Step 2: Examine Rapid PVST+ convergence.

a. **(Must do)** Create a topology change by enabling interface range **F0/1-2** on S3 again.

```
S3(config)#interface range f0/1-
2 S3(config-if)#no shutdown
```

b. **(Skipped)** you would use debugging of spanning-tree (**S3#debug spanning-tree**) to record the convergence time with real switches.

After all messages of the topology change have been received stop debug mode by the command **no debug spanning-tree events.**

Using the time stamp from the first and last Rapid RSTP debug message, calculate the time that it took for the network to converge.

**Result: < 1ms**

### Step 3: PortFast and BPDUGuard

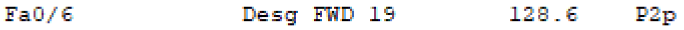
**PortFast** is a feature of spanning tree that transitions a port immediately to a forwarding state as soon as it is turned on. This is useful in connecting hosts so that they can start communicating on the VLAN instantly, rather than waiting on spanning tree.

**BPDUGuard** prevents form STP attack from access ports

a. Configure all access ports on switch S1 and S3 with PortFast mode.

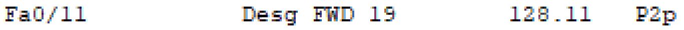
In which state are switch ports, which have been configured with PortFast?

**S1:**



```
Fa0/6               Desg FWD 19         128.6    P2p
```

**S3:**



```
Fa0/11              Desg FWD 19         128.11   P2p
```

b. Configure all access ports on switch S1 and S3 to be protected against STP attacks.

Record the status of Port F0/11 at switch S3:

**role: Designated port**

**status: forwarding**

## Reflections

a. What is the main benefit of using Rapid PVST+?

**allows faster spanning-tree calculations and convergence in response and provides optimized performance (ref)**

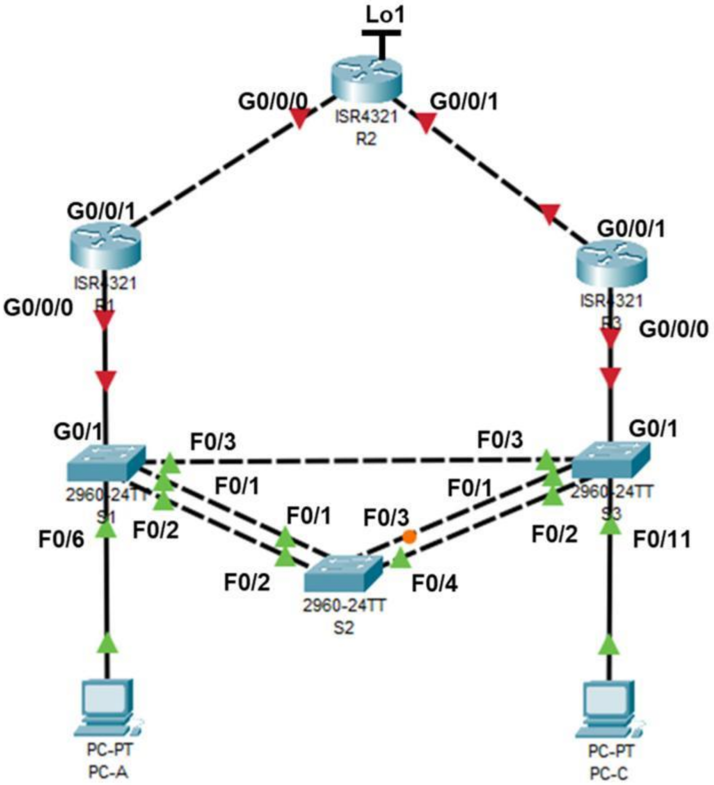
b. How does configuring a port with PortFast allow for faster convergence?

**permits for an access port to transit into a forwarding status which minimizes convergence time.**

c. Any idea how BPDU guard prevents from STP initiated denial-of-service (DOS) attacks?
**If a port is BPDU guard enabled and it gets BPDU, the port gets disabled. Also violation of policy is reported and gets stopped in such a way**. (ref)

# Task 2 - LACP EtherChannel Link Aggregation

### Packet Tracer Topology



We continue with the PT Topology and Addressing Table.

## Part 1: Configure Link Aggregation Control Protocol (LACP)

LACP is a link aggregation protocol developed by the IEEE. In this Part, the link between S1 and S2, and the link between S2 and S3 will be configured using LACP.

### Step 1: Configure LACP between S1 and S2.

a. Configure the link between S1 and S2 as channel-group 2 (Po2)

- Use LACP as the link aggregation protocol.
- Switch S1 shall get EtherChannel mode **active**, switch S2 EtherChannel shalle get EtherChannel mode **passive**.

b. Configure channel-groups to be trunk ports with the same trunk conditions of Task 1.

c. Verify that the ports have been aggregated. Use **show etherchannel summary**.

- What protocol is Po2 using for link aggregation? **LACP**
- Which interface name is given to the aggregated link? **Po2(SD)**
- Which state information (flags) are given for this interface? **Fa0/1(I) Fa0/2(I) Fa0/3(I)**
  **I-stand alone**
- How many channel groups are in use? **ONLY 1**

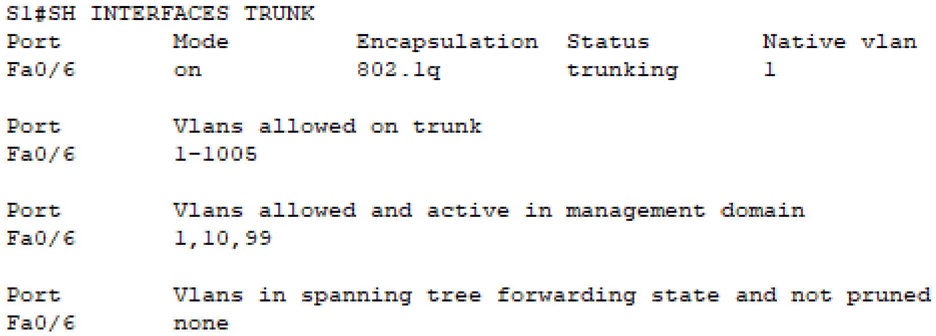
### Step 2: Verify that the ports are configured as trunk ports.

a. Issue the **show interfaces trunk** command on S1.

b. Check trunk ports and native VLAN.

Trunk ports on S1? **F0/6**

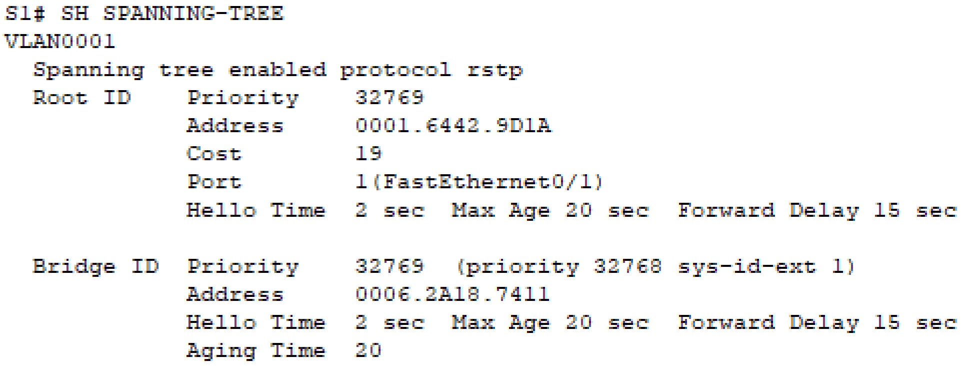
Native VLAN on trunk ports on S1?



```
S1#SH INTERFACES TRUNK
Port        Mode         Encapsulation  Status        Native vlan
Fa0/6       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/6       1-1005

Port        Vlans allowed and active in management domain
Fa0/6       1,10,99

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/6       none
```

In case of native VLAN mismatch, correct native VLAN on the aggregated channel group PO2.
**CORRECTED, BUT STILL NOT CHANGING**

c. From the **show spanning-tree** output, record port cost and port priority of the aggregated link Po2.



```
S1# SH SPANNING-TREE
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32769
             Address     0001.6442.9D1A
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0006.2A18.7411
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
```

### Step 3: Configure LACP between S2 and S3.

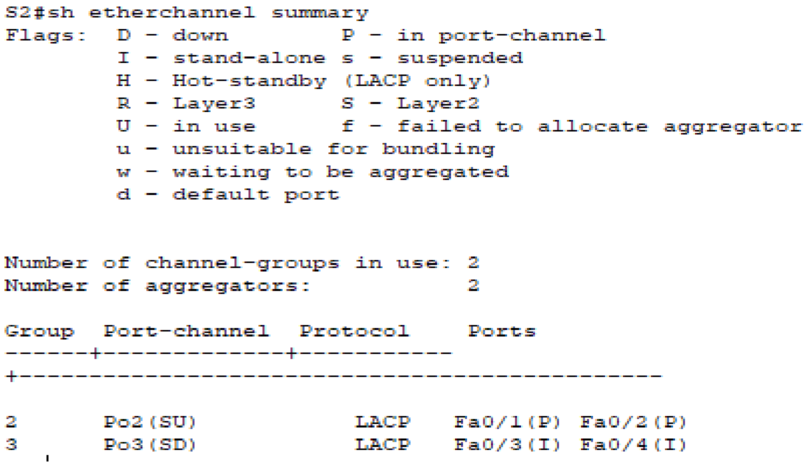
a. Similar to Po2, configure the links between S2 and S3 as channel-group Po3 and use LACP as the link aggregation protocol.

Name the LACP interface between S2 and S3 **channel-group 3**

**(Po3)** Po3 at S2 is in LACP mode active.

b. Verify that the EtherChannel has formed by **show etherchannel**

**summary**.



```
S2#sh etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------
+----------------------------------------------

2      Po2(SU)           LACP   Fa0/1(P)  Fa0/2(P)
3      Po3(SD)           LACP   Fa0/3(I)  Fa0/4(I)
```

c. EtherChannel is active (y/n)? **yes**

### Step 4: Verify end-to-end connectivity.

Verify that devices can ping each other within the same VLAN. If not, troubleshoot until there is end-to- end connectivity.

From S3 ping S1 and S2. Ping works (y/n)?

**From S3 to S1 result:**

```
S3#ping 192.168.99.11

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.99.11, timeout is 2 seconds:
!.!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/118/449 ms
```

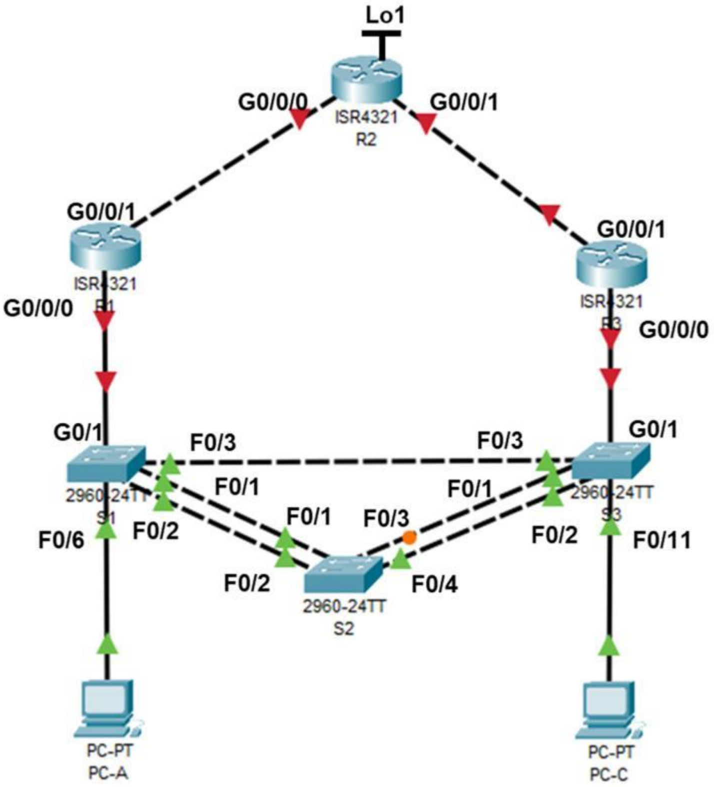
**From S3 to S2 result:**

```
S3#ping 192.168.99.12

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.99.12, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/16/76 ms
```

From PC-A ping PC-C. Ping works (y/n)? **NO**

# Lab 3 – HSRP Default Gateway Redundancy

## Packet Tracer Topology



We continue with the PT Topology and Addressing Table.

## Background / Scenario

First Hop Redundancy Protocols (FHRPs) provide redundant default gateways for end devices with no end-user configuration necessary.

## Part 1: Extent Switch Configuration

### Step 1: Configure Additional Access Ports for VLAN 10

For simplification, we only route the network of VLAN 10 (192.168.10.0 / 24) and allocate all switch ports to routers as access ports in VLAN 10.
(An alternative option is to configure router-on-a-stick.)

a. On switch S1, configure interface G0/1 as Access Port for VLAN 10.

b. On switch S3, configure interface G0/1 as Access Port for VLAN 10.

## Part 2: Basic Router Configuration

### Step 1: Configure basic settings for each router.

a. Disable DNS lookup.

b. Configure device name

c. Assign **class** as the privileged EXEC encrypted password.

d. Assign **cisco** as the console password, enable login, configure **logging synchronous** to prevent console messages from interrupting.

e. Configure password encryption

f. Save your running configuration in the startup configuration.

### Step 2: Router Interfaces

a. Configure IP addresses for the router interfaces (R1, R2 and R3) as listed in the Addressing Table.

b. In router R2 also create a loopback interface Lo1 with IP address 209.165.200.225 and mask 255.255.255.224, which simulates Internet access.

### Step 3: Static Routing

Because there are remote networks for all routers, we must add routes in all routers.

a. In router R1, configure a static default route to exit interface G0/0/1.

b. In router R2, configure a static route to network 192.168.10.0 / 24 with exit interface G0/0/1.

c. In router R2, configure a default route with exit to the loopback interface Lo1.

d. In router R3, configure a static default route to exit interface G0/0/1.

### Step 4: Verify connectivity.

a. From PC-A, you should be able the default gateway at R1 (y/n).

b. From PC-C, you should be able the default gateway at R3 (y/n).

c. From PC-C, you should be able to ping the G0/0/1 interface at R2 (y/n).

d. From PC-C, you should be able to ping the Lo1 loopback interface at R2 (y/n).

## Part 3: First Hop Redundancy with HSRP

Even though the topology has been designed with some redundancy (two routers and two switches on the same LAN network), both PC-A and PC-C are configured with only one gateway address. If the R3 router or the interfaces on the router went down, PC-C could lose its connection to the Internet.

### Step 1: Determine the path for Internet traffic for PC-A and PC-C.

a. From a command prompt on PC-A, issue a **tracert** command to the 209.165.200.225 loopback address of R2. Which path did the packets take from PC-A?

b. From a command prompt on PC-C, issue a **tracert** command to the 209.165.200.225 loopback address of R2. Which path did the packets take from PC-C?

### Step 2: Observe ICMP responses while breaking the link to the default router

a. From a command prompt on PC-A, issue a **ping –t** command to the **209.165.200.225** address on R2. Make sure you leave the command prompt window open.

b. As the ping continues, shut down the switch S1 interface

G0/1. What happened to the ping traffic?

c. Switch-on the switch S1 interface G0/1 again.

Re-issue a ping to 209.165.200.225 from PC-A to make sure connectivity is

re-established. Is ping working again?

### Step 3: HSRP on R1 and R3.

We use the virtual IP address **192.168.10.254** for HSRP.

R1 becomes the active router via configuration of the HSRP priority command with preemptive priority.

R3 is standby router.

a. Configure HSRP on R1.

b. Configure HSRP on R3.

c. Verify HSRP by issuing the **show standby** command on R1 and R3.

Which priority has the active router?

Which priority has the standby router?

What is the MAC address for the virtual IP address?

d. Use the **show standby** command on R1 and R3 to view an HSRP status summary.

At router R1 use **show standby brief** as well**.** Which information is missing compared to show standby?

e. Change the default gateway address at PC-A, and PC-C. Which address should you use?

Verify the new settings. Issue a ping from both PC-A and PC-C to the loopback address of

R2. Are the pings successful (y/n)?

### Step 4: Observe ICMP responses while breaking the link to the default router

a. From PC-A use **tracert** to the Lo1 interface address 209.165.200.225. Record the path taken by the ICMP packets now.

b. From PC-A issue a **ping –t** command to the **209.165.200.225** address on R2. Make sure you leave the command prompt window open.

As the ping continues, shut down the switch S1 interface

G0/1. What happens to the ping traffic?

How long was it interrupted?

c. At PC-A stop ping (ctrl-c) and use **tracert** to the Lo1 interface address

209.165.200.225. Which path is taken now by the ICMP packets?

d. Switch-on the switch S1 interface G0/1 again.

Re-issue **tracert** to 209.165.200.225 from PC-A to make sure connectivity to active router is re- established.
(Repeat tracert, if the path has not been changed yet.)

## Checkout

When you successfully finished this Lab, record your solution.

1. Write your answers in red color into this PDF-File and save it as **SRWE-Lab2-Result.pdf**.
2. Save your final Packet Tracer file **SRWE-Lab2-PT.pkt**
3. Record the running configuration of switch S1, router R1, and router R2 (**show run**)
   in one text file **SRWE-Lab2-S1-R1-R2.txt**
4. Upload these 3 files as requested in 1.-3. in Ilias.

   **Do NOT upload a ZIP-file or any other format.**