

113-SIG-3002
Implement Local Area Network (LAN) Redundancy
Status: Approved

Distribution Restriction: Approved for public release; distribution is unlimited.

Destruction Notice: None

Foreign Disclosure: FD1 - This training product has been reviewed by the training developers in coordination with the US Army Signal School and FG foreign disclosure officer. This training product can be used to instruct international military students from all approved countries without restrictions.

Condition: You have a fully operational hierarchical network. You must prevent disruption of network services to users. You have available a network plan, 3 Cisco Routers, 3 Cisco Switches (with Cisco IOS release 15.2(4) M3 universal image or comparable), 3 PC (Windows 7, Vista, or XP with terminal emulation software), 1 console cable, 6 ethernet crossover cables.

Standard: Implements multiple redundant paths within a switched network and eliminates a single point of failure.

Special Condition: None

Safety Risk: Low

MOPP 4:

Task Statements

Cue: None

DANGER
None

WARNING
None

CAUTION
None

Remarks: None

Notes: All required references and technical manuals will be provided by the local Command via Cisco Networking Academy at www.netacad.com.

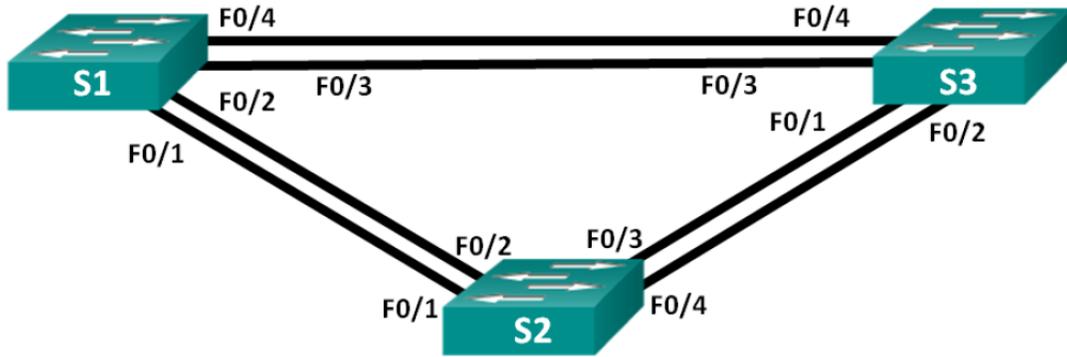


Figure 1: Switched Network with Redundant Links

Performance Steps

1. Establish redundant physical paths between switches.

- a. Connect additional crossover cables.
- b. Configure ports according to your network plan.

2. Determine the root bridge.

- a. Display spanning tree information. `switch# show spanning-tree`
- b. Manage the root bridge assignment.

(1) Configure a primary root bridge. NOTE: Perform multiple instances for all existing VLANs.
`switch(config)# spanning-tree vlan {vlan-id} root primary`

(2) Configure a secondary root bridge for all existing VLANs.
`switch(config)# spanning-tree vlan {vlan-id} root secondary`

3. Configure Rapid Per VLAN Spanning Tree Plus (PVST+) and Portfast.

a. Enable Rapid PVST+ on the switch. NOTE: must be configured on all switches
`switch(config)# spanning-tree mode rapid-pvst`

b. Enable PortFast on access ports.
`switch(config)# interface {interface-type slot/port}`
`switch(config-if)# spanning-tree portfast`

c. Enable bridge protocol data unit (BPDU) guard on access ports.
`switch(config)# interface {interface-type slot/port}`
`switch(config-if)# spanning-tree bpduguard enable`

d. Clear all detected spanning tree protocol (STP).
switch# clear spanning-tree detected-protocols

e. Verify configuration. switch# show running-config | include spanning-tree mode

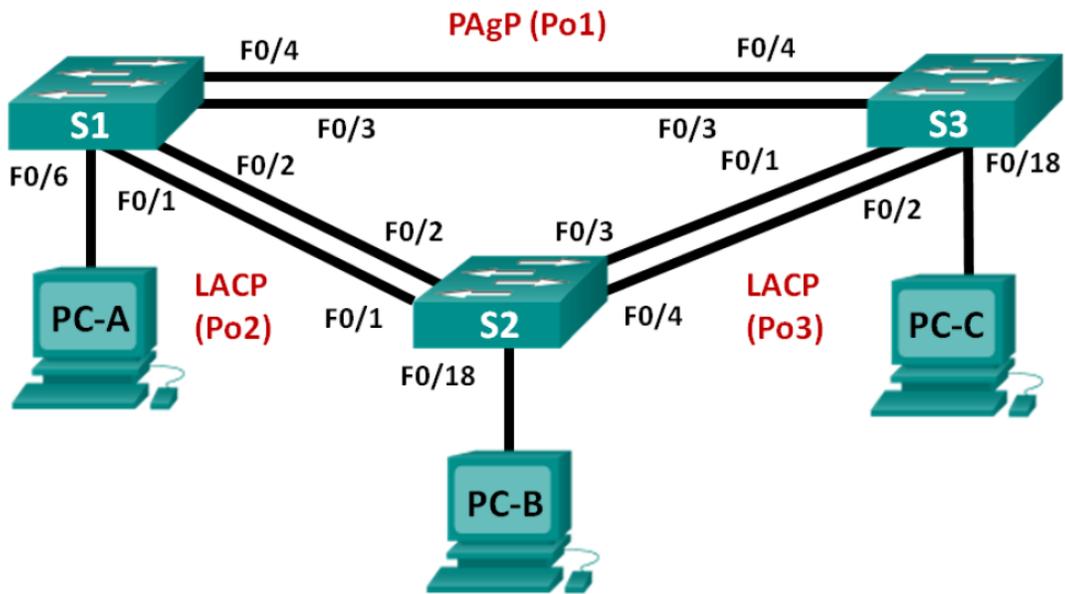


Figure 2: Link Aggregation with Etherchannel

Cue: Configurations in step 4 are based on Figure 2 for better understanding.

4. Configure link aggregation with EtherChannel.

a. Identify the links for PAgP and for LACP. NOTE: If you have trunk ports, you must configure the same properties on the port-channels.

b. Configure Cisco-proprietary protocol Port Aggregation Protocol (PAgP) for appropriate links.

```
S1(config)# interface range f0/3-4  
S1(config-if-range)# channel-group 1 mode desirable (Creates Port-channel 1)
```

```
S3(config)# interface range f0/3-4  
S3(config-if-range)# channel-group 1 mode desirable (Creates Port-channel 1)
```

c. Verify that the ports have been aggregated. S1# show etherchannel summary

d. Configure the open standard/multivendor IEEE 802.3ad-defined protocol Link Aggregation Control Protocol (LACP).

```
S1(config)# interface range f0/1-2
```

```
S1(config-if-range)# channel-group 2 mode active (Creates Port-channel 2)
```

```
S2(config)# interface range f0/1-2
```

```
S2(config-if-range)# channel-group 2 mode active (Creates Port-channel 2)
```

```
S2(config)# interface range f0/3-4
```

```
S2(config-if-range)# channel-group 3 mode active (Creates Port-channel 3)
```

```
S3(config)# interface range f0/1-2
```

```
S3(config-if-range)# channel-group 3 mode active (Creates Port-channel 3)
```

e. Verify that the ports have been aggregated.

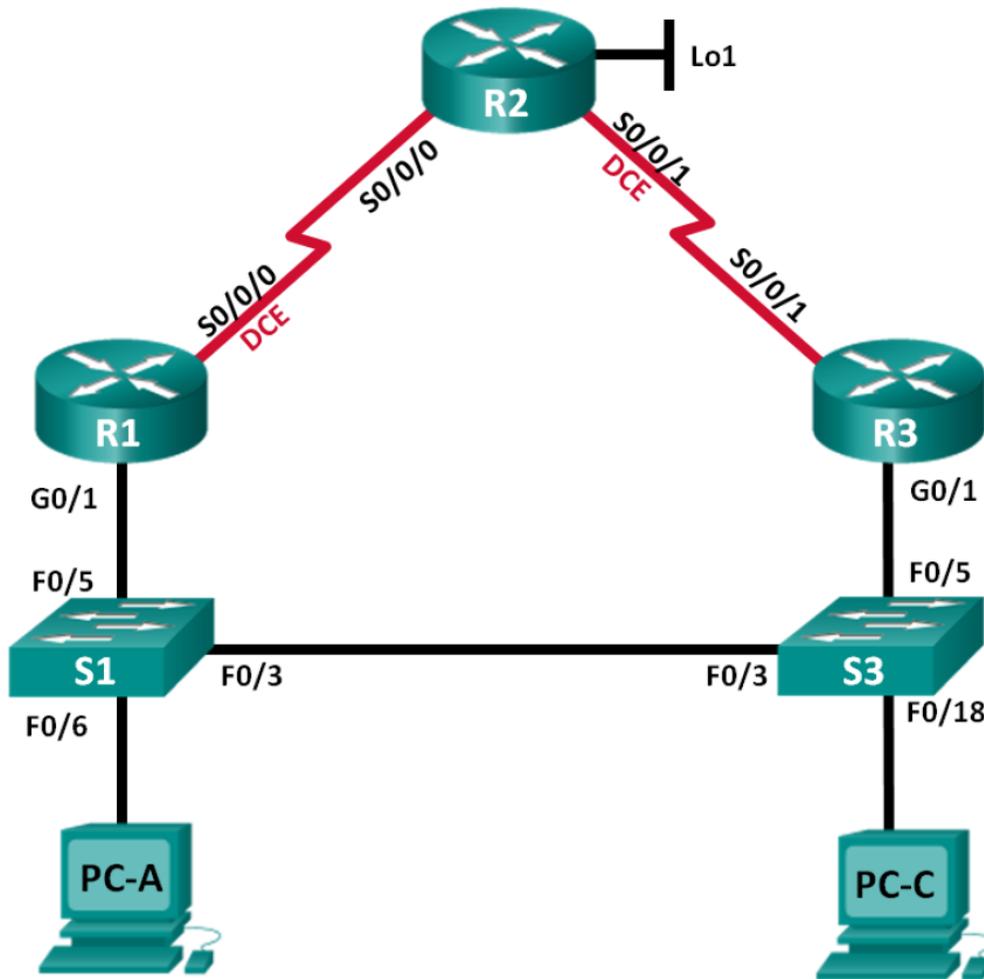


Figure 3: First Hop Redundancy

Cue: Configurations in steps 4 & 5 are based on Figure 3 for better understanding.

5. Configure first hop redundancy.

a. Determine whether you want backup default gateways or load balancing.

b. Configure first hop redundancy using Hot Standby Router Protocol (HSRP) NOTE: this protocol is used on standby/backup default gateways.

(1) Configure HSRP for forwarding/primary router. (R1 for example)

```
R1(config)#interface G0/1
R1(config-if)# standby 1 ip {default-gateway ip address} Note: standby # must reflect different instances if supporting VLANs
R1(config-if)# standby 1 priority {number greater than 100}
R1(config-if)# standby 1 preempt Note: this ensures the router settings take effect immediately
```

(2) Configuring HSRP for standby/backup router. (R3 for example)

```
R3(config)#interface G0/1
R3(config-if)# standby 1 ip {default-gateway ip address}
```

(3) Verify HSRP. router# show standby

c. Configure first hop redundancy using Gateway Load Balancing Protocol (GLBP) NOTE: this protocol provides backup and load balancing.

(1) Configure GLBP for load balancing.

```
R1(config)#interface G0/1
R1(config-if)# glbp 1 ip {default-gateway ip address} Note: GLBP # must reflect different instances if supporting VLANs
R1(config-if)# glbp 1 priority {number greater than 100}
R1(config-if)# glbp 1 preempt Note: this ensures the router settings take effect immediately
R1(config-if)# glbp # load-balancing round-robin
```

```
R3(config)# interface g0/1
R3(config-if)# glbp 1 ip {default-gateway ip address}
R3(config-if)# glbp 1 load-balancing round-robin
```

(2) Verify GLBP. router# show glbp brief

(Asterisks indicates a leader performance step.)

Evaluation Guidance: Guidance: Score the Soldier GO if all steps are passed (P). Score the Soldier NO GO if any step is failed (F). If the Soldier fails any step, show what was done wrong and how to do it correctly.

Evaluation Preparation: Ensure that the equipment is available, serviceable, and ready for use. Use the reference and evaluation guide to score the Soldier's performance. Brief Soldier: Tell the Soldier what is required IAW the task condition and standards.

PERFORMANCE MEASURES	GO	NO-GO	N/A
1. Redundant physical paths between switches are established.			
2. Determined the root bridge.			
3. Configured Rapid Per VLAN Spanning Tree Plus (PVST+) and Portfast.			
4. Configured link aggregation with EtherChannel.			
5. Configured first hop redundancy.			

Supporting Reference(s): None

TADSS : None

Equipment Items (LIN): None

Materiel Items (NSN) :

Step ID	NSN	LIN	Title	Qty
	7025-01-581-2387	05004N	Cisco Integrated Router Gen 2: CISCO 2901/K9	3
	5895-01-539-4546	FA9516	Catalyst 2960 24 PT	3

Environment: Environmental protection is not just the law but the right thing to do. It is a continual process and starts with deliberate planning. Always be alert to ways to protect our environment during training and missions. In doing so, you will contribute to the sustainment of our training resources while protecting people and the environment from harmful effects. Refer to the current Environmental Considerations manual and the current GTA Environmental-related Risk Assessment card.

Safety: In a training environment, leaders must perform a risk assessment in accordance with ATP 5-19, Risk Management. Leaders will complete the current Deliberate Risk Assessment Worksheet in accordance with the TRADOC Safety Officer during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 3-11.5, Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination.

Prerequisite Individual Tasks : None

Supporting Individual Tasks : None

Supported Individual Tasks : None

Supported Collective Tasks :

Task Number	Title	Proponent	Status
11-5-7166(Step: 2.)	Conduct Enterprise Management	11 - Signal (Collective)	Approved
(Step: 2.)	Created from Template: Conduct Enterprise Management	11 - Signal (Collective)	Proposed

ICTL Data :

ICTL Title	Personnel Type	MOS Data
MOS 25B Information Technology Specialist Skill Levels 1, 2, 3, 4 and 5	Enlisted	MOS: 25B
MOS 25C Radio Operator- Maintainer Skill Levels 1, 2, and 3	Enlisted	MOS: 25C
MOS 25Q Multichannel Transmission Systems Operator- Maintainer Skill Levels 1, 2, and 3	Enlisted	MOS: 25Q

MOS 25N Nodal Network Systems Operator-Maintainer Skill Levels 1, 2, and 3	Enlisted	MOS: 25N
MOS 25U Signal Support Systems Specialist Skill Levels 1, 2, 3, and 4	Enlisted	MOS: 25U
MOS 25L Cable Systems Installer-Maintainer Skill Levels 1, 2, and 3	Enlisted	MOS: 25L