Group Assignment 1 - Group Lab Activity 1

TNE10006/TNE60006 S2 2023

Assignment Weight:

7.5%

Assignment Points:

75

Submission Due Date:

Week 7 Lab session.

Reference Material:

- Lab SU-5a – Configuring Per-Interface Inter-VLAN Routing
- Lab SU-5b – Configuring 802.1Q Trunk-Based Inter-VLAN Routing
- Lab SU-6a – Troubleshooting Inter-VLAN Routing

Instructions:

1. Form a group of 3-4 people amongst the students present in the lab session.
2. Discuss and answer the questions in Group Assignment 1 with your group members.
3. Organise for your group to meet as needed to complete all the questions.
4. Each group will submit one completed Group Assignment 1
5. Submit Group Assignment 1, in the Canvas shell, under the Group Lab Activity 1
6. Late penalties will apply for submission after the due date.

Group Assignment 1 Sections:

Section 1: Lab SU-5a Per-Interface Inter-VLAN Routing Configuration (15 marks)

Section 2: Lab SU-5b 802.1Q Trunk-Based Inter-VLAN Routing Configuration (7 marks)

Section 3: Labs SU-5a and SU-5b Reflection (14 marks)

Section 4: Lab SU-6a Inter-VLAN Routing Troubleshooting (30 marks)

Section 5: Lab SU-6a Connectivity Scenarios (9 marks)

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Section 1: Lab SU-5a Per-Interface Inter-VLAN routing Configuration (15 marks)

Q1. After completing steps 1-3 in **Part 2 Configure Switches with VLANs and Trunking of Lab SU-5a**,

a) Did S3 and S4 ping each other? Yes/No? If yes, explain why? If no, explain why not.
(1 mark)

The answer is YES, it can ping because Gi1/0/5 has been configured in trunk mode on both switches, allowing VLANs to communicate with one another. Moreover, both switches are in the same network (192.168.10.0).

b) Would S3 ping PC-A? Yes/No? If yes, explain why? If no, explain why not.
(1 mark)

The answer is YES, because S3 and PC-A's connection to Gi1/0/7, which is in the access mode and allows VLAN 10 traffic, including S3 and PC-A to ping. (PC-A and S3 are in the same network).

c) Would S3 ping PC-B? Yes/No? If yes, explain why? If no explain why not.
(1 mark)

The answer is NO, S3 (192.168.10.11/24) and PC-B (192.168.20.3/24) cannot ping each other because they use different network ports. Additionally, we have not yet configured the default gateway (R1), and S3 and PC-B are in a different VLAN.

d) Would S4 ping PC-A? Yes/No? If yes, explain why? If no, explain why not.
(1 mark)

The answer is YES, S4 can ping PC-A through S3 because Gig1/0/5 is configured in trunk mode, allowing VLANs to carry packets, and Gi1/0/7, which is connected between S3 and PC-A, is configured in access mode, allowing VLAN 10 traffic, including S3 and PC-A to ping.

e) Would PC-A ping PC-B? Yes/No? If yes, explain why? If no explain why not.
(1 mark)

The answer is NO, because those two PCs are in different VLANs and there are no layer 3 router devices that support inter-vlan communication.

Q2. After completing steps 1-3 in **Part 3: Basic Router Configuration of Lab SU-5a**,

a) How many directly connected networks (C) were there in R1's routing table? If any, list them.
(2 marks)

There are 2 directly connected networks (C) in R1's routing table:

192.168.10.0/24 - Gi0/0/1

192.168.20.0/24 - Gi0/0/0

b) Would all devices now be able to ping each other? Give reasons for your answer.
(2 marks)

The answer is YES. Due to the configuration and activation of the layer 3 router, all devices can now ping one another, enabling inter-vlan communication. This has the effect of allowing devices on different VLANs to now ping one another.

c) When PC-A pings PC-B, would this traffic traverse R1? Yes/No? If yes, explain why. If no, explain why not.
(1 mark)

The answer is YES, traffic must traverse R1 because PC-A (Vlan 10) and PC-B (Vlan 20) have different vlans. As a result, the traffic must be routed through the router.

d) When PC-A pings S3, would this traffic traverse R1? Yes/No? If yes, explain why. If no, explain why not.
(1 mark)

The answer is NO, as they are connected to the same local network (192.168.10). Thus, they are not required to travel through R1.

Q3. If you shutdown port Gi0/0/1 on R1,

a) How many directly connected (C) networks would there be in R1's routing table? If any, list them.
(2 marks)

Only 1 directly connected network (C), 192.168.20.0/24 - Gi0/0/0, will remain.

b) Would S3 and S4 still ping each other? Yes/No? If yes, explain why. If no, explain why not. (1 mark)

Yes, since S3 and S4 share the same network and default gateway and cannot communicate without using the router.

c) Would PC-A and PC-B still ping each other? Yes/No? If yes, explain why. If no, explain why not.
(1 mark)

No, because port g0/0/1 is not active, no traffic reaches VLAN 10.

Section 2: Lab SU-5b Trunk-Based Inter-VLAN Routing Configuration (7 marks)

Q1. After completing steps 1-4 in **Part 2 Configure Switches with VLANs and Trunking of lab SU-5b**,

a) How many directly connected (C) networks are there in R1's routing table? If any, list them.
(2 marks)

There are 4 directly connected networks (C) in R1's routing table:

- 192.168.1.0/24 directly connected to port g0/0/1.99.
- 192.168.10.0/24 directly connected to port g0/0/1.10.
- 192.168.20.0/24 directly connected to port g0/0/1.20.
- 209.165.200.0/24 directly connected to port lo0.

b) Would S3 ping PC-A? If yes, would this traffic traverse R1?
(1 mark)

Yes, S3 will be able to ping PC-A. Due to PC-A and S3's participation in different networks, the traffic will pass through R1.

c) Would PC-A ping PC-B? If yes, would this traffic traverse R1?
(1 mark)

Yes, since PC-A and PC-B are on different vlans, PC-A will be able to ping PC-B. As a result, they require layer 3 routeing device R1 to communicate across vlans. This traffic will therefore travel along R1.

d) What was the purpose of pinging S3 and S4 using the source option from R1?
(1 mark)
Pinging S3 and S4 from R1 is done to emphasise inter-vlan communication and to make sure that devices can ping one another through a layer 3 routeing device.

Q2. If you shutdown port Gi0/0/1 on R1,

a) How many directly connected (C) networks would there be in R1's routing table? If any, list them.
(2 marks)

All networks that were initially connected to the sub-interface of port g0/0/1 on R1 will stop sending traffic if that port is shut down. That sub-interface is:

- 192.168.1.0/24 directly connected to port g0/0/1.99.

- 192.168.10.0/24 directly connected to port g0/0/1.10.
- 192.168.20.0/24 directly connected to port g0/0/1.20.

As a result, because it is a Loopback virtual interface, the 209.165.200.225/27 network is the only one that is unaffected by the closure of port g0/0/1.

Section 3: Labs SU-5a and SU-5b Reflection (14 marks)

Q1. Answer the following questions regarding IP settings on layer 2 switches:

a) On a layer 2 switch, what is the purpose of creating an interface VLAN and allocating and IP address to it?
(1 mark)

Allocating an IP address allows a network administrator to remotely configure and manage the network after creating an interface vlan to enable remote access.

b) On a layer 2 switch, what is the purpose of configuring a default gateway?
(1 mark)

To its default gateway, which is the router's IP address, the switch will forward packets with IP addresses from outside its local network. Inter-VLAN/inter-network communication is made possible by configuring a default gateway.

c) Based on what you learned on labs SU-5a and SU-5b, which IP address should be configured as the default gateway IP on layer 2 switches?
(1 mark)

IP addresses for the switch's management vlan and the router that are on the same network.

Q2. Answer the following questions regarding inter-vlan routing configuration:

a) Explain the benefits of using the “router-on-a-stick” topology for inter-vlan routing instead of the per-interface routing approach?
(4 marks)

The "router-on-a-stick" topology provides several benefits for inter-VLAN routing as compared to the per-interface routing approach:

1. Cost Efficiency: Router-on-a-stick uses just one interface to manage multiple VLANs. In contrast, per-interface routing needs a separate interface for every VLAN, making it costlier.
2. Scalability: If you add more VLANs as your network grows, router-on-a-stick doesn't need more router interfaces. But with per-interface routing, every new VLAN means a new router interface.
3. Flexibility: With router-on-a-stick, changing or adding VLANs is easy. You don't need to mess with the router's physical setup.
4. Conserves Ports: Using one interface for many VLANs means you have extra ports on the router for other things.
5. Simpler Setup: Fewer cables run between the switch and the router with router-on-a-stick. This looks neater and is easier to manage.
6. Steady Performance: All VLANs share the bandwidth of one link in router-on-a-stick. So, no single VLAN hogs all the bandwidth.
7. Easier Troubleshooting: If there's a problem with VLAN routing, it's simpler to find the issue when only one interface is involved.

b) Are there any disadvantages to using “router-on-a-stick” inter-vlan routing as compared to the per-interface routing approach?
(2 marks)

1. Bandwidth Limitation: Since all VLANs share the bandwidth of a single link in the router-on-a-stick configuration, it can become a bottleneck if there's heavy traffic across multiple VLANs.
2. Performance Issues: Heavy traffic on one VLAN can affect the performance of other VLANs since they all share a single interface.
3. Complexity: The configuration of sub-interfaces and correct tagging can be more complex initially compared to straightforward per-interface setups.
4. Single Point of Failure: If the single interface or link fails, all VLANs lose connectivity to the router.

5. Potential for Increased Latency: As traffic needs to be tagged and untagged for different VLANs, there might be a slight increase in latency.

6. Overhead: Encapsulating frames with VLAN tags adds a minor overhead to each frame.

c) When configuring a router-on-a-stick topology, the link between the switch and the router must carry traffic for multiple VLANs. How is this achieved on the router? How is this achieved on the switch?
(4 marks)

On the Router:

- Sub-interfaces: On the router, you create sub-interfaces for each VLAN. These sub-interfaces act as virtual interfaces under the main physical interface.
- Encapsulation: Each sub-interface is configured to use 802.1Q encapsulation, followed by the specific VLAN ID it represents. This means when the router receives a tagged frame on the main interface, it knows which sub-interface (and hence which VLAN) it belongs to base on the tag.

On the Switch:

- Trunk Port: The port on the switch that connects to the router is configured as a trunk port. A trunk port can carry traffic from multiple VLANs.
- VLAN Tagging: The switch uses 802.1Q tagging to mark frames with their respective VLAN IDs when sending them out on the trunk port. When receiving frames, the switch uses the tag to determine which VLAN the frame belongs to and forwards it to the appropriate access port.

d) Other than directly connected (C) networks, did you observe any other type of networks in R1's routing table? If yes, specify what type of networks were there and what do they represent.
(1 mark)

The other type of network is added as a local (L) route. This route pinpoints the exact IP address of the router's interface, making it faster for the router to recognize when a packet is meant for that specific interface, compared to searching through all connected networks.

Section 4: Lab SU-6a Inter-VLAN Routing Troubleshooting (30 marks)

Q1. Refer to **Part 2 Troubleshoot Inter-VLAN Routing Configuration of Lab SU-6a**,

a) Were there any networks missing from R1's routing table? If so, which networks?
(3 marks)

Yes, 3 networks are missing:

VLAN 1: 192.168.1.0/24

VLAN 10: 192.168.10.0/24

VLAN 20: 192.168.20.0/24

b) After all relevant R1 interfaces were enabled, were there any networks still missing? were there any networks that should not have been present? If so, specify which networks are missing and which networks should not be present.
(1 mark)

Yes, Network 192.168.11.0/24 on port g0/0/1.10

c) Were all R1's interfaces, including loopback and sub-interfaces, configured correctly? If not, list the configuration issues you found.
(3 marks)

- There were some setup issues. Int G0/0/1 should have been turned on without a shutdown command, but this was not done. Loopback was configured correctly, but the interfaces and sub-interfaces were not. All the sub-interfaces from port G0/0/1, including G0/0/1.1, G0/0/1.10, and G0/0/1.20, are therefore not in use.
- Trunking from S3 (Gi1/0/11 and Gi1/0/5) must be turned on manually.

Q2. Refer to **Part 3 Verify VLAN Configuration and Port Assignments and Trunking of Lab SU-6a**,

a) Were there any VLANs numbers or names missing from S3's VLAN database? If so, list them.
(1 mark)

Yes, as there is one missing: VLAN 20 – Engineering.

b) Were all access ports on S3 assigned to the correct VLANs? If not, list the missing or incorrect assignments.
(1 mark)

No, not every access port was given the proper vlan assignment.

The access mode for Interface G1/0/7, which is currently set to VLAN 1, was intended to be enabled and assigned to VLAN 10.

The interfaces G1/0/5 and G1/0/11 are currently in switchport mode access even though trunk mode is where they should be.

c) Were there any VLANs numbers or names missing from S4's VLAN database? If so, list them.
(1 mark)

Yes. Switchport VLAN 10 was automatically created under the name VLAN0010 rather than R&D because it was accessed by Switchport without being configured in Switch 4. As there is no need to use a shutdown command, VLAN 1 should also be operational.

d) Were all access ports on S4 assigned to the correct VLANs? If not, list the missing or incorrect assignments.
(1 mark)

No, not all access ports were assigned to the correct vlan.

- Interface G1/0/24 should be assigned to VLAN 20 rather than VLAN 10.

e) Based on Lab SU-6a topology diagram, which port(s) on S3 should operate in trunking mode?
(2 marks)

G1/0/11 and G1/0/5 should be in trunk mode.

f) Based on Lab SU-6a topology diagram, which port(s) on S4 should operate in trunking mode?
(1 mark)

G1/0/5 should be in trunk mode.

g) Were all ports that should operate in trunking mode configured correctly? If not, list the configuration issues you found.
(2 marks)

S3: The correct mode for G1/0/5 should be trunk, not access.

Q3. Use the table provided to list the configuration issues you found in Lab SU-6a. For each issue, list the troubleshooting command(s) that helped you find it and the configuration command(s) you used to fix it.
(2 marks for each correct issue)

Device	Configuration Issue	Troubleshooting Command(s)	Re-Configuration Command(s)
R1	G0/0/1 interface is not active	show ip route	R1(config)#int g0/0/1 R1(config-if)#no shutdown R1(config-if)#exit
R1	G0/0/1.10's sub-interface has the incorrect ip address (192.168.11.0)	sh ip int brief	R1(config)#int g0/0/1.10 R1(config-if)#ip address 192.168.10.1 255.255.255.0 R1(config-if)#exit
R1	Misconfigured G0/0/1.1 encapsulation dot1Q sub-interface.	sh ip int brief	R1(config)#int g0/0/1.1 R1(config-if)#encapsulation dot1Q 1 R1(config-if)#Ip address 192.168.1.1 255.255.255.0 R1(config-if)#exit
S3	G1/0/7 has not been designated as an access port for vlan 10.	Show vlan brief	S3(config)#int g1/0/7 S3(config-if)#switchport mode access S3(config-if)#switchport access VLAN 10 S3(config-if)#exit
S3	Vlan 20 is missing.	Show vlan brief	S3(config)#vlan 20 S3(config-if)#name Engineering S3(config-if)#exit
S3	The access mode for interfaces G1/0/5 and G1/0/11 is incorrectly set.	sh int trunk	S3(config)# int gi1/0/5 S3(config-if)# switchport mode trunk S3(config-if)#exit S3(config)# int gi1/0/11 S3(config-if)# switchport mode trunk S3(config-if)#exit

S3 S4	The Vlan 1 interface is not active.	sh ip int brief	S3(config)#int vlan 1 S3(config-if)#no shutdown S3(config-if)#exit --- S4(config)#int vlan 1 S4(config-if)#no shutdown S4(config-if)#exit

Section 5: Lab SU-6a Connectivity Scenarios (9 marks)

Q1. After fixing all configuration issues in Lab SU-6a,

a) Can S3 and S4 ping each other? If so, does this traffic traverse R1? Give reasons for your answers.
(1 mark)

Yes, due to their shared VLAN, S3 and S4 can ping each other without the traffic passing through the router.

b) Can S3 and S4 ping all router sub-interfaces and loopback interface? Give reasons for your answer.
(1 mark)
Yes, as G0/0/1.1 on the router sub-interface is the default gateway for S3 and S4. For S3 to ping, packets from VLAN 1 are routed through the default gateway to R1's VLAN 1 sub-interface at port G0/0/1. The router then removes the VLAN ID 1 tag and attaches the VLAN ID of the destination. S3 and S4 can ping the loopback interface and all router sub-interfaces as a result.

Q2. If you were to connect PC-A and PC-B to the network as shown in Lab SU-6a Topology Diagram,

a) What IP address would you configure on PC-A as the Default Gateway?
(1 mark)

The IP address for the G0/0/1.10 sub-interface on R1 for VLAN 10 is 192.168.10.1.

Therefore, 192.168.10.1 should be the default gateway on PC-A.

b) What IP address would you configure on PC-B as the Default Gateway?
(1 mark)

The IP address for the G0/0/1.20 sub-interface on R1 for VLAN 10 is 192.168.20.1.

Therefore, 192.168.20.1 should be the PC-B's default gateway.

c) Would PC-A and PC-B be able to ping each other? If so, would this traffic traverse R1? Give reasons for your answers.
(1 mark)

Since PC-A (VLAN 10) and PC-B (VLAN 20) are on different VLANs, they can both ping each other. So, to communicate between VLANs, they must go through the layer 3 routeing device

(R1). Due to this, R1 is traversed by the packet.

Q3. In Lab SU-6a, if you did not configure VLAN 20 on S3,

a) Would PC-A and PC-B ping each-other? Give reasons for your answer.
(1 mark)

No, because if VLAN 20 is not configured on S3, then PC-B would not have any network connectivity because it's on a non-existent VLAN. Therefore, PC-A and PC-B would be on separate VLANs and cannot communicate directly.

b) Would PC-A ping R1's loopback interface? Give reasons for your answer.
(1 mark)
Yes, if inter-VLAN routing is configured correctly and PC-A has the correct default gateway set. PC-A's ability to ping R1's loopback doesn't depend on the configuration of VLAN 20, but on its own VLAN configuration and routing.

c) Would PC-B ping R1's loopback interface? Give reasons for your answer.
(1 mark)
No, if VLAN 20 isn't configured, PC-B has no network connectivity and thus cannot reach R1 or any other device.

Q4. In Lab SU-6a, if you did not configure the default gateway on S3 and/or S4,

a) Would PC-A and PC-B ping each-other? Give reasons for your answer.
(1 mark)

Yes, if they are on the same VLAN and subnet and are connected to the same switch or through trunked switches.

Communication within the same VLAN and subnet doesn't require a default gateway. Default gateways are needed only when a device wants to communicate outside of its local network or VLAN. If PC-A and PC-B are on the same VLAN, they don't need to route the traffic, so they don't need a default gateway for communication with each other.