# Group Assignment 1 - Group Lab Activity 1

TNE10006/TNE60006 S1 2023

**Assignment Weight:**

7.5%

**Assignment Points:**

75

**Submission Due Date:**

By the start of Week 7 Lab session.

**Reference Material:**

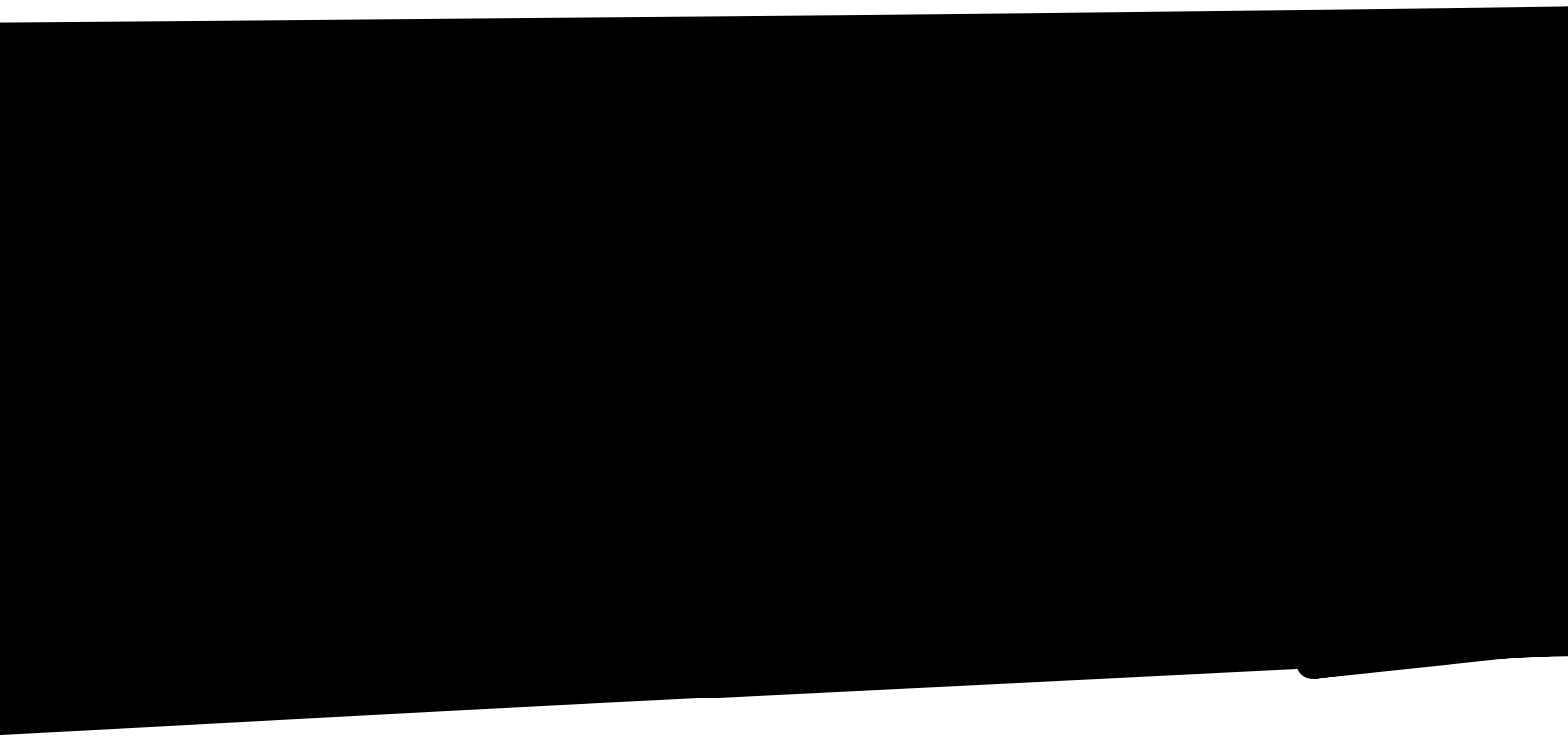
- Lab SU-5a – Configuring Per-Interface Inter-VLAN Routing
- Lab SU-5b – Configuring 802.1Q Trunk-Based Inter-VLAN Routing
- Lab SU-6a – Troubleshooting Inter-VLAN Routing

**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 again 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)



# 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)

Yes, because S3 and S4 are on the same network (VLAN 10)

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

Yes, because PC-A and S3 are on the same network (VLAN 10)

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

No, because PC-B is on VLAN 20 and S3 is on VLAN 10 these devices would have to communicate through a layer 3 routing device.

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

Yes, because S4 and PC-A are on the same network (VLAN 10)

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

No, because PC-B is on VLAN 20, and PC-A is on VLAN 10 these devices would have to communicate through a layer 3 routing device.

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 were 2 directly connected networks:
- 192.168.10.0/24 through Gi0/0/1
- 192.168.20.0/24 through Gi0/0/0

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

Yes, all devices are now able to ping each other as there is now a layer 3 device (the Router). This allows for inter-VLAN communication.

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)

Yes, as PC-A belongs to a different VLAN than that of PC-B. This means that the routing device is required for this inter-VLAN communication.

d) When PC-A pings S3, would this traffic traverse R1? Yes/No? If yes, explain why. If no, explain why not.
(1 mark)
No, as PC-A and switch 3 belong to the same VLAN. This allows PC-A to ping Switch 3 directly without the need of the routing device (Intra-VLAN communication).

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)
There is only one directly connected network:

- 192.168.20.0/24 through Gi0/0/0

b) Would S3 and S4 still ping each other? Yes/No? If yes, explain why. If no, explain why not.
(1 mark)
Yes, S3 and S4 can send each other packets through the trunk port established on Gi1/0/5

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, as there is no way for VLAN 10 to connect to the router (and thus communicate with VLAN 20). This means that PC-A is unable to send packets to PC-B.

# 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 in R1's routing table:

- The management VLAN (99) 192.168.1.0/24
- The student VLAN (10) 192.168.10.0/24
- The faculty-admin VLAN (20) 192.168.20.0/24
- The loopback interface 209.165.200.224/27

b) Would S3 ping PC-A? If yes, would this traffic traverse R1?
(1 mark)
Yes, Switch 3 can ping PC-A. This traffic will traverse Router 1 as they belong to different VLANs.

c) Would PC-A ping PC-B? If yes, would this traffic traverse R1?
(1 mark)
Yes PC-A can ping PC-B. This traffic will traverse over Router 1 as they belong to different VLANs and Networks.

d) What was the purpose of pinging S3 and S4 using the source option from R1?
(1 mark)
Because each subinterface is related to a different ip address, using 'source' specifies the source IP used to ping the destination IP. This tests that the Switches can still receive pings from different VLANS.

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)

There is only 1 directly connected network in R1's routing table:

- The loopback interface (209.165.200.224/27)

# 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 an IP address to it?
(1 mark)
This is done for management and security purposes. By doing this, it allows for an external device to connect to the layer 2 switch and perform management tasks. It makes the device more secure because you are not connecting through a port which any bad actor could potentially use.

b) On a layer 2 switch, what is the purpose of configuring a default gateway?
(1 mark)
When the switch receives traffic intended for another network, the switch can then send and forward the traffic to the router (the default gateway is the router's IP address). Configuring the default gateway is also needed when the switch needs to be managed remotely from another network.

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)

On layer 2 switches, the default gateway should be set to the IP address of the layer 3 router sub-interface that is related to the management VLAN.

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 main advantage of using the router-on-a-stick topology is that it allows for the use of only one interface to connect all switches and VLANs in the network to the router. This is achieved by using 802.1q trunking. This is useful because in a per-interface routing approach, each network and VLAN needs its own port on the router. While this may work for smaller networks, multiple VLANs can quickly hit a physical limit based on your available hardware.

Router-on-a-stick is more scalable and allows for a far greater amount (compared to per-interface routing) of VLANs to connect to the one router through the use of subinterfaces. This means that an administrator of the network can add a new VLAN to the network without any issues. In a per-interface approach, this is limited by the number of physical port interfaces on the router. This makes Router-on-a-stick more efficient and cost-effective than a per-interface routing approach.

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

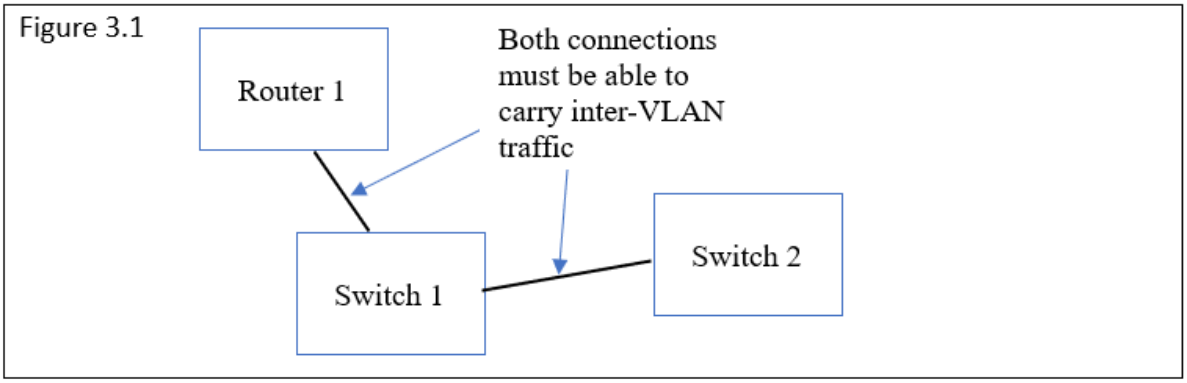
Yes. Due to the all traffic being carried over a singular connection, the "router-on-a-stick" networking topology both has a single point of failure (making the network more susceptible to DDOS attacks) and can have congestion issues because requires the port connected between the router and switch to process a lot more traffic compared to a per-interface approach. It can also be more technically challenging to set up initially.

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)

Though 802.1Q encapsulation VLAN tagging.

Firstly, the connection between the router and switch must be configured as an 802.1q trunk (which allows the connection to carry 802.1q frames). Additionally, all switches must have a path to the router made of entirely 802.1q trunks. For example, in the diagram below (Figure 3.1), the connection between Switch 1 and Switch 2 must be an 802.1q trunk or else the router-on-a-stick topology will not work.

Figure 3.1



While this allows the network to carry traffic for multiple VLANs, this does not allow for the traffic to be differentiated. This is where 802.1q VLAN tagging comes in.

For example, a device from VLAN 20 attempts to communicate with a device in VLAN 10. The original device sends a message which the switch identifies as having come from a port with membership to VLAN 20. Since a computer is not VLAN aware, the switch is left with the task of tagging this message with VLAN 20. This then allows the traffic to travel through the network until it reaches the subinterface for VLAN 20 on the router.

Here the router will identify which network the traffic needs to be sent to by looking at the destination IP address. It will use its own sub-interfaces to determine that this message belongs to VLAN 10, before sending the traffic back down the connection. Then the switch will forward the traffic until it reaches the intended destination. In figure 3.1, it is critical that Switch 1 has all VLANs in the Network configured or else it will not carry the traffic to the Router.

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)

Yes, there are also local networks (L), which are the IP address assigned to the interface. There is one local network for every directly connected (C) network.

# Section 4: Validate and Troubleshoot Inter-VLAN Routing (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)
VLAN 1 (Management), VLAN 10 (R&D) and VLAN 20 (Engineering) are missing.

b) After all relevant R1 interfaces were enabled, were there any networks that should not have been present? If so, which networks?
(1 mark)
Yes, G0/0/1.10 has an IP address 192.168.11.1/24, which is not a network (192.168.11.0) specified in the Network Topology.

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

- The port Gi0/0/1 was administratively down on the router, so this had to be enabled.
- The IP address for interface Gi0/0/1.10 was incorrectly configured as 192.168.11.1
- The dot1q VLAN for Gi0/0/1.1 was incorrectly configured as 11 instead of 1

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, VLAN 20 – Engineering was missing from S3's VLAN database.

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

No. Gi1/0/7 is not assigned correctly (missing from VLAN 10).

c) Were there any VLANs numbers or names missing from S4's VLAN database? If so, list them.
(1 mark)
Yes, VLAN 10 does not have a name. It should be R&D.

d) Were all access ports on S4 assigned to the correct VLANs? If not, list the missing or incorrect assignments.
(1 mark)
No, interface Gi1/0/24 was set to access VLAN 10 instead of VLAN 20.

e) Based on Lab SU-6a topology diagram, which port(s) on S3 should operate in trunking mode?
(2 marks)
Ports Gi1/0/11 and Gi1/0/5 should operate as trunk ports.

f) Based on Lab SU-6a topology diagram, which port(s) on S4 should operate in trunking mode?
(1 mark)
Port Gi1/0/5 should operate as a trunk port.

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

No, while Gi1/0/11 was correctly operating as a trunk port, Gi1/0/5 was incorrectly configured as an access port.

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)** |
|---|---|---|---|
| Router | Port Gi0/0/1 was administratively down | #show ip interface brief | #interface gi0/0/1<br>#no shutdown |
| Router | IP Address for sub interface Gi0/0/1.10 incorrectly configured | #show ip interface brief<br>or<br>#show ip route | #interface gi0/0/1.10<br># ip address 192.168.10.1 255.255.255.0 |
| Router | Dot 1q incorrectly configured for sub interface gi0/0/1.1 (incorrectly set to 11) | #sh run \| section interface | #interface gi0/0/1.1<br>#encapsulation dot1q 1<br>#ip address 192.168.1.1 255.255.255.0 |
| Switch 3 | Missing some VLAN configuration – VLAN 20 not configured | #show vlan brief | #vlan 20<br>#name Engineering |
| Switch 3 | Gi1/0/7 not accessing VLAN 10 | #show vlan brief | #interface gi1/0/7<br>#switchport mode access<br>#switchport access vlan 10 |

| | | | |
|---|---|---|---|
| Switch 3 | Not all necessary ports operating as trunks – Gi1/0/5 not operating as trunk | #show interface trunk | #interface gi1/0/5<br>#switchport mode trunk |
| Switch 4 | VLAN 10 has no name | #show vlan brief | #vlan 10<br>#name R&D |
| Switch 4 | Gi1/0/24 incorrectly accessing VLAN 10 | #show vlan brief | #interface gi1/0/24<br>#switchport mode access<br>#switchport access vlan 20 |

# 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)

Switch 3 can ping Switch 4. This traffic does not traverse Router 1 as Switch 3 and 4 are a part of the same VLAN and Network.

b) Can S3 and S4 ping all router sub-interfaces and loopback interface? Give reasons for your answer. (1 mark)
Switch 3 and Switch 4 can ping all sub-interfaces or else inter-VLAN communication would not be possible. This is due to the trunk port configured on Gi1/0/11 on Switch 3 and 802.1Q encapsulation tagging being correctly configured.

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)
192.168.10.1

b) What IP address would you configure on PC-B as the Default Gateway? (1 mark)
192.168.20.1

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)
Yes, and the traffic would traverse through the router as PC-A and PC-B are a part of different VLANs.

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, as switch 3 would not carry VLAN 20 traffic.

b) Would PC-A ping R1's loopback interface? Give reasons for your answer.
(1 mark)
Yes, as PC-A is a part of VLAN 10 and VLAN 10 still exists on Switch 3.

c) Would PC-B ping R1's loopback interface? Give reasons for your answer.
(1 mark)

No, because S3 doesn't have VLAN 20 configured, it is unable to process VLAN 20 traffic.

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

Would PC-A and PC-B ping each-other? Give reasons for your answer.
(1 mark)
Yes, because PC-A and PC-B still have their default gateways. Removing the default gateway from Switch 3 and 4 prevents these switches from communicating with devices outside the network, not PC-A and PC-B.