Case Study

Semester 1 - 2022

Network Design and Implementation

V4.6

**Due Date**

**Sunday 9 May 2022 23:59 hours**

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Phase 0 – Ensure you read this

1. Assignment

* The Case Study team of up to 4 persons
* Team members are restricted to your lab class.
* Your team has to be registered on ESP (<https://esp.swin.edu.au/>).
* **Please form your team, by week 2.**
* **Email pgranville@swin.edu.au for Case Study specifications.** 
  + **Include the following in the email:**
    - **Tutor Name**
    - **ESP Team Number**
    - **Each Team member’s:**
      * **Student Id**
      * **Name**
      * **Session Time**

1. Case Study Deliverables
2. **A Case Study Report as a Microsoft Word Doc**
3. **A Packet Tracer Prototype, latest V8 version**
4. **An Individual Reflection Report**

1. Case Study Submission - Details
2. The Case Study Report, Packet Tracer Prototype, must be submitted to ESP
3. **The Individual Reflection Report must the emailed to your class tutor**
4. **Due Date**: **Sunday 9 May 2022 23:59 hours**
5. **Late submission: A late penalty of 10% per day or part there of applies.**

Phase 1 - Case Study Overview

Best Motors Ltd is a company that leases buys and sells and repairs cars, trucks and buses. The Head Office is at the Guca site. The other company sites are in Ljubis, Mackat and Lucani.

The company is implementing a network that should support potential growth over the next five years. The task is to design, implement and fully document the proposed Vehicles Are Us Company network. You must prepare:

1. A Written Report
2. A **prototype** of the network, built using Packet Tracer V8 as a proof of concept that your team can build a network that will satisfy the company’s requirements.
3. Please note the following:

* You have **11 weeks** (which includes the Mid-Semester Break) to complete the case study. It is important to form your team and get your Case Study specifications from **pgranville@swin.edu.au**
* Given the nature of the case study, it is not possible to cover all the required knowledge in lectures before you start and finish the case study. However, unit lecture material and CISCO guides are available on Canvas for you to reference. You can also access information on the Cisco company website
* In forming a team: it is the responsibility of each student to negotiate with other students in their lab class to form the team.
* This case study requires the building and configuration of a network using skills gained through studying the Unit material.
* It is important to read and understand each requirement to ensure that the case study is completed accurately.
* **Case Study Specifications**

**(Email pgranville@swin.edu.au for Case Study specifications)**

* + Specification Number (Spec No) 5.2
* *Pseudo private* Class A Internal network address 70.32.0.0/19
* Class B NAT Pool Public 150.2.0.0/21 IP address range
* Class C ISP Network Connection 207.5.2.0/30 IP addresses
* Class B ISP Internet Web Server 150.17.5.0/30 IP address
* Wireless deployment site Lucani
* Expected Percentage Growth of staff for VLSM design 30
* Switch Management VLAN number 33

1. Company Site Layouts

**At Guca:**

* The Leasing, Marketing and Vehicle Servicing groups are on floor 1.
* The Business group is on floor 2
* The Servers are on floor 1
* Site size 1500metres x 1500metres
* Building Floor size 100metres x 200metres
* Technical Support group on floor 1

**At Ljubis:**

* Leasing, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
* Site size 1500metres x 2000metres
* Building Floor size 120metres x 30metres

**At Lucani:**

* Sales, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
* Site size 2000metres x 2000metres
* Building Floor size 225metres x 30metres

**At Mackat:**

* Sales, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
* Site size 1250metres x 2000metres
* Building Floor size 125metres x 40metres

Phase 2 – IP addressing and VLSM Design

The Vehicles Are Us Company requires you to use Packet Tracer V8 for development and demonstration of the prototype. The prototype **does** **not need to have in it all the devices** that would be required in the actual physical implementation.

In implementing your VLSM design, you need to consider the following:

1. The Company workgroups

* Guca
  + Leasing group
  + Marketing group
  + Business group
* Ljubis
  + Leasing group
* Lucani
  + Sales group
* Mackat
  + Sales group
* All Sites
  + Security group
  + Technical Support group
  + Vehicle Servicing group

2. The number of staff

Each staff member will have either a desktop PC or a Laptop PC.

* Guca
  + 125 staff in the Leasing group (162.5)
  + 180 staff in the Marketing group (234)
  + 200 staff in the Business group (260)
* Ljubis
  + 80 staff in the Leasing group (104)
* Lucani
  + 140 staff in the Sales group. (182)
* Mackat
  + 125 staff in the Sales group (162.5)
* All sites
  + 20 staff in the Security group, 5 staff at each site. (5 turns into 6.5 so 7 per site)
  + 20 staff in the Technical Support group, 5 staff at each site (5 turns into 6.5 so 7 per site)
  + 20 staff in the Vehicle Servicing group, 5 staff at each site (5 turns into 6.5 so 7 per site)

3. Server Farm

* Separate company Server Farm VLAN at the Guca site. You can decide the number and type of servers required. You must allow for IP address space for the Server farm in your VLSM design.

4. Switch Management VLANs

* A Switch Management VLAN must be created at each site
* For the Management VLAN number refer to your specifications

5. Printer

* Allow for 1 printer for at each company site (kept its ip with techsupport vlan instead of doing a separate vlan for each printer in each areas)

6. VLSM Implementation

The company requires the use of VLSM Design to ensure efficient use of the IP address space.

* Use *pseudo private* class A network (refer to your specifications) for internal addressing
* Take into account the for expected % growth (refer to your specifications) of current IP requirements when determining size of subnets.
* Clearly identify ip address space that is available for future use.
* Record details in table A to show the subnets that meet the Company requirements.

**Table A: VLSM Design**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of**  **host addresses required** | **Subnet Network**  **Address** | **Subnet Mask** | **Subnet**  **Prefix** | **Max Number of Hosts Possible** | **Address Space**  **Future Use**  **Y/N** | **VLAN Name** | **Site Location** |
|  |  |  |  |  |  |  |  |
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Phase 3 – Routing Protocol Planning

The company network will use OSPF as the routing protocol:

* OSPF MD5 authentication is required on the link between Guca and Mackat routers
* The bandwidth on all internal router to router serial links must be set to 256
* Set passive interface for relevant interfaces
* Configure a default route to Mackat ISP
* Advertise default route to other internal routers
* Guca Only: router must be accessible via SSH for maintenance by Technical Support group

Phase 4 – Switch and VLAN Planning

* All sites
  + Rather than use VLAN 1 as the default management VLAN at each site, configure a Management VLAN with VLAN number provided by your specifications. All switches will be in this Management VLAN.
  + All unallocated switch ports must be shutdown
  + All access switches must have one access port for each VLAN configured, except for the Management VLAN
* Ljubis Only: access switch ports must be secured using port security
* Mackat Only: access switches require path redundancy to a distribution switch. The distribution switch must be configured as the route bridge for all VLANs
* Guca Only: switches at this site must be accessible via SSH for maintenance by Technical Support group

Phase 5 – Configure Switches, VLANs

* Refer to Phases 2, 4
* There must be a PC (clearly identified and connected eg PC Sales) on each VLAN to allowing testing of the network
* For each site, record Switch details in table B:

**Table B: Switch Details**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Model** | **# of Ports** | **Location** | **Management VLAN IP**  **Address** | **Default Gateway**  **IP Address** | **Management**  **Vlan** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Phase 6 – Ether Channel

* The company wants to implement Ether Channel.
* In the **prototype** just implement LACP Ether Channel only for the Lucani site

Phase 7 – Configure Routers and Routing Protocol

* Refer to Phase 2 for VLSM subnets and IP Address assignment.
* Refer to Phase 3 for details regarding OSPF.
* The Internet Web Server attached to Mackat ISP has a Class B address (given by your lab tutor). This Web Server represents the “Internet”.
* Configure a static route on Mackat ISP to the internal network
* For each site, record Router IP address details in table C.

**Table C: Router Details**

Site: Router Name:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Interface/Sub  Interface  Type/Number | **Description and Purpose** | **Network/VLAN Name** | **Network Address** | **Interface IP address** | **Subnet Mask /value** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Phase 8 – Configuring IP Addresses

**8.1 DHCP – Ljubis Site**

* The company wants to use DHCP.
* In the **prototype** just implement DHCP only for Ljubis site.
* DHCP must dynamically provide IP address information to PC workstations/Laptops.
* Use the information documented in Phase 1 to configure each DHCP pool.
* Connect only 1 PC workstation to a switch for each of the appropriate VLANs .
* Label the PCs, for example PCLeasing. This will aid your team and the Tutor in testing the Packet Tracer prototype

**8.2 Other Sites**

* Directly configure all devices with an IP address

**Table D: Ljubis DHCP Server Pool IP Host Addresses**

|  |  |  |  |
| --- | --- | --- | --- |
| **VLAN Name** | **IP Address Pool Range** | **Subnet mask**  /value | **Default Gateway**  IP Address |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Table E: Statically assigned IP Host Addresses – Servers, Printers etc**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Server/Printer etc **Name** | **In which**  **VLAN** | **IP Address** | **Subnet**  **Mask**  **/Value** | **Default Gateway**  **IP Address** | **Service/s Provided** |
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Phase 9 – PPP

* Configure PPP and CHAP authentication on the link to the ISP.

Phase 10 – Wireless LAN Deployment Site

* In the prototype, you will implement a wireless LAN only at the deployment site given in your specification.
* The Site Security group must have access to the network via the wireless LAN.
* Determine the number of Wireless Access Points that are required at the site to support the Security group. Show the details of your calculation.
* With the help of graph paper (scan it to include in the report), show to scale the deployment of the wireless access points across the site.
* In the prototype configure one wireless access point, and test that a Security group laptop can ping all devices within the site.

Table F: Wireless Access Point Details

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Model** | **SSID** | **Channel** |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

Phase 11 – NAT Configuration

The company wants to use private addresses. The addresses provide by your tutor do not actually belong to the private range, but are sufficient for the purpose of building the prototype network.

1. 1. Configure NAT on the router that is acting as your gateway router to the Internet as follows:

* Define the NAT pool. Please use the Class B NAT pool public address given to you by your lab tutor.
* Use Static NAT to assign a static public address to each of the servers in Server Farm
* The rest of the address range can be used with the NAT pool.
* Define an access control list, which will permit all IP traffic from permitted internal addresses.
* Overload your NAT pool

1. 2. Test that NAT is working from a host on any LAN or VLAN. The host should be able to ping and browse to the Internet Web Server.

Phase 12 – Access Control at Guca Site

The company requires the implementation of ACLs to control the flow of IP traffic within its network and to the Internet. In the **prototype**, you will implement Named Access Control Lists**,** at the **Guca** site only.

1. Before you implement the ACLs, test that each PC is able to browse and ping the Internet Web Server, all the Internal Servers and PCs on other VLANs
2. You are to implement ACLs that will control IP traffic flow between the VLANs and the Internet as follows:
   1. ACL Rules for Server Farm LAN Access

You must decide the ACL access rules as to which VLANs can access which servers in the Server Farm VLAN

* 1. ACL Rules for Group Access VLANs

1. All VLANs are permitted access to Internet unless specifically denied below
2. All VLANs are permitted access to other VLANs unless specifically denied below
3. PC hosts in the Marketing VLAN denied access to the Leasing VLAN.
4. PC hosts in Vehicle Servicing VLAN is denied access all other VLANs
5. PC hosts in all other VLANs are denied access to Technical Support VLAN
6. Use a table to record the testing of the ACLs (add Rows as needed):

**Table G: Record of ACL Testing Guca**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source Host** | **Destination Host/Server** | **Protocol** | **Expected Result**  Permitted/Denied | **Achieved**  Yes/No |
| Host on Leasing Only | Internet Web Server | HTTP |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
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Title Page, Identification and Specification Information

**Note: If you do not provide the correct Identification Details – Team, Full Names, Student Ids and Lab Classes as shown in examples below it will be difficult to record your results.**

**Marks are allocated for providing full and correct Title Page, Identification and Specification Information.**

**Team Identification Details**

* Team Title Page
* For each team member provide, student name, id, lab day/time/room, unit code

**Example Title Page:**

**\*\*\*** **Team Case Study \*\*\***

**ESP**  **Team:** **T022**

**Lab Class: Tuesday 11:30 ATC328**

**Class Tutor: John Brown**

**Team Members**

**Mick Mouse 123456789**

**Black Cat 765432112**

**Snow White 123331234**

**Specification Information**

* + Specification Number : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Class A Internal network address : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Class B NAT pool public address : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Class C ISP network connection address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Class B ISP Internet Web server address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Wireless Deployment Site : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Management VLAN Number : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Percentage Growth (VLSM) : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Case Study Report Structure

The report should include concise explanation, rationale and justification for your design and implementation. The report (excluding tables A to H) should not exceed 20 pages.

* Discussion of Network Design Issues
  + Discuss and provide rationale/justifications for your design choices for the following:
    - IP VLSM Design
    - Routing Protocols
    - Switches: VLANs, STP, EtherChannel
    - Wireless LANs and Site Layout for the specified site
    - DHCP
    - NAT
    - Security and Access Control Policies
    - System Testing and Verification Strategy
* Tables A to G
* **Note: DO NOT include show run output in your report**

**Case Study Report Group - Mark Allocation 49 marks**

**Title Page, Identification, and Specification Information - Correct and Complete** (4 marks)

**Total (4 marks)**

**Discussion of Network Design Issues**

IP VLSM Design (4 marks)

Routing Protocols (4 marks)

Switches: VLANs, STP, EtherChannel (4 marks)

Wireless LANs and Site Layout for the specified site (6 marks)

DHCP (3 marks)

NAT (4 marks)

Security and Access Control Policies (4 marks)

System Testing and Verification Strategy (6 marks)

**Total (35 marks)**

**Report Structure and Layout**

Clear statements of issues and good presentation style (8 marks)

Tables A to H provided (2 marks)

**Total (10 marks)**

**Network Prototype Group - Mark Allocation 39 marks**

Implementation and Functionality

Switch Implementation (6 marks)

Wireless LAN Implementation (4 marks)

Router Implementation (14 marks)

Security Polices and Access Control Implementation (15 marks)

Total (39 marks)

Case Study Reflection Report - Individual

**Marked out of 2**

Each team member prepares a Reflection Report

A critical reflection is the process of reviewing how things went in the case study.

You should reflect on your actions, considering what worked well and what did not.

What did you learn from this experience?

How would you approach a future team assignment?

Etc

Here our group had started with basically only two members at first, me and James. Then a few weeks later (just after the mid semester skill), we were joined by Sajid and a few weeks after that we were joined by Jaysen as we still had space for one more member.

Although gathering all the members took time, in the beginning me and James believed that we would complete the project on our own and thus had worked accordingly, setting up all the preplanning regarding network design, VLSM and ip address allocation before the other two joined us. During this time we had only worked once a week and thus our progress was quite slow.

When Sajid had joined, we wanted to pick up the speed and get more of the configurations done. Unfortunately, Sajid had soon got into a car accident, resulting in him being hospitalized. This delayed our work speed as we had started to wait for his arrival, hoping he will get well soon and then we would quickly finish the rest. But that wasn’t the case at all as he soon had to move to Sydney for further treatment which resulted in his total lack of contribution in the case study.

After realising this, we not to wait any longer and instead took Jaysen into our team to resume our work with full vigor. Unfortunately, by then we had wasted too many days and had too many configurations to complete. Thus instead of following once a week basis of work, we shifted it to 3 days a week where we would distribute work amongst ourselves and troubleshoot everything whenever we would meet. Although this method “saved time”, errors would still pop up when we would integrate and combine our work during those days. Thus we ended up using the “saved time” in troubleshooting and correcting those errors.

Finally in the very last week, we started to work on both the documentation (ie report writing) and also complete the remaining packet tracer configuration setup simultaneously as we realised we would need to submit both on 9th May (Monday) and not just the configuration. Although this was quite difficult, we were still able to provide the adequate time needed to complete the case study (including all troubleshooting and thus could submit everything before deadline.

Overall, I learnt a crucial lesson from all of this, do not wait and believe you have all the time in the world. Instead start working in advance and prepare contingencies in case things go wrong. Furthermore, always troubleshoot and ensure that the added configuration parts not only works on its own, but also works properly without in habiting any of the other configurations, when integrated into the system.