

Case Study

Semester 1 - 2020

Network Design and Implementation

V4.2

Due Date

Sunday 10 May 2020 23:59 hours

Table of Contents

1. Phase 0 - Ensure you read this
2. Phase 1 - Case Study Overview
3. Phase 2 - IP addressing and VLSM Design
4. Phase 3 - Routing Protocol Planning
5. Phase 4 - Switch and VLAN Planning
6. Phase 5 - Configure Switches, VLANs
7. Phase 6 - Ether Channel
8. Phase 7 - Configure Routers and Routing Protocol
9. Phase 8 - Configuring IP Addresses
10. Phase 9 - Configure Frame Relay and PPP
11. Phase 10 - Wireless LAN Deployment Site
12. Phase 11 - NAT Configuration
13. Phase 12 -Access Control at Nakuru Site

14. Title Page, Identification and Specification Information
15. Case Study Report Structure
16. Case Study Report and Network Prototype - Mark Allocation
17. Case Study Video Presentation
18. Case Study Video Presentation - Mark Allocation

Phase 0 – Ensure you read this

1. Assignment - Team or Individual

a) For students doing the unit for the first time:

- This is a **Team** assignment.
- The Case Study is to be completed by a team of 3 to 4 persons. **If your team is less than 3 members you will not get the team mark.**
- Team members can be drawn from across the Unit, they are not 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, and inform a tutor of your ESP Team Number, Members' Names, Student IDs and Lab Classes.**
- **A tutor will issue with your network address specifications.**

b) For students repeating the unit:

- This is an **Individual** assignment. **Please inform your Tutor that you are a repeating student.**
- You have to be registered on ESP (<https://esp.swin.edu.au/>).
- **Please inform, by week 2, a tutor of your ESP Team Number, Name, Student ID and Lab Class**
- **A tutor will issue with your network address specifications.**

2. Case Study Deliverables

The following **three** deliverables must be submitted to **ESP**:

- 1) **A Case Study Report** – structure outlined below
 - a) Identification Details: Team or Individual
 - b) Report Structure
- 2) **A Packet Tracer Prototype, latest V7 version**
- 3) **A Video Presentation file**

3. Case Study Submission - Deadline

The deliverables must be submitted to **ESP** by **Sunday 10 May 2020 23:59 hours**

Late submission - a late penalty of 10% per day or part there of applies.

Phase 1 - Case Study Overview

Best Vehicles R Us Ltd is a company that leases buys and sells and repairs cars, trucks and buses. The Head Office is at the Nakuru site. The other company sites are in Kinamba, Chuka and Nyerin.

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 Best Vehicles R Us Company network. You must prepare:

1. A Written Report
2. A Video Presentation where each member of the team outlines their contributions to the project
3. A **prototype** of the network, built using Packet Tracer V7 as a proof of concept that your team can build a network that will satisfy the company's requirements.

4. Please note the following:

- You have **10 weeks** (which includes the Mid-Semester Break) to complete the case study. It is important to **form your team and get your specifications from a tutor early**.
- 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
- The case study is:
 - a **team** assessment for **first time** students
 - an **individual** assessment for **repeating** students.
- In forming a team: it is the **responsibility of each student to negotiate with other students** within the unit 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.**
- **The get following information from a Tutor !**
 - Specification Number (Spec No)
 - **Pseudo private** Class A Internal network address (to ensure uniqueness between assignments)
 - Class B NAT Pool Public IP address range
 - Class C ISP Network Connection IP addresses
 - Class B ISP Internet Web Server IP address
 - Wireless deployment site
 - Expected Percentage Growth of staff for VLSM design
 - Switch Management VLAN number

5. Company Site Layouts

At Nakuru:

- 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 500metres x 500metres
- Building Floor size 100metres x 200metres
- Technical Support group on floor 1

At Kinamba:

- Leasing, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
- Site size 150metres x 200metres
- Building Floor size 20metres x 30metres

At Nyeri:

- Sales, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
- Site size 100metres x 100metres
- Building Floor size 25metres x 30metres

At Chuka:

- Sales, Vehicle Servicing and Technical Support groups are on the ground floor of a single level building
- Site size 125metres x 100metres
- Building Floor size 25metres x 40metres

Phase 2 – IP addressing and VLSM Design

The Best Vehicles R Us Company require you to use Packet Tracer V7 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

- Nakuru
 - Leasing group
 - Marketing group
 - Business group
- Kinamba
 - Leasing group
- Nyeri
 - Sales group
- Chuka
 - 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.

- Nakuru
 - 125 staff in the Leasing group
 - 180 staff in the Marketing group
 - 200 staff in the Business group
- Kinamba
 - 80 staff in the Leasing group
- Nyeri
 - 140 staff in the Sales group.
- Chuka
 - 125 staff in the Sales group
- All sites
 - 20 staff in the Security group, 5 staff at each site.
 - 20 staff in the Technical Support group, 5 staff at each site
 - 20 staff in the Vehicle Servicing group, 5 staff at each site

3. Server Farm

- Separate company Server Farm VLAN at the Nakuru 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. Printers and Photocopiers

- Allow for 1 printer and 1 photocopier for at each company site

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 that are 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 |
|-----------------------------------|------------------------|-------------|---------------|------------------------------|------------------------------|-----------|---------------|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Phase 3 – Routing Protocol Planning

The company network will use OSPF as the routing protocol:

- OSPF MD5 authentication is required on the link between **Nakuru** and **Chuka** routers
- The bandwidth on all internal router to router links must be set to 512
- Set passive interface for relevant interfaces
- Configure a default route to **Chuka** ISP
- Advertise default route to other internal routers
- **Nakuru 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
- **Kinamba Only:** access switch ports must be secured using port security
- **Chuka Only:** access switches require path redundancy to a distribution switch. The distribution switch must be configured as the route bridge for all VLANs
- **Nakuru 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 | VTP Mode | VTP Domain |
|------|-------|------------|----------|----------------------------|----------------------------|-----------------|----------|------------|
| | | | | | | | | |
| | | | | | | | | |

Phase 6 – Ether Channel

- The company wants to implement Ether Channel.
- In the **prototype** just implement LACP Ether Channel **only** for the **Nyeri** 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 **Chuka** ISP has a Class B address (given by your lab tutor). This Web Server represents the “Internet”.
- Configure a static route on Chuka 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 – Kinamba Site

- The company wants to use DHCP.
- In the **prototype** just implement DHCP **only** for **Kinamba** site.
- DHCP must dynamically provide IP address information to PC workstations/Laptops.
- DHCP must manually provide an IP address to the printer
- 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: Kinamba 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 |
|-------------------------------|------------------|------------|--------------------------|-------------------------------|-----------------------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Phase 9 – Configure Frame Relay and PPP

- Configure a Cloud in Packet Tracer as Frame Relay Switch, use it to connect the company's sites
- 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. 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.
- Assign a static address to each of the servers.
- 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

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 Nakuru 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 Access Control Lists **only** at the **Nakuru** site.

- i. 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
- ii. You are to implement ACLs that will control IP traffic flow between the VLANs and the Internet as follows:
 - a. 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
 - b. ACL Rules for Group Access VLANs
 - i. All VLANs are permitted access to Internet unless specifically denied below
 - ii. All VLANs are permitted access to other VLANs unless specifically denied below
 - iii. PC hosts in the Marketing VLAN denied access to the Leasing VLAN.
 - iv. PC hosts in Vehicle Servicing VLAN is denied access all other VLANs
 - v. PC hosts in all other VLANs are denied access to Technical Support VLAN
- iii. Use a table to record the testing of the ACLs (add Rows as needed):

Table G: Record of ACL Testing Nakuru

| Source Host | Destination Host/Server | Protocol | Expected Result Permitted/Denied | Achieved Yes/No |
|----------------------|-------------------------|----------|-------------------------------------|--------------------|
| Host on Leasing Only | Internet Web Server | HTTP | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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.

Identification Details: Team OR Individual

i) **Team Identification Details (remember a team must have at least 3 members)**

- 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 – First Time Students

Team Members

| | | | | | |
|-------------------|------------------|------------------|--------------|---------------|-----------------|
| Mick Mouse | 123456789 | Tuesday | 11:30 | ATC328 | TNE20002 |
| Black Cat | 765432112 | Tuesday | 11:30 | ATC328 | TNE70003 |
| Snow White | 123331234 | Wednesday | 14:30 | ATC329 | TNE20002 |

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) : _____
- **Tutor** who provided specification : _____

ii) Individual Identification Details

- Individual Title Page
- Provide student name, id, lab day/time/room, unit code
- Indicate whether **Repeating** or **First Time** student

Example Title:

*** Individual Case Study ***

ESP No: T022

Fred Flintstone 1234567 Tuesday 11:30 ATC329 TNE20002

Please indicate status: **Repeating** ☐ **First Time** ☐

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) : _____
- **Tutor** who provided specification : _____

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 and Network Prototype Mark Allocation

Marked out of a 100 with marks allocated as follows:

Report -----

Title Page, Identification, and Specification Information - Correct and Complete (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 -----

Packet Tracer Prototype Implementation and Functionality

- Switch Implementation (6 marks)
- Wireless LAN Implementation (4 marks)
- Router Implementation (16 marks)
- Security Policies and Access Control Implementation (15 marks)

Total (41 marks)

Assignment Type -----

Assignment Type Mark

- Team** - 3 to 4 persons - First Time Students - Team Management mark (10 marks)
- Not a Team** - 1 to 2 persons - First Time Students - No Team Management mark (0 marks)
- Repeat** - Repeat Student – (10 marks)

Total (0 or 10 marks)

Total 100 marks

Case Study Video Presentation

The team must put together a Video Presentation. Each team member must give an overview of their contribution to the Case Study.

Case Study Video Presentation – Mark Allocation

Marked out of a 10, with marks allocated as follows:

- **Organisation – Team (3 marks)**
 - Overall organisation of the presentation for all group members. This will be assessed on the structure of the presentation.
- **Presentation Skills – Individual (4 marks)**
 - How well is the individual able to clearly articulate their part of the presentation and how well is the individual able to talk and engage the viewer.
- **Content – Individual (3 marks)**
 - How well does the individual presentation cover the required content.

Total 10 marks