

**-** School of Innovation, Design & Technology **-**

**IT5506 Bachelor of Information Technology**

**IT5487 Diploma in Information Systems**

**(Level 5)**

Practical Lab 1.2

# Configure router and switch-based Ethernet network

**Student No.**  **\_\_\_\_2231290\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Name:** **\_\_\_\_\_\_\_Andrew Graff\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Score:** **\_\_\_\_\_\_ / 100 points**

Details

Due Date:  **06 October 2022**

This Lab is worth **10%** of the over-all course grade

Overview

Learning Outcomes:

On successful completion of this assessment, the learner will be able to:

1. Describe network protocol models and devices to explain the layers of communications in data networks.
2. Design and calculate IP addresses and subnet masks for both IPv4 and IPv6 for given simple networks, using IPv4 and IPv6.
3. Explain fundamental Ethernet concepts.

Tasks

There are four parts to this assessment.

Part one you will use the Cisco Packet Tracer application to build a virtual network consisting of routers, switches, servers, printers and computers. The network will be built based on the network topology diagram using the appropriate network media to connect devices together.

Part two you will design an IPv4 network addressing scheme to use on your network devices. You will need to break the overall IPv4 network domain into smaller subnets. You will be using the Variable Length Subnet Mask (VLSM) subnetting technique to create these smaller broadcast domains. Once your IPv4 addressing scheme has been identified you will the create a matching IPv6 hexadecimal addressing scheme ensuring devices have the same subnet id and host id of IPv4 and IPv6 addresses.

You will use the following addresses for your network.

* **192.168.10.0 /24**
* **2023:5506:5487:: /64**

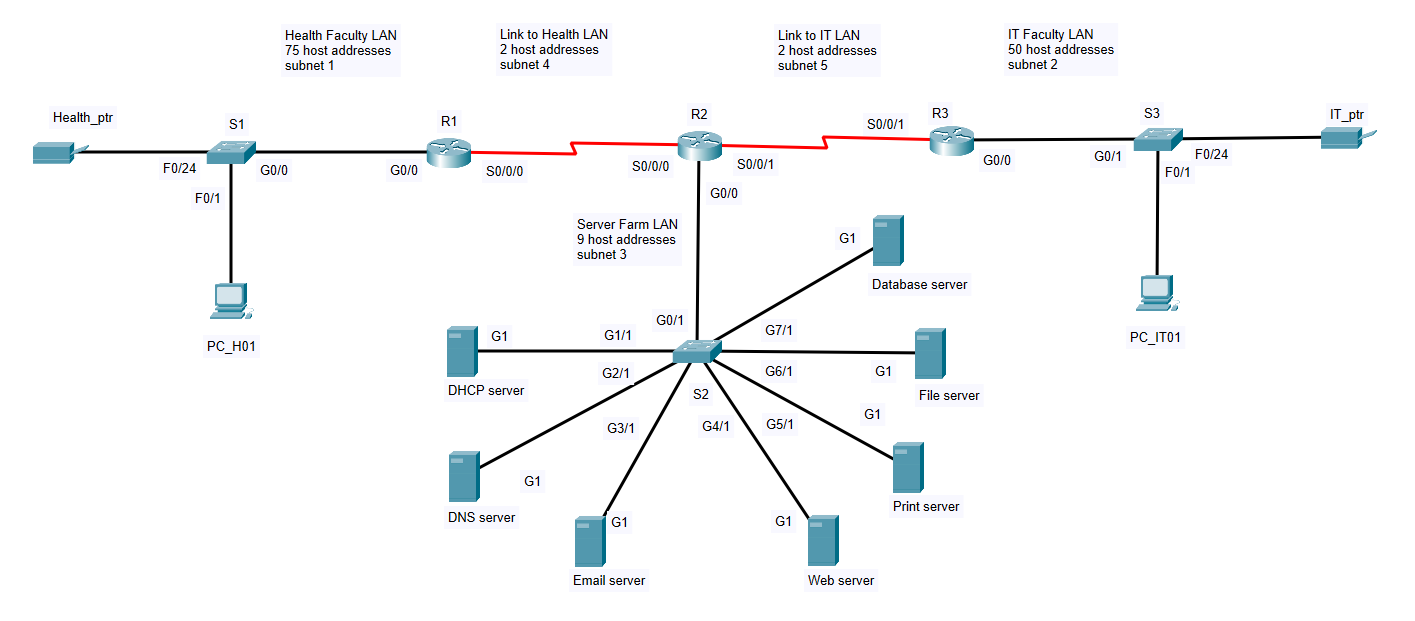
Part three you will configure network devices with the appropriate IPv4 and IPv6 addresses as identified in your IP Addressing Scheme. Network routers and switches also need basic security and routing configuration settings.

Part four you must verify connectivity between the computers and all other devices. All devices must be reachable via their IPv4 and IPv6 GUA addresses while switches will only be reachable via their IPv4 addresses.

There are two assessment files that you need to upload our Moodle page. These are to be completed and uploaded to Moodle Lab 1.2 Submission Box for marking.

1. Lab 1.2 PT assessment file
2. Lab 1.2 assessment tasks (this file)

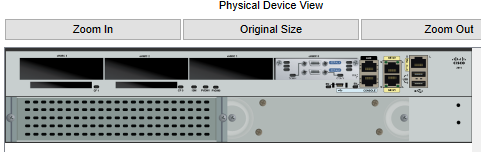
**Network Logical Topology Diagram**



**Part One: Build the Network** **22 marks**

Using the Packet Tracer application build the virtual network based on the Network Topology Diagram above.

1. Open Packet Tracer application and create a new file.
2. Add all network devices **5 marks**
3. Add new interfaces and ports to routers, switches and servers **9 marks**
4. Connect media to appropriate interfaces and ports and NIC’s **8 marks**
5. Add the following Routers to the desktop.
   1. Click on the Network Devices icon
   2. Click on the Routers icon
   3. Select the 2911 Router and add 3 routers to the desktop
      1. You will need to add serial interfaces to each router
      2. Click on R1 router and the Physical tab
      3. Turn the Power Off
      4. Click on the Modules tab to view interface modules to add
      5. Click on the HWIC-2T module and drag it to the empty interface port closet to the existing LAN ports
      6. Power On the router
      7. Repeat these steps for R2 and R3 routers



1. Add the following Switches to the desktop
   1. Click on the Network Devices icon
   2. Click on the Switches icon
   3. Select the 2960 Switch and add 2 switches to the desktop
   4. These will be used for the IT and Health LAN’s.
   5. Now select the PT-Empty switch and add 1 switch to the desktop
      1. This switch will be used for the Server Farm LAN
      2. You will need to add Gigabit Ethernet interfaces to the switch
      3. Click on the PT-Empty switch and the Physical tab
      4. Turn the Power Off
      5. Click on the Modules tab to view interface modules to add
      6. Click on the PT-SWITCH-NM-1CGE module and drag it to the empty interface port closet to the existing Power button
      7. Repeat this step until you have added 8 new interfaces
      8. Power On the switch

A close-up of a device

Description automatically generated

1. Add the following End-user devices to the desktop eg computers, printers and servers
   1. Click on the End Devices icon
   2. Click on the Printer icon and add 2 printers to the desktop
   3. Click on the PC icon and add 2 PC to the desktop
   4. Click on the Server icon and add 7 servers
      1. Each server will need to have a Gigabit Ethernet NIC installed
      2. Click on a server and the Physical tab
      3. Turn the Power Off
      4. Click on the Modules tab to view interface modules to add
      5. Click on the PT-HOST-NM-1CGE module, drag to the empty NIC port
      6. Turn the Power On
      7. Repeat these steps for each server

A close up of a computer

Description automatically generated A close-up of a computer

Description automatically generated A close-up of a computer port

Description automatically generated

1. Connect all network devices based on the network topology diagram
   1. Connect router to router
      1. Click on the Connections icon
      2. Click on the Serial DCE cable
      3. Connect to R2 router serial interface
      4. Connect to R1 router serial interface
      5. Click on the Serial DTE cable
      6. Connect to R2 router serial interface
      7. Connect to R3 router serial interface
   2. Connect routers to LAN switches
      1. Click on the Connections icon
      2. Select the appropriate utp patch cable to use
      3. Connect to R1 router gigabit ethernet interface
      4. Connect to S1 switch gigabit ethernet port
      5. Click on the Connections icon
      6. Select the appropriate utp patch cable to use
      7. Connect to R2 router gigabit ethernet interface
      8. Connect to S1 switch gigabit ethernet port
      9. Click on the Connections icon
      10. Select the appropriate utp patch cable to use
      11. Connect to R3 router gigabit ethernet interface
      12. Connect to S3 switch gigabit ethernet port
   3. Connect Printers to LAN switches
      1. Click on the Connections icon
      2. Select the appropriate utp patch cable to use
      3. Connect to S1 switch fast ethernet port
      4. Connect to printer fast ethernet port
      5. Select the appropriate utp patch cable to use
      6. Connect to S3 switch fast ethernet port
      7. Connect to printer fast ethernet port
   4. Connect Computers to LAN switches
      1. Click on the Connections icon
      2. Select the appropriate utp patch cable to use
      3. Connect to S1 switch fast ethernet port
      4. Connect to computer fast ethernet port
      5. Select the appropriate utp patch cable to use
      6. Connect to S3 switch fast ethernet port
      7. Connect to printer fast ethernet port
   5. Connect servers to LAN switch
      1. Click on the Connections icon
      2. Select the appropriate utp patch cable to use
      3. Connect to DHCP server to S2 switch G1/1 gigabit ethernet port
      4. Connect to DNS server to S2 switch G2/1 gigabit ethernet port
      5. Connect to Email server to S2 switch G3/1 gigabit ethernet port
      6. Connect to Web server to S2 switch G4/1 gigabit ethernet port
      7. Connect to Print server to S2 switch G5/1 gigabit ethernet port
      8. Connect to File server to S2 switch G6/1 gigabit ethernet port
      9. Connect to Database server to S2 switch G7/1 gigabit ethernet port

**Part Two: Design the IP Addressing Scheme** **36 marks**

1. **Network IP Address Requirements**

You have been assigned the following network IP addresses to use. Based on these addresses you will create a subnet addressing scheme that will minimise the number of wasted IPv4 addresses.

|  |  |
| --- | --- |
| ***IPv4 address*** | **192.168.10.0 /24** |
| ***IPv6 address*** | **2023:5506:5487:: /64** |

Use the Variable-Length Subnet Mask (VLSM) subnetting method to subnet the existing IPv4 network address to meet the following network requirements. These are the minimum IP addresses needed for each LAN.

Note when using VLSM start from the subnet needing the most addresses first, then the next highest etc until you cover all subnet requirements

1. Health Faculty LAN needs 75 host addresses
2. IT Faculty LAN needs 50 host addresses
3. Server Farm LAN needs 9 host addresses
4. Link to IT LAN needs 2 host addresses
5. Link to Health LAN needs 2 host addresses
6. **Complete the Binary IP Addressing table**

In the following subnet addressing table using binary number system identify each subnets network address, first useable host address, last useable host address and the subnets broadcast address.

**Subnetting questions**. **5 marks**

Identify number of host bits needed for each subnet and the total number of useable addresses available.

1. Based on the original network address and subnet mask address (/24), how many host bits, and how many useable addresses in the original broadcast domain

|  |
| --- |
| 256 host, 254 useable addresses, |

1. Health Faculty is the first subnet needed

|  |
| --- |
| 128 host, 126 useable addresses, 255.255.255.128 |

1. IT Faculty subnet is the second subnet needed

|  |
| --- |
| 64 host, 62 useable addresses, 255.255.255.192 |

1. Server Farm subnet is the third subnet needed

|  |
| --- |
| 16 host, 14 useable addresses, 255.255.255.224 |

1. Links to Health and IT LAN are the fourth and fifth subnets needed

|  |
| --- |
| 4 host, 2 usable addresses, 255.255.255.252 |

1. **Binary IPv4 Subnet Addressing Table** **10 marks**

Now complete the Binary IPv4 Addressing table to document the range of IPv4 addresses to use in each subnet and the decimal equivalent of the binary addresses.

Note: You only need to show the binary for the last 8 bits of the address eg for the address of 192.168.10.1 it would be shown as **00000001**. For the subnet mask write this down in the shortened slash format eg **/24**.

|  |  |  |
| --- | --- | --- |
| 1. **Subnet 1. Health Faculty** | **Binary IPv4 address** | **Decimal** |
| Subnet network address | 192.168.10.0 /25 | 00000000 |
| First useable host address | 192.168.10.1 /25 | 00000001 |
| Last useable host address | 192.168.10.126 /25 | 01111110 |
| Subnet broadcast address | 192.168.10.127 /25 | 01111111 |

|  |  |  |
| --- | --- | --- |
| 1. **Subnet 2 IT Faculty** | **Binary IPv4 address** | **Decimal** |
| Subnet network address | 192.168.10.128 /26 | 10000000 |
| First useable host address | 192.168.10.129 /26 | 10000001 |
| Last useable host address | 192.168.10.190 /26 | 10111110 |
| Subnet broadcast address | 192.168.10.191 /26 | 10111111 |

|  |  |  |
| --- | --- | --- |
| 1. **Subnet 3 Server Farm** | **Binary IPv4 address** | **Decimal** |
| Subnet network address | 192.168.10.192 /27 | 11000000 |
| First useable host address | 192.168.10.193 /27 | 11000001 |
| Last useable host address | 192.168.10.222 /27 | 11001110 |
| Subnet broadcast address | 192.168.10.223 /27 | 11001111 |

|  |  |  |
| --- | --- | --- |
| 1. **Subnet 4 and 5 LAN Links** | **Binary IPv4 address** | **Decimal** |
| Subnet network address | 192.168.10.224 /30 | 11100000 |
| First useable host address | 192.168.10.225 /30 | 11100001 |
| Last useable host address | 192.168.10.228 /30 | 11101110 |
| Subnet broadcast address | 192.168.10.229 /30 | 11101111 |

|  |  |  |
| --- | --- | --- |
| 1. **Reserved Addresses** | **Binary IPv4 address** | **Decimal** |
| Subnet network address | 192.168.10.230 /28 | 11110000 |
| First useable host address | 192.168.10.231 /28 | 11110001 |
| Last useable host address | 192.168.10.245 /28 | 11110110 |
| Subnet broadcast address | 192.168.10.246 /28 | 11110111 |

1. **IP Address Allocation Specifications**

Based on your IP addressing scheme use the appropriate subnet and host addresses as specified below. Then complete the IP Address Allocation Table.

Health Faculty Subnet

* R1 router G0/0 interface gets the first ip address of the subnet
* S1 switch vlan 1 interface gets the second ip address of the subnet
* P1 printer gets the last ip address of the subnet
* Host computers get rest of the subnet addresses starting from the third ip address of the subnet

IT Faculty Subnet

* R3 router G0/0 interface gets the first ip address of the subnet
* S3 switch vlan 1 interface gets the second ip address of the subnet
* P3 printer gets the last ip address of the subnet
* Host computers get rest of the subnet addresses starting from the third ip address of the subnet

Server Farm Subnet

* R2 router G0/1 interface gets the first ip address of the subnet
* S2 switch vlan 1 interface gets the second ip address of the subnet
* Server computers get rest of the subnet addresses starting from the third ip address of the subnet
  + DHCP server gets the third ip address of the subnet
  + DNS server gets the fourth ip address of the subnet
  + Email server gets the fifth ip address of the subnet
  + Web server gets the sixth ip address of the subnet
  + Print server gets the seventh ip address of the subnet
  + File server gets the eighth ip address of the subnet
  + Database server gets the nineth ip address of the subnet

LAN Link Subnets

1. R2 router S0/0/0 interface gets the first ip address of the subnet
2. R1 router S0/0/0 interface gets the second ip address of the subnet
3. R2 router S0/0/1 interface gets the first ip address of the subnet
4. R3 router S0/0/1 interface gets the second ip address of the subnet

Unused IP addresses

* The rest of the unused ip addresses are reserved for future use.

Once you have identified the IPv4 subnet addressing scheme you will then implement the IPv6 hexadecimal addressing scheme to match the IPv4 subnet and host addresses allocated to the different LAN’s and complete the IP Address Allocation table below

1. **IP Address Allocation Table** **21 marks**

Note IPv6 GUA addresses must match the IPv4 subnet id and host numbers but in hexadecimal format

Note IPv6 LLA addresses for the computers, printers and servers are automatically generated, do not change.

Note IPv4 you only need to show the last decimal digit of the address e.g. 192.168.10.1 would be .1 and /24 for the subnet mask

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Device | Interface | IPv4 | IPv4 DFG | IPv6 LLA | IPv6 GUA | IPv6 DFG |
| R1 | G0/0 | 192.168.10.1 | n/a | FE80::1:1 | 2023:5506:5487:1::1 | n/a |
|  | S0/0/0 | 192.168.10.226 | n/a | FE80::4:2 | 2023:5506:5487:4::E2 | n/a |
| R2 | G0/0 | 192.168.10.193 | n/a | FE80::3:1 | 2023:5506:5487:3::C1 | n/a |
|  | S0/0/0 | 192.168.10.225 | n/a | FE80::4:1 | 2023:5506:5487:4::E1 | n/a |
|  | S0/0/1 | 192.168.10.229 | n/a | FE80::5:1 | 2023:5506:5487:5::E5 | n/a |
| R3 | G0/0 | 192.168.10.129 | n/a | FE80::2:1 | 2023:5506:5487:2::81 | n/a |
|  | S0/0/1 | 192.168.10.230 | n/a | FE80::5:2 | 2023:5506:5487:5::E6 | n/a |
| Switches | | | | | | |
| S1 | Vlan 1 | 192.168.10.2 | 192.168.10.1 | n/a | n/a | n/a |
| S2 | Vlan 1 | 192.168.10.194 | 192.168.10.193 | n/a | n/a | n/a |
| S3 | Vlan 1 | 192.168.10.130 | 192.168.10.129 | n/a | n/a | n/a |
| Computers, Printers and Servers | | | | | | |
| Health\_Faculty\_PC | NIC | 192.168.10.3 | 192.168.10.1 | n/a | 2023:5506:5487:1::3 | FE80::1:1 |
| Health\_Printer | NIC | 192.168.10.126 | 192.168.10.1 | n/a | 2023:5506:5487:1::7E | FE80::1:1 |
| IT\_Faculty\_PC | NIC | 192.168.10.131 | 192.168.10.129 | n/a | 2023:5506:5487:2::83 | FE80::2:1 |
| IT\_Printer | NIC | 192.168.10.190 | 192.168.10.129 | n/a | 2023:5506:5487:2::BE | FE80::2:1 |
| DHCP | NIC | 192.168.10.195 | 192.168.10.193 | n/a | 2023:5506:5487:3::C3 | FE80::3:1 |
| DNS | NIC | 192.168.10.196 | 192.168.10.193 | n/a | 2023:5506:5487:3::C4 | FE80::3:1 |
| Email | NIC | 192.168.10.197 | 192.168.10.193 | n/a | 2023:5506:5487:3::C5 | FE80::3:1 |
| Web | NIC | 192.168.10.198 | 192.168.10.193 | n/a | 2023:5506:5487:3::C6 | FE80::3:1 |
| Print | NIC | 192.168.10.199 | 192.168.10.193 | n/a | 2023:5506:5487:3::C7 | FE80::3:1 |
| File | NIC | 192.168.10.200 | 192.168.10.193 | n/a | 2023:5506:5487:3::C8 | FE80::3:1 |
| Database | NIC | 192.168.10.201 | 192.168.10.193 | n/a | 2023:5506:5487:3::C9 | FE80::3:1 |

**Part Three: Configure the Network Devices** **32 marks**

Now that the design phase is complete start configuring the devices. Based on your addressing table you can configure IP address settings for all devices.

1. **Computer configuration**  **2 marks**
   1. Configure the ipv4 address, subnet mask DNS server, and ipv4 default gateway
   2. Configure ipv6 GUA address, prefix, DNS server and ipv6 default gateway
   3. Accept the default LLA ipv6 address
2. **Printer configuration** **2 marks**
   1. Assign an appropriate display name to the printers e.g. IT\_ptr and Health\_ptr
   2. Configure the ipv4 address, subnet mask, DNS server and ipv4 default gateway
   3. Configure the ipv6 GUA address, prefix, DNS server and ipv4 default gateway
3. **Server configuration** **7 marks**
   1. Assign an appropriate display name to servers eg. DHCP, DNS
   2. Configure the ipv4 address, subnet mask DNS server, and ipv4 default gateway
   3. Configure ipv6 GUA address, prefix, DNS server and ipv6 default gateway
   4. Accept the default LLA ipv6 address
4. **Switch configuration** **9 marks**
   1. For each switch configure the following settings

|  |  |
| --- | --- |
| Mark | Configure these settings |
| 1 | Set Hostname to **S1, S2 or S3** |
| 1 | Set the secret password to: **itsasecret** |
| 1 | Set console password to: **letmein** |
| 1 | Set vty access password to: **class** |
| 1 | Configure a login message of the day to:  “**Authorized Access only!**” |
| 1 | Set the IPv4 default gateway address based on addressing tables |
| 1 | Configure VLAN 1 interface address based on addressing tables |
| 1 | Encrypt all passwords |
| 1 | Save the configuration to NVRAM |

1. **Router configuration** **12 marks**
   1. For each router configure the following settings

|  |  |
| --- | --- |
| Mark | Configure these settings |
| 1 | Enable IPv6 unicast-routing  Note: This **MUST BE THE** **FIRST** command inputted to enable IPv6 routing |
| 1 | Set Hostname to **R1, R2 or R3** |
| 1 | Set the secret password to: **itsasecret** |
| 1 | Set console password to: **letmein** |
| 1 | Set vty access password to: **class** |
| 1 | Configure a login message of the day to:  “**Authorized Access only!**” |
| 3 | Configure serial and ethernet interfaces based on addressing tables   * description * ipv4 address and subnet mask * ipv6 GUA address and prefix * ipv6 LLA address * activate the interface |
| 2 | Configure IPv4 and IPv6 static routes to other LAN networks |
| 1 | Save the configuration to NVRAM |

**Part Four: Connectivity Testing** **10 marks**

Time to conduct connectivity testing. You will test ipv4 and ipv6 GUA address connectivity.

1. Using the ping command conduct connectivity testing from the IT computer to all other devices. If any of the connectivity tests fail troubleshoot the problems and fix any connectivity issues.
2. **Ping connectivity test results table**

|  |  |  |
| --- | --- | --- |
| Device | IPv4 address | IPv6 GUA address |
| IT\_printer | 192.168.10.190 | 2023:5506:5487:2::BE |
| S1 VLAN 1 interface | 192.168.10.2 | n/a |
| R1 G0/0 interface | 192.168.10.1 | 2023:5506:5487:1::1 |
| R1 S0/0/0 interface | 192.168.10.226 | 2023:5506:5487:4::E2 |
| R2 S0/0/0 interface | 192.168.10.225 | 2023:5506:5487:4::E1 |
| R2 S0/0/1 interface | 192.168.10.229 | 2023:5506:5487:5::E5 |
| R3 S0/0/1 interface | 192.168.10.230 | 2023:5506:5487:5::E6 |
| R3 G0/0 interface | 192.168.10.129 | 2023:5506:5487:2::81 |
| S3 VLAN 1 interface | 192.168.10.130 | n/a |
| Health\_printer | 192.168.10.126 | 2023:5506:5487:1::7E |
| Health computer | 192.168.10.3 | 2023:5506:5487:1::3 |
| R2 G0/1 interface | 192.168.10.193 | 2023:5506:5487:3::C1 |
| S2 VLAN interface | 192.168.10.194 | n/a |
| DHCP server | 192.168.10.195 | 2023:5506:5487:3::C3 |
| DNS server | 192.168.10.196 | 2023:5506:5487:3::C4 |
| Email server | 192.168.10.197 | 2023:5506:5487:3::C5 |
| Web server | 192.168.10.198 | 2023:5506:5487:3::C6 |
| Print server | 192.168.10.199 | 2023:5506:5487:3::C7 |
| File server | 192.168.10.200 | 2023:5506:5487:3::C8 |
| Database server | 192.168.10.201 | 2023:5506:5487:3::C9 |

Assessment complete.

Upload this file and your Packet Tracer file to Moodle

**Marking Schedule**

|  |  |
| --- | --- |
| **Part One: Build the Network** | **22 Marks** |
| Add all devices  1 mark for each set of devices added e.g., 3 routers, 3 switches, 7 servers, 2 printers and 2 computers | 5 marks |
| Update interfaces on routers, switches and servers  0.5 marks for each interface added  3 router serial interfaces  8 switch Gigabit Ethernet ports  7 server Gigabit Ethernet NIC’s | 9 marks |
| Connect devices using ports specified in the Topology Diagram  0.25 for each correct cable to port connections  2 serial cables  14 ethernet utp cables | 8 marks |
|  | |
| **Part Two: Design the IP Addressing Scheme** | **36 Marks** |
| 2a – 2e  1 mark per question | 5 marks |
| 3a – 3e Binary IPv4 Subnet Addressing Tables  2 marks per table | 10 marks |
| 5. IP Address Allocation Table  1 mark for each line of interface address settings | 21 marks |
|  | |
| **Part Three: Configure the Network Devices** | **32 Marks** |
| 1 configure computers | 2 marks |
| 2 configure printers | 2 marks |
| 3 configure servers | 7 marks |
| 4 configure switches | 8 marks |
| 5 configure routers | 13 marks |
| Note to marker   * Mark both computers. 1 mark per correct ipv4 and ipv6 addresses. Add total and divide by 8. Use this average mark as the result * Mark both printers. 1 mark per correct ipv4 and ipv6 address. Add total and divide by 8. Use this average mark as the result * Mark all 7 servers. 1 mark per correct ipv4 and ipv6 address. Add total and divide by 8. Use this average mark as the result * Mark all 3 switches add totals and divide by 3 to get the average mark for configuration tasks. Use this average mark as the result * Mark all 3 routers add totals and divide by 3 to get the average mark for configuration tasks. Use this average mark as the result | |
|  | |
| **Part Four: Connectivity Testing** | **10 Marks** |
| 2. Ping connectivity test results table  0.25 marks per address successfully tested | 10 marks |
|  | |
| **Total** | **100 Marks** |