Practical – Week 11

Objectives:

The aim of this week's practical is:

- Design an IPv4 subnetting scheme, and
- Implement the design by assigning IP addresses to devices and verifying connectivity

Tasks:

Accordingly, you will need to complete the following two tasks in this week's practical class:

1. Lab – Designing and Implementing an IPv4 Addressing Scheme

Instructions of the labs are on next pages, and the worksheet for the labs (to be completed and submitted) is in a separate word document in Week 11 Practical folder.

Assessment:

This week's Practical is assessed in class, and it is worth 3% of the total score of the course.

Notes:

- To be awarded marks for this Practical, a student must:
  - attend week 11 Practical class. Being absent from the class will result in zero marks for week 11's practical, and
  - complete the lab and submit the following two files in week 11 practical class using the "Practical-Week 11-Submission" link in Week 11 section of Learnonline course site:
    1. the completed lab worksheet, and
    2. The Packet Tracer file (a .pkt file) for Parts 2 & 3 of the lab

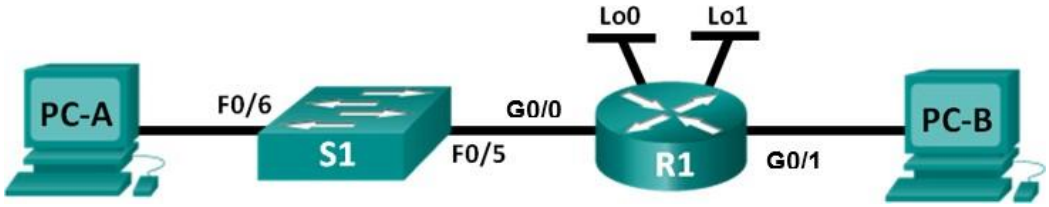
    If you cannot finish the lab in class time, you need to let your tutor know before leaving the class and submit the above required two files by Sunday 11:59 pm of Week 11. Late submission will result in zero marks for week 11's practical.

Lab - Designing and Implementing an IPv4 Addressing Scheme

Reminder:

1. Please review Week 11 slides to familiarise yourself with the method of creating equal sized subnets, and read through the examples given in Week 11 readings.
2. Please read the lab instruction carefully (including the background and notes) and strictly follow the instruction to complete the steps.
3. For Part 1, while following the steps below, type your answers to the questions in the worksheet provided. Parts 2 and 3 of this lab are to be completed using Packet Tracer. At the end of the class, you need to submit the worksheet (a word document) and the PT file (a .pkt file) as required on previous page.
4. After having finished the steps up to a **checkpoint**, inform your tutor before you move on.

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0			N/A
	G0/1			N/A
	Lo0			N/A
	Lo1			N/A
S1	VLAN 1			
PC-A	NIC			
PC-B	NIC			

Objectives

Part 1: Design a Network Subnetting Scheme

Part 2: Configure the Devices

Part 3: Test and Troubleshoot the Network

Background / Scenario

In this lab, starting from a single network address and network mask, you will subnet the network into multiple subnets. The subnet scheme should be based on the number of host computers required in each subnet, as well as other network considerations, like future network host expansion.

After you have created a subnetting scheme and completed the network diagram by filling in the host and interface IP addresses, you will build the network according to the given topology in Packet Tracer, and

implement the addressing scheme by configuring host PCs and router interfaces, including loopback interfaces. The loopback interfaces are created to simulate additional LANs attached to router R1.

After the network devices and host PCs have been configured, you will use the **ping** command to test for network connectivity.

This lab provides minimal assistance with the actual commands necessary to configure the router. However, the required commands are provided in Appendix A. Test your knowledge by trying to configure the devices without referring to the appendix.

Required Resources

- A PC with Packet Tracer installed (for completing Parts 2 and 3).

Part 1: Design a Network Subnetting Scheme

Step 1: Create a subnetting scheme that meets the required number of subnets and required number of host addresses.

In this scenario, you are a network administrator for a small subdivision within a larger company. You must create multiple subnets out of the **192.168.0.0/24** network address space to meet the following requirements:

- The first subnet is the employee network. You need a minimum of 25 host IP addresses.
- The second subnet is the administration network. You need a minimum of 10 IP addresses.
- The third and fourth subnets are reserved as virtual networks on virtual router interfaces, loopback 0 and loopback 1. These virtual router interfaces simulate LANs attached to R1.
- You also need two additional unused subnets for future network expansion.

Note: Variable length subnet masks will not be used. You are required to **create equal-sized subnets** to accommodate the above requirement.

Answer the following questions to help create a subnetting scheme that meets the stated network requirements:

1) How many host addresses are needed in the largest required subnet? _____

2) What is the minimum number of subnets required? _____

3) The base network that you are tasked to subnet is 192.168.0.0/24. What is the /24 subnet mask in binary?

   _____

4) The subnet mask is made up of two portions, the network portion, and the host portion. This is represented in the binary by the ones and the zeros in the subnet mask.

   In the network mask, what do the ones represent? _____

   In the network mask, what do the zeros represent? _____

5) To subnet a network, some bits from the original host portion of the addresses are borrowed and changed into network bits to identify the subnets. The number of **bits borrowed** (sometimes known as **subnet bits**) defines the number of subnets.

   Given each of the possible subnet masks depicted in the following binary format, how many subnets and how many hosts are created in each example from the base network 192.168.0.0/24?

   Hint: Remember that the number of host bits defines the number of hosts per subnet, and the number of subnet bits defines the number of subnets. **The subnet bits (depicted in bold type face below) are the bits that have been borrowed from the host bits of the base network.** The /24 is the slash prefix notation and corresponds to a dotted decimal mask of 255.255.255.0.

(/25) 11111111.11111111.11111111.**1**0000000

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

(/26) 11111111.11111111.11111111.**11**000000

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

(/27) 11111111.11111111.11111111.**111**00000

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

(/28) 11111111.11111111.11111111.**1111**0000

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

(/29) 11111111.11111111.11111111.**11111**000

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

(/30) 11111111.11111111.11111111.**111111**00

Dotted decimal subnet mask equivalent: _____

Number of subnet bits (i.e. bits borrowed)?_____Number of subnets created?_____,

Number of hosts in each subnet? _____

6) From the calculation above, which subnet masks meet the required number of minimum host addresses? (**Hint**: there are more than one subnet marks which meet the requirement)

_____

7) From the calculation above, which subnet masks meets the minimum number of subnets required? (**Hint**: there are more than one subnet masks which meet the requirement)

_____

8) From the calculation above, which subnet mask meets **both** the required minimum number of hosts and the minimum number of subnets required?

_____

9) When you have determined which subnet mask meets all of the stated network requirements, you will derive each of the subnets starting from the original network address. List the subnets from first to last below. Remember that the first subnet is 192.168.0.0 with the newly acquired subnet mask.

Subnet Address (i.e. network address of each subnet)	Prefix (slash notation /xx, where xx is the number of network bits)	Subnet Mask (in dotted decimal format)

Note that when equal sized subnets are created from a base network, the prefix and subnet mask will be the same for each subnet created.

Step 2: Complete the addressing table and the diagram showing where the host IP addresses will be applied.

Read the following description/requirement carefully BEFORE you start to complete the addressing table.

1) Based on the subnetting scheme derived in the previous step, complete the addressing table below by assigning the subnets and addresses as instructed:

a) **Assign the subnets as follows**:

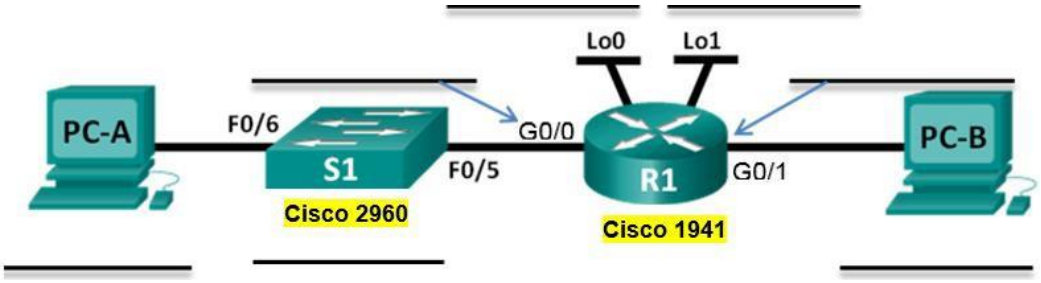
- assign the 1st subnet to the employee network, i.e. PC-A's network;
- assign the 2nd subnet to the administration network, i.e. PC-B's network;
- assign the 3rd and 4th subnets to loopback 0 and loopback 1 respectively.

b) **Within each subnet, assign the host addresses** as follows:

- assign the 1st usable host address in the corresponding subnet to the router's Ethernet interface or loopback interface
- assign the 2nd usable host address in the corresponding subnet to PC-A or PC-B
- assign the last usable host address in the corresponding subnet to S1's VLAN 1.

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0			N/A
	G0/1			N/A
	Lo0			N/A
	Lo1			N/A
S1	VLAN 1			
PC-A	NIC			
PC-B	NIC			

2) Refer to the diagram below, on the following lines provided, fill in the **IP addresses** and **subnet masks in slash notation** from the above addressing table you just completed, for the individual devices or interfaces (i.e. the PCs, router interfaces and S1 VLAN1).



Checkpoint: Now inform your tutor that you have done Part 1 and ask if you can move on to the next parts or not. Your tutor may ask you some relevant questions to check your understanding of the work and whether you need any help or not.

Part 2: Build the Network and Configure the Devices

In this Part, you will create the network shown in the above network topology diagram in Packet Tracer. You will also configure basic settings on the PCs and router, such as the router Gigabit Ethernet interface IP addresses, and the PC's IP addresses, subnet masks, and default gateways.

Notes:

1. In this lab (Parts 2 and 3), you will create and work with your own Packet Tracer file, which will be saved as a file with a .pkt file extension.
2. You must set up User Profile for the .pkt file created. To set up User Profile, after open Packet Tracer, go to the menu and click Options ➔ User Profile …, then in the User Profile window brought up, enter you details and click OK.

Step 1: Build the network

a. In Packet Tracer, set up the network according to the topology diagram you have just completed above. Use the following devices and connect them according to the topology diagram. Make sure you use the models of router and switches listed below so that you have the correct interfaces.

- **1 Router** (**Cisco 1941** with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- **1 Switch** (**Cisco 2960** with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- **2 PCs**
- **Ethernet cables**

Note: The Gigabit Ethernet interfaces on Cisco 1941 routers are autosensing. With a real Cisco 1941 router, as shown in the topology diagram, an Ethernet straight-through cable may be used between the router and PC-B. However, **in Packet Tracer, an Ethernet crossover cable must be used between the router and PC-B.**

For all the commands used in the following configuration steps, refer to **Appendix A** at the end of this lab document.

(You are encouraged to firstly attempt the following configuration steps without looking at Appendix A)

Step 2: Configure the router.

a. Assign **R1** as the hostname for the router.

b. Configure both the **G0/0** and **G0/1** interfaces with the IP addresses and subnet masks that you put in the Addressing Table in Step 2 of Part 1, and then enable the interfaces.

c. Loopback interfaces are created to simulate additional LANs on R1 router. Configure the loopback interfaces **lo0** and **lo1** with the IP addresses and subnet masks that you put in the Addressing Table in Step 2 of Part 1. After they are created, loopback interfaces are enabled, by default.

Note: You can create additional loopbacks for testing with different addressing schemes, if desired.

Step 3: Configure the PC interfaces.

According to the Addressing Table that you completed in Step 2 of Part 1,

a. Configure the IP address, subnet mask, and default gateway settings on PC-A.

b. Configure the IP address, subnet mask, and default gateway settings on PC-B.

Step 4: Configure the switch

a. Assign the **S1** as the hostname for the switch.

b. Configure the IP address, subnet mask, and default gateway settings on S1 according to the Address Table that you completed in Step 2 of Part 1.

Part 3: Test and Troubleshoot the Network

In Part 3, you will use the **ping** command to test network connectivity.

a. Test to see if PC-A can communicate with its default gateway. From PC-A, open a command prompt and ping the IP address of the router Gigabit Ethernet 0/1 interface. Do you get a reply? _____

b. Test to see if PC-B can communicate with its default gateway. From PC-B, open a command prompt and ping the IP address of the router Gigabit Ethernet 0/0 interface. Do you get a reply? _____

c. Test to see if PC-A can communicate with PC-B. From PC-A, open a command prompt and ping the IP address of PC-B. Do you get a reply? _____

d. If you answered “no” to any of the preceding questions, then you should go back and check all of your IP address and subnet mask configurations, and ensure that the default gateways have been correctly configured on PC-A and PC-B.

e. If you verify that all of the settings are correct, and you can still not ping successfully, then there are a few additional factors that can block ICMP pings. On PC-A and PC-B within Windows, make sure that the Windows Firewall is turned off for the Work, Home, and Public networks.

f. Experiment by purposely misconfiguring the gateway address on PC-A to 10.0.0.1. What happens when you try and ping from PC-B to PC-A? Do you receive a reply?

_____

Checkpoint: Save the Packet Tracer file with the file extension .pkt and inform your tutor.

Upload the .pkt file together with the worksheet using the submission link for this week’s Practical, before the deadline.

Appendix A: Configuration Details for Steps in Part 2

Step 2: Configure the router.

a. Assign the **R1** as the hostname for the router.

Console into the router and enable privileged EXEC mode.

```
Router> enable
Router#
```

Enter into configuration mode.

```
Router# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

Assign a device name to the router.

```
Router(config)# hostname R1
R1(config)#
```

b. Configure both the **G0/0** and **G0/1** interfaces with IP addresses and subnet masks, and enable them.

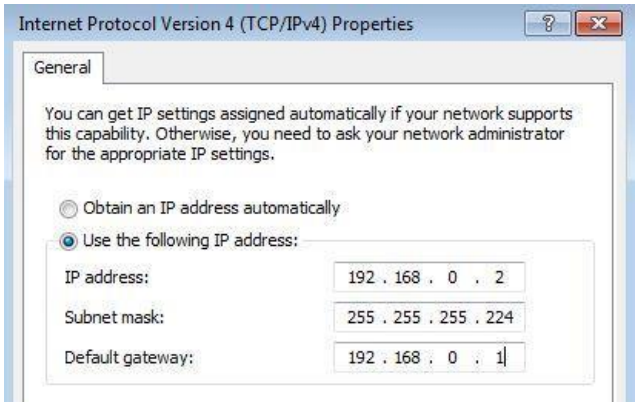
```
R1(config)# interface g0/0
R1(config-if)# ip address <ip address> <subnet mask>
R1(config-if)# no shutdown
R1(config-if)# interface g0/1
R1(config-if)# ip address <ip address> <subnet mask>
R1(config-if)# no shutdown
```

c. Loopback interfaces are created to simulate additional LANs off of router R1. Configure the loopback interfaces with IP addresses and subnet masks. When they are created, loopback interfaces are enabled, by default.

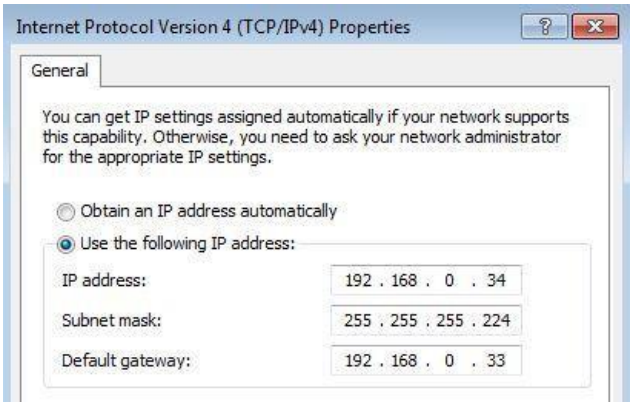
```
R1(config)# interface loopback 0
R1(config-if)# ip address <ip address> <subnet mask>
R1(config-if)# interface loopback 1
R1(config-if)# ip address <ip address> <subnet mask>
R1(config-if)# end
```

Step 3: Configure the PC interfaces.

a. Configure the IP address, subnet mask, and default gateway settings on PC-A.



b. Configure the IP address, subnet mask, and default gateway settings on PC-B.



Step 4: Configure the switch

a. Assign the **S1** as the hostname for the switch.

Console into the switch and enable privileged EXEC mode.

```
Switch> enable
Switch#
```

Enter into configuration mode.

```
Switch# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
```

Assign a device name to the switch.

```
Switch(config)# hostname S1
S1(config)#
```

b. Configure the IP address, subnet mask, and default gateway settings on S1.

```
S1(config)# ip default-gateway <ip address of S1's default gateway>
S1(config)# interface vlan 1
S1(config-if)# ip address <ip address> <subnet mask>
S1(config-if)# no shutdown
```