Practical – Week 10

Objectives:

The aim of this week's practical includes:

- Learn and practice how to do the conversion between binary and dotted decimal formats of IPv4 Addresses.
- Use the ANDing operation to identify network addresses, broadcast address and host addresses of a network.

Tasks:

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

1. Lab – Convert IPv4 Addresses between dotted decimal and binary formats
2. Lab - Identify IPv4 Addresses

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 10 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 10 Practical class, and being absent from the class will result in zero marks for week 10's practical, and
  - complete the labs and submit the completed lab worksheet in week 10 practical class using the "Practical-Week 10-Submission" link in Week 10 section of Learnonline course site. If you cannot finish the labs in class time, you need to let your tutor know before leaving the class and submit the worksheet by Sunday 11:59 pm of Week 10. Late submission will result in zero marks for week 10's practical.

Lab – Convert IPv4 Addresses between Dotted Decimal and Binary

Reminder:

- Try not to use any calculators
- While following the steps below, type your answers to the questions in the worksheet provided.

Objectives

Convert IPv4 Addresses between Dotted Decimal and Binary

Background / Scenario

To understand the operation of devices on a network, we need to look at addresses the way devices do — in binary notation. To do this, we must convert the dotted decimal form of an IPv4 address (and its subnet mask) to binary notation. It is also important to know how to convert an IPv4 address and it subnet mask in binary format to their dotted decimal forms. This lab provides a video instruction on how to do the conversions and some exercises for you to practice the conversions.

Part 1: Learn How to Convert IPv4 addresses from Dotted Decimal to Binary

Watch the video **"Binary-decimal-conversion.mp4"** in this week's practical folder on Learnonline course site.

Part 2: Convert IPv4 Addresses from Dotted Decimal to Binary

In Part 2, you will convert decimal numbers to their binary equivalent. After you have mastered this activity, you will convert IPv4 addresses and subnet masks from dotted decimal to their binary form.

Step 1: Convert decimal numbers to their binary equivalent.

Fill in the following table by converting the decimal number to an **8-bit binary number**. The first number has been completed for your reference. Recall that the eight binary bit values in an octet are based on the powers of 2, and from left to right are 128, 64, 32, 16, 8, 4, 2, and 1. If the converted number has LESS than 8 bits, add the leading 0s to fill in the 8 places

Decimal	Binary
192	11000000
168	
10	
255	

Step 2: Convert the IPv4 addresses or subnet masks to their binary equivalent.

An IPv4 address or subnet mask can be converted using the same technique you used above, one octet at a time. Fill in the table below with the binary equivalent of the addresses provided. To make your answers easier to read, separate the binary octets with a period.

Decimal	Binary
192.168.10.10	11000000.10101000.00001010.00001010
172.16.18.183	
10.86.252.17	
255.255.192.0	

Part 3: Convert IPv4 Addresses from Binary to Dotted Decimal

Convert the following IP addresses or subnet mask in binary format to their dotted decimal representations. For each address or subnet mask, the conversions need to be done one octet at a time, from a binary number to a decimal number.

Binary	Decimal
11000000.10101000.00001010.00001010	192.168.10.10
11000000.10101000.01100100.00011000	
11100000.00000001.00000011.11111110	
11111111.11111111.11111111.11110000	

Lab – Identifying IPv4 Addresses

Before start:

It is very important to **go through this week's slides** to know the following key **concepts:**

- Dotted decimal representation and binary representation of an IPv4 address
- The structure of an IPv4 address (i.e. the two portions of an IPv4 address)
- Subnet Mask
- For a (sub) network, network address, broadcast address and usable host addresses
- (Bitwise) ANDing operation
- Default gateway of a host and a switch

Reminder:

1. Read the instruction carefully (including all notes), and strictly follow the instruction to complete this lab.
2. Try not to use any calculators
3. Refer to this week's slides and the videos embedded in the slides to help in completing this lab
4. While following the steps below, type your answers to the questions in the worksheet provided.

Objectives

Part 1: Use Bitwise ANDing Operation to Determine Network Addresses

Part 2: Identify IPv4 Addresses

Part 3: Apply Network Address Calculations

Background / Scenario

Every IPv4 address is comprised of two parts: a network portion and a host portion. The network portion of an address is the same for all devices that reside in the same network. The host portion identifies a specific host within a given network. The subnet mask is used to determine the network portion of an IP address. Devices on the same network can communicate directly; devices on different networks require a router to communicate.

To understand the operation of devices on a network, we need to look at addresses the way devices do — in binary notation. To do this, we must convert the dotted decimal form of an IP address and its subnet mask to binary notation. After this has been done, we can use the bitwise ANDing operation to determine the network address.

This lab provides instructions on how to determine the network and host portion of IP addresses by converting addresses and subnet masks from dotted decimal to binary, and then using the bitwise ANDing operation. You will then apply this information to identify addresses in the network.

Part 1: Use Bitwise ANDing Operation to Determine Network Addresses

If you haven't done so, watch the video "addresses.mp4" in this week's practical folder on Learnonline site before attempting this part and Part 2. In the video you will learn how to determine the network address, first and last usable host addresses, and broadcast address of the network of a given IP address and its subnet mask.

In Part 1, you will use the bitwise ANDing operation to calculate the network address for a provided host address. You will first need to convert an IPv4 decimal address and subnet mask to their binary equivalent and then use the bitwise ANDing to get the network address. Once you have the binary form of the network address, you can convert it to its dotted decimal form.

Notes: **(1)** The ANDing process compares the binary value in each bit position of the 32-bit host IP with the corresponding position in the 32-bit subnet mask. If there are two 0s or a 0 and a 1, the ANDing result is 0. If there

are two 1s, the result is a 1, as shown in the example here. **(2)** Get the binary value of the network address first, then convert it to the decimal format.

Description	Decimal	Binary
IP Address	192.168.10.131	11000000.10101000.00001010.10000011
Subnet Mask	255.255.255.192	11111111.11111111.11111111.11000000
Network Address	192.168.10.128	11000000.10101000.00001010.10000000

a. Enter the missing information into the table below:

Description	Decimal	Binary
IP Address	172.16.145.29	
Subnet Mask	255.255.0.0	
Network Address		

b. Enter the missing information into the table below:

Description	Decimal	Binary
IP Address	192.168.10.10	
Subnet Mask	255.255.255.0	
Network Address		

c. Enter the missing information into the table below:

Description	Decimal	Binary
IP Address	192.168.68.210	
Subnet Mask	255.255.255.128	
Network Address		

d. Enter the missing information into the table below:

Description	Decimal	Binary
IP Address	172.16.188.15	
Subnet Mask	255.255.240.0	
Network Address		

Part 2: Identify Network, Broadcast and Usable Host Addresses

First look through the following example.

Given:	
IP Address	192.168.100.51
Subnet Mask	/26
Find:	
Subnet mask in **dotted decimal format**	255.255.255.192
Network Address	192.168.100.0
First usable host address	192.168.100.1
Last usable host address	192.168.100.62
Broadcast address	192.168.100.63

Detailed steps:

1. **Convert the given IP address and subnet mask to their binary representations**

Given:		**Convert the given IP address and subnet mask to their binary representations**
IP Address	192.168.100.51	**192.168.100.51** converts to 11000000.10101000.01100100.00110011
Subnet Mask	/26	**/26** means that the first 26 bits of the subnet mask are 1s, and the remaining 6 bits are 0s, i.e. the subnet mask in binary is: 11111111 1111111 11111111 11000000. (Converting this to **dotted decimal** representation, we get 255.255.255.192)

2. **Find the network address by bitwise ANDing of the given IP address and the subnet mask**

Here you need to use **binary representations** of the given IP address and its subnet mask

	Decimal	**Binary**
Given **IP Address**	192.168.100.51	11000000.10101000.01100100.00110011
Given **Subnet Mask**	255.255.255.192	11111111.11111111.11111111.11000000
Network Address	192.168.100.0	11000000.10101000.01100100.00000000

ANDing the IP address and the **Subnet mask gives the NETWORK ADDRESS**

ANDing

1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
1	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

3. **Find the first usable Host Address**

The first usable host address is the one immediately following the network address. We've just found that the network address is 192.168.100.0, so the address immediately following it is: 192.168.100.1, or in binary: 11000000.10101000.01100100.00000000**1**

Note:

- if using **decimal representation**, we increase the value of the **last** section of the network address by 1 to get the first usable host address;

- if using **binary representation**, we change the last bit of the network address from 0 to 1 to get the first usable host address)

4. Find the broadcast address

The network address is 11000000.10101000.01100100.00000000, and the host bits are the last 6 bits. We **change all the host bits from 0s to 1s to get the broadcast address**, which is 11000000.10101000.01100100.00111111 in **binary**, or 192.168.100.63 in **dotted decimal** representation.

5. Find the last usable host address

The **last usable host address** is the one immediately prior to the broadcast address. We've just found that the broadcast address is 192.168.100.63, so the address immediately prior to it is: 192.168.100.62, or in binary: 11000000.10101000.01100100.00111110

Note:

- if using **dotted decimal** representation, we decrease the value of the **last** section of the broadcast address by 1 to get the last usable host address;
- if using **binary** representation, we change the last bit of the broadcast address from 1 to 0 to get the last usable host address

Now it is your turn to answer the following address identification questions.

a. Enter the missing information into the table below:

Given:	
IP Address	192.168.10.10
Subnet Mask	/24
Find:	
Subnet mask in **dotted decimal** format	
Network Address	
First usable host address	
Last usable host address	
Broadcast address	

b. Enter the missing information into the table below:

Given:	
IP Address	10.101.99.17
Subnet Mask	/23
Find:	
Subnet mask in **dotted decimal** format	
Network Address	
First usable host address	
Last usable host address	
Broadcast address	

c. Enter the missing information into the table below:

Given:	
IP Address	209.165.200.227
Subnet Mask	/27
Find:	
Subnet mask in **dotted decimal** format	
Network Address	
First usable host address	
Last usable host address	
Broadcast address	

Part 3: Apply Network Address Calculations

For two devices to communicate **directly** without using a router, the two devices must be in **the same IP network** or subnet. In other words, the network addresses (that are derived from the two devices' IP addresses and subnet masks) must be the same. If the network addresses of the two devices **are not the same**, the communication between the two devices will require the help of router(s).

For the following exercises in **Step 1 and Step 2** you must do the **ANDing** process for EACH address given, then see if they are the same, or if they are different.

Step 1: Determine whether IP addresses are on same network.

a. You are configuring two PCs. PC-A is given an IP address of 192.168.1.18, and PC-B is given an IP address of 192.168.1.33. Both PCs receive a subnet mask of 255.255.255.240.

1) What is the network address for PC-A? _____
2) What is the network address for PC-B? _____
3) Will these PCs be able to communicate directly with each other (without using a router – in other words, are they in the same network)? _____
4) What is the highest address that can be given to PC-B that allows it to be on the same network as PC-A? _____ **(Hint: this is the last usable host address of PC-A's network)**

b. You are configuring two PCs. PC-A is given an IP address of 10.0.0.16, and PC-B is given an IP address of 10.1.14.68. Both PCs receive a subnet mask of 255.254.0.0.

1) What is the network address for PC-A? _____
2) What is the network address for PC-B? _____
3) Will these PCs be able to communicate directly with each other (without using a router)? _____
4) What is the lowest address that can be given to PC-B that allows it to be on the same network as PC-A? _____**(Hint: this is the first usable host address of PC-A's network)**

Step 2: Identify the default gateway address.

a. Your company has a policy to use the **first IP address** in a network as the **default gateway** address. A host on the local-area network (LAN) has an IP address of 172.16.140.24 and a subnet mask of 255.255.192.0.

1) What is the **network address** for this network?_____

2) What is the **default gateway** address for this host?_____

b. Your company has a policy to use the first IP address in a network as the default gateway address. You have been instructed to configure a new server with an IP address of 192.168.184.227 and a subnet mask of 255.255.255.248.

1) What is the **network address** for this network?_____

2) What is the **default gateway** for this server?_____