MULTIMEDIA UNIVERSITY®

FACULTY OF ENGINEERING

ECE2056 Data Communications and Networking

Assignment

Design a Smart Home Network

Trimester 3, 2020/2021

Instructions

1. Download the latest version of Cisco Packet Tracer from
   `https://www.netacad.com/courses/packet-tracer`. You may have to
   register for a free account first.

2. By the end of the assignment, you are required to submit:

   a) Report (further instructions below)

   b) Packet Tracer file (.pkt) containing the network and configurations

3. Each group should have a maximum of THREE (3) students

   a) Submit only ONE report per group.

   b) Submit only ONE Packet Tracer file per group.

Design a Smart Home Network

1. Introduction

Packet Tracer is a free, extensible, and graphic network simulation platform developed by Cisco. By simulating routers and switches, it demonstrates device deployment scenarios and most importantly, it provides an opportunity to practice device configuration and troubleshooting.

As part of this assignment, you are expected to **further explore the program and practice your configuration skills**. Tutorials can be easily found through Google and YouTube. A relevant video for this assignment can be viewed at:

<p align="center">https://www.youtube.com/watch?v=_sr9yTw20FU</p>

<p align="center">Keyword Search: Setting up IOT in Cisco Packet Tracer - Registration Server</p>

2. Design Goals

In this assignment, we will be implementing a virtual home network to support smart home devices such as sensors and alarm. This allows homeowners to view the status of their house remotely via their computers or smartphones.

The network layout or topology shown in Figure 1 can generally be divided into two sections, namely the Internet and Home Network sections.

<u>Internet</u>

The Internet section has 2 network devices which are the *Thingspeak Server* and the homeowner's *iPhone 11 Pro* smartphone. Thingspeak is an IoT analytics platform service that allows users to aggregate, visualise, and analyse live data streams in the cloud. Essentially, it is a cloud-based service that allows us to **send** IoT data to it for record and analysis, and subsequently, **download, view, or receive notifications** from anywhere in the world. In this assignment, we will simulate the Thingspeak Server by placing a server in the Internet section.

On the other hand, the smartphone can be used to access the Thingspeak server via the Internet to view the status of the smart house from outside the house.

<u>Home Network</u>

In addition to the usual computing devices such as laptop and desktop in the Home Network, there are the smart house devices such as motion alarm, door alarm, and siren. Although these sensors are similar in functionality to regular house alarm systems, they are considered as smart IoT devices because they have network-connectivity, thus Internet-capable.
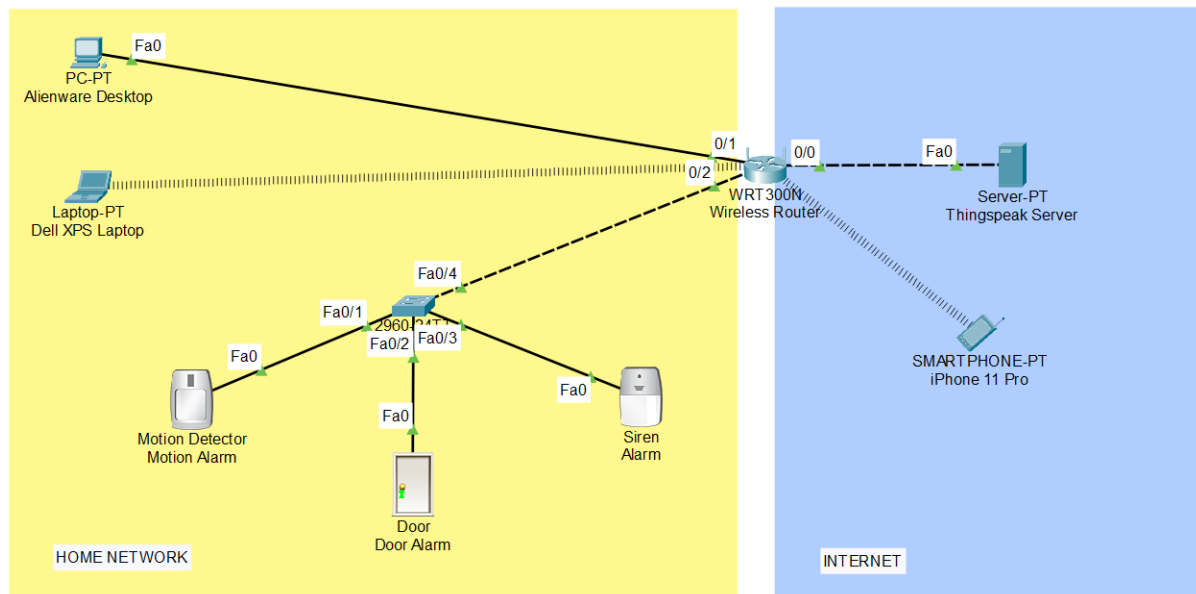
3. Network Description

Figure 1: Topology diagram of Smarthome Network

Table 1: List of IP addresses

Device Name	Interface	IP Address	Subnet Mask	Gateway/DNS	Others
Alienware Desktop	FastEthernet0	DHCP	DHCP	DHCP	–
Dell XPS Laptop	Wireless0	DHCP	DHCP	DHCP	SSID: Default
Thingspeak Server	FastEthernet0	Static: 10.0.0.1	Static: 255.0.0.0	Static: Gateway: Blank DNS: 10.0.0.1	–
iPhone 11 Pro	Wireless0	DHCP	DHCP	DHCP	SSID: Default
Motion Alarm	FastEthernet0	DHCP	DHCP	DHCP	IOT Server: Remote Server: www.thingspeak.com Username: admin Password: admin
Door Alarm	FastEthernet0	DHCP	DHCP	DHCP	IOT Server: Remote Server: www.thingspeak.com Username: admin Password: admin
Alarm	FastEthernet0	DHCP	DHCP.0	DHCP	IOT Server: Remote Server: www.thingspeak.com Username: admin Password: admin
Wireless Router	Internet	Static: 10.0.0.10	Static: 255.0.0.0	Static: Gateway: 10.0.0.1 DNS: 10.0.0.1	–
	LAN	Static: 192.168.0.1	Static: 255.255.255.0	–	DHCP Server: Enabled Leave other DHCP Server settings to default
Switch	–	–	–	–	–

4. Prepare the Network

a) Select the following equipment type for each of the devices listed in Table 1 and arrange them according to Figure 1.

Table 2: Equipment Types

Device Name	Equipment Type
Alienware Desktop	End Devices | PC
Dell XPS Laptop	End Devices | Laptop
Thingspeak Server	End Devices | Server
iPhone 11 Pro	End Devices | Smart Device
Motion Alarm	End Devices | Home | Motion Detector
Door Alarm	End Devices | Home | Door
Alarm	End Devices | Home | Siren
Wireless Router	Network Devices | Wireless Devices | WRT300N
Switch	Network Devices | Switches | 2960

b) Use the connections shown in Table 3 to connect all the devices together according to the topology shown in Figure 1.

Table 3: Connection Types

Device A		Device B		Connection between Devices A and B
Name	Port	Name	Port	
Alienware Desktop	FastEthernet0	Wireless Router	Ethernet 1	Copper Straight-Through
Motion Alarm	FastEthernet0	Switch	FastEthernet0/1	Copper Straight-Through
Door Alarm	FastEthernet0	Switch	FastEthernet0/2	Copper Straight-Through
Alarm	FastEthernet0	Switch	FastEthernet0/3	Copper Straight-Through
Thingspeak Server	FastEthernet0	Wireless Router	Internet	Copper Cross-Over
Switch	FastEthernet0/4	Wireless Router	Ethernet 2	Copper Cross-Over
Dell XPS Laptop	–	Wireless Router	–	Wireless (Connected to SSID: Default)
iPhone 11 Pro	–	Wireless Router	–	Wireless (Connected to SSID: Default)

c) Specifically for **Dell XPS Laptop**, change the Physical module by doing the following:
- Referring to Figure 2, select the Physical tab.
- Turn off the laptop by clicking the On/Off switch.
- Drag the default PT-LAPTOP-NM-1CFE from the Module slot and drop it to the MODULES section on the left of the window.
- Drag PT-LAPTOP-NM-1W-AC from the MODULES section and drop it into the Module slot.
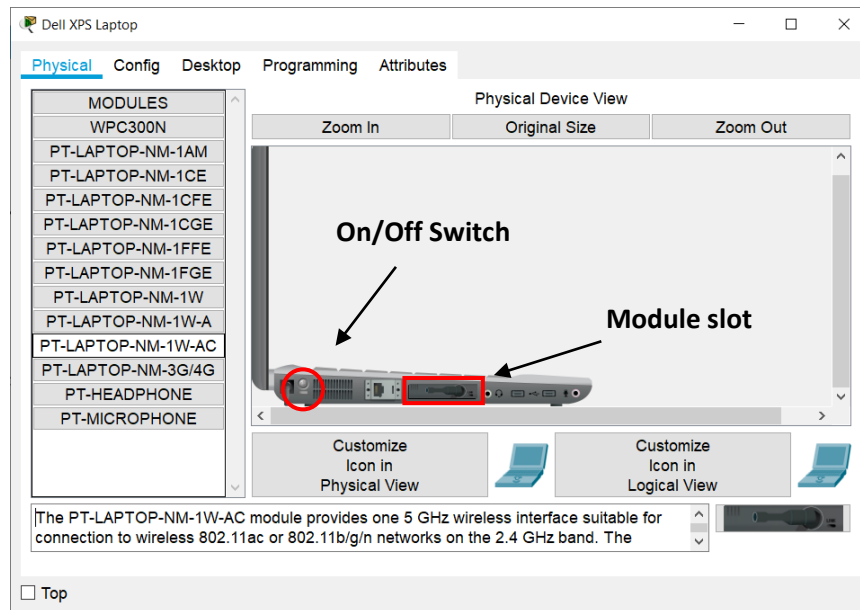- Turn on the laptop.

Figure 2: Swapping the wired module for a wireless one on the laptop.

5. Rename Network Devices

a) By default, Cisco Packet Tracer will name the devices with increasing number (e.g. PC0, PC1, PC3, …)

b) In order to change the names, go into each device and change the Display Name in the Settings section under the Config tab as shown in Figure 3.
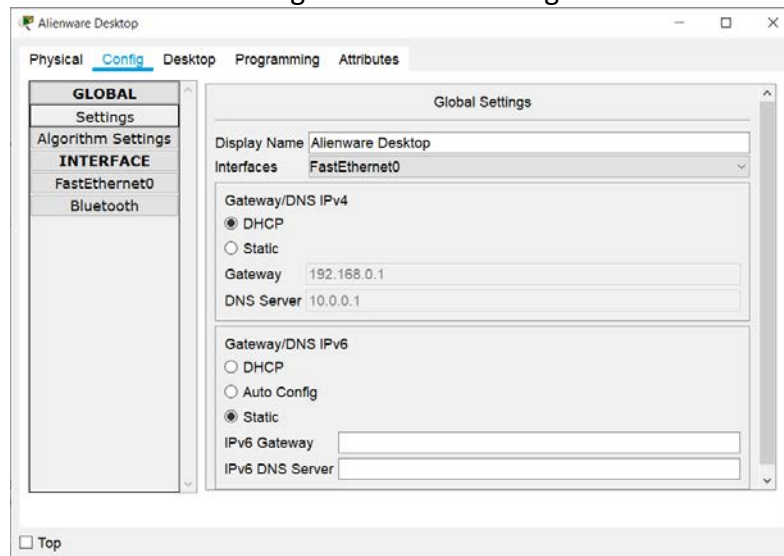

Figure 3: Changing the Display Name.

c) Do the same for all the other devices using the names shown in Table 2.

> Take a screenshot of the results whenever you see this icon. Include the screenshot in your report. An example can be seen in Figure 3.

6. Configure Static Address and Enable DHCP on the Wireless Router

a) Configure the static addresses for the **Internet** and **LAN** interfaces of the Wireless Router as shown in Figure 4. Use the IP addresses shown in Table 1.
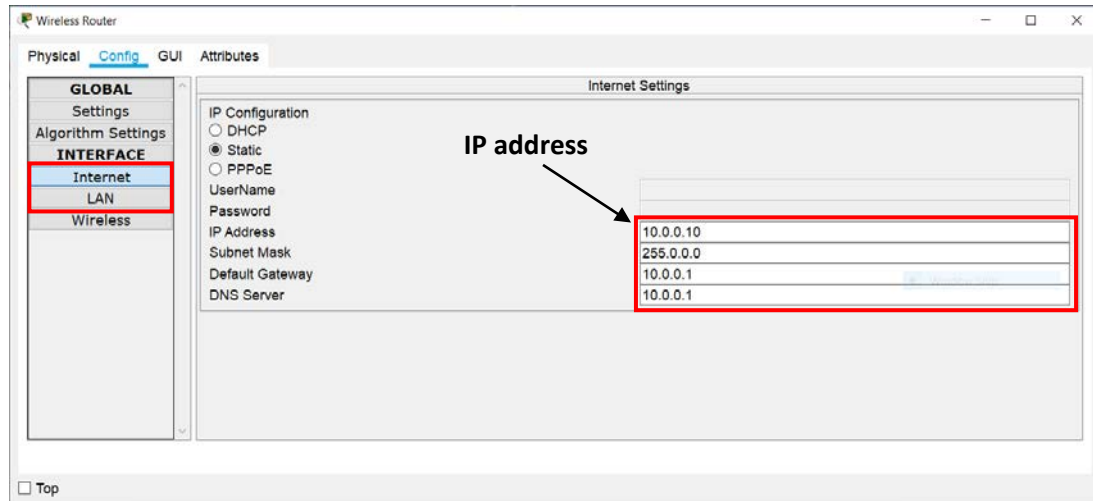
Figure 4: Configuring IP address on the Wireless Router.

b) Next, go to the GUI tab and configure the DHCP Server Settings by scrolling down the Setup page to see it. DHCP should have already been automatically configured but ensure that it looks like Figure 5. Do not forget to click Save Settings at the bottom of the page.
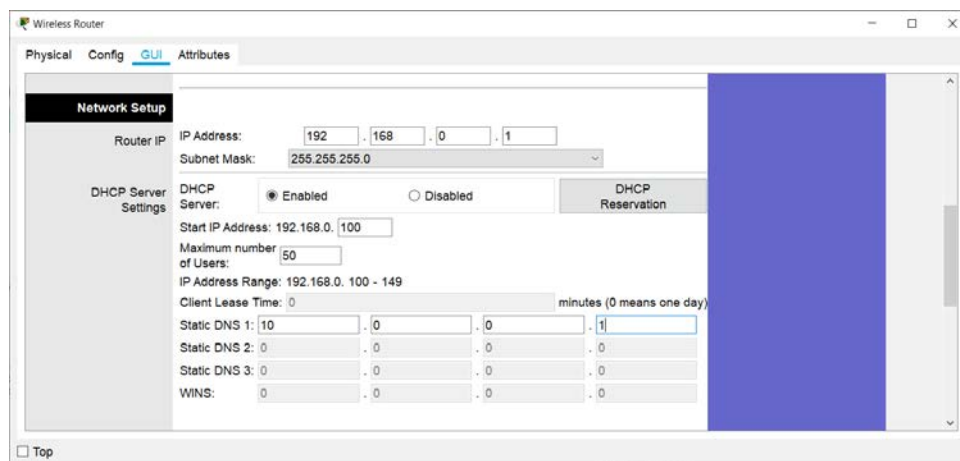
Figure 5: Configuring DHCP on the Wireless Router.

7. Configure Static Address and Enable DNS on the Thingspeak Server

a) Configure the IP address for the server using the same approach as shown in Figure 4 and in accordance to the IP address detailed in Table 1.

b) To enable DNS, go to the Services tab and click on DNS on the left of the window. Enable the service and configure it as shown in Figure 6. Pay attention to all the elements highlighted in red.

Figure 6: Configuring DNS on Thingspeak Server.

c) What is DNS and why is it important for the Internet to work? Which part of the smart home utilises DNS? Provide the domain name and the corresponding Ipv4 address.

> Be sure to answer or discuss this point/question in your report.

8. Configure IP Addresses on Other Network Devices

a) Configure the IP address on the Alienware Desktop using the IP addresses detailed in Table 1.
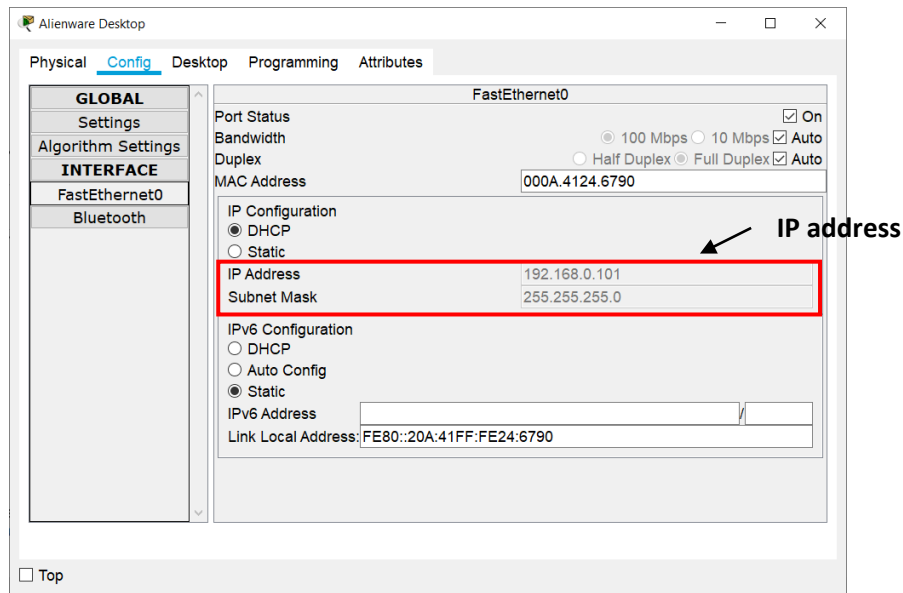
Figure 7: Configuring the IP address on a network device.

b) Do the same for all the other **wired devices** such as Motion Alarm, Door Alarm, and Alarm. Use the IP addresses detailed in Table 1.

c) For the wireless devices such as Dell XPS Laptop and iPhone 11 Pro, ensure that they are connected to the WiFi network called Default. If successful, they should be automatically assigned IP addreses as shown in Figure 8.
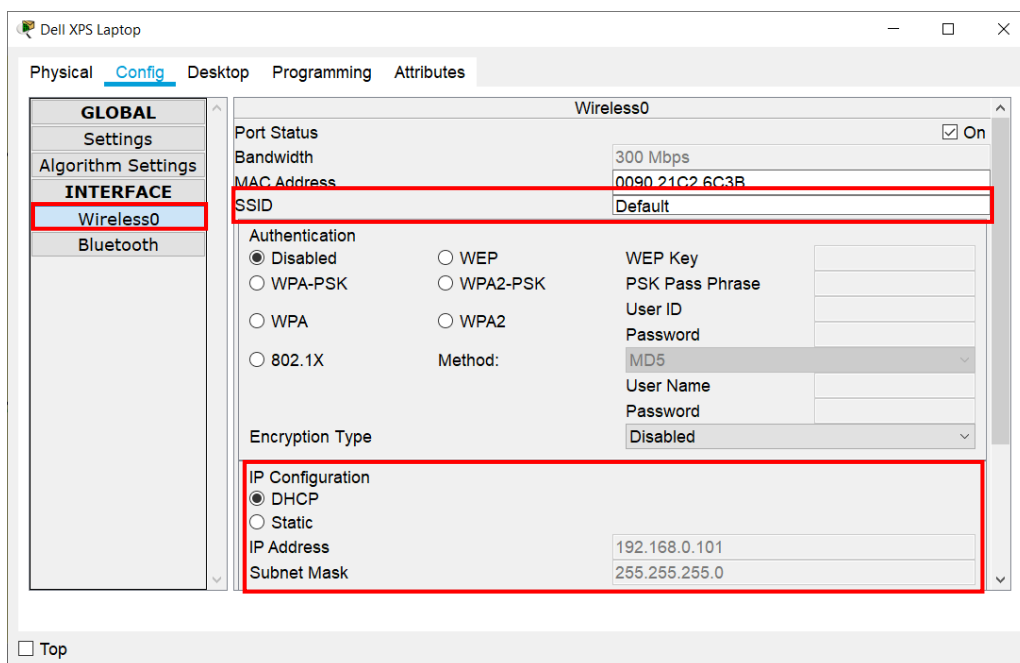

Figure 8: Connecting wireless devices to the WiFi network.

d) What is DHCP and how does it help in configuring IP addresses?

8

e) What is a static IP address and how is it different from DHCP?

9. Test point-to-point connectivity

a) Use the `ping` command to check the connectivity between network devices. The `ping` command can be accessed by selecting Command Prompt from the Desktop tab in each device as shown in Figure 9.
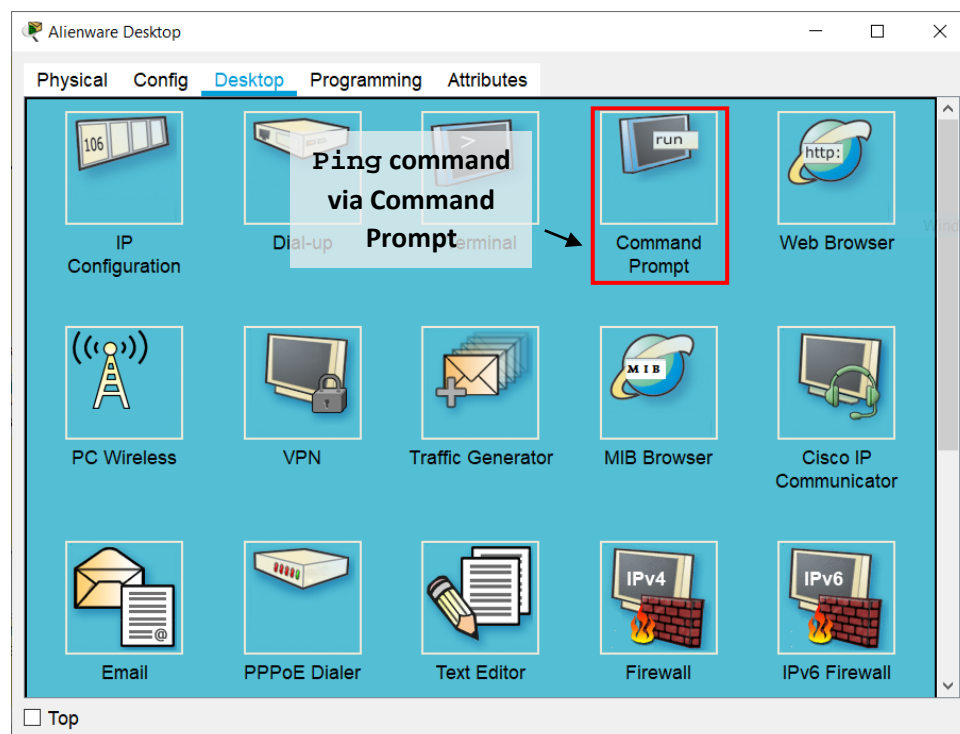

Figure 9: Starting Command Prompt.

b) The `ping` command requires the destination IP address with the following:

ping <destination ip address>

Example: `ping 192.168.0.1`

The IP address of the destination can be found using the example from Figure 7. A successful ping is shown in Figure 10.
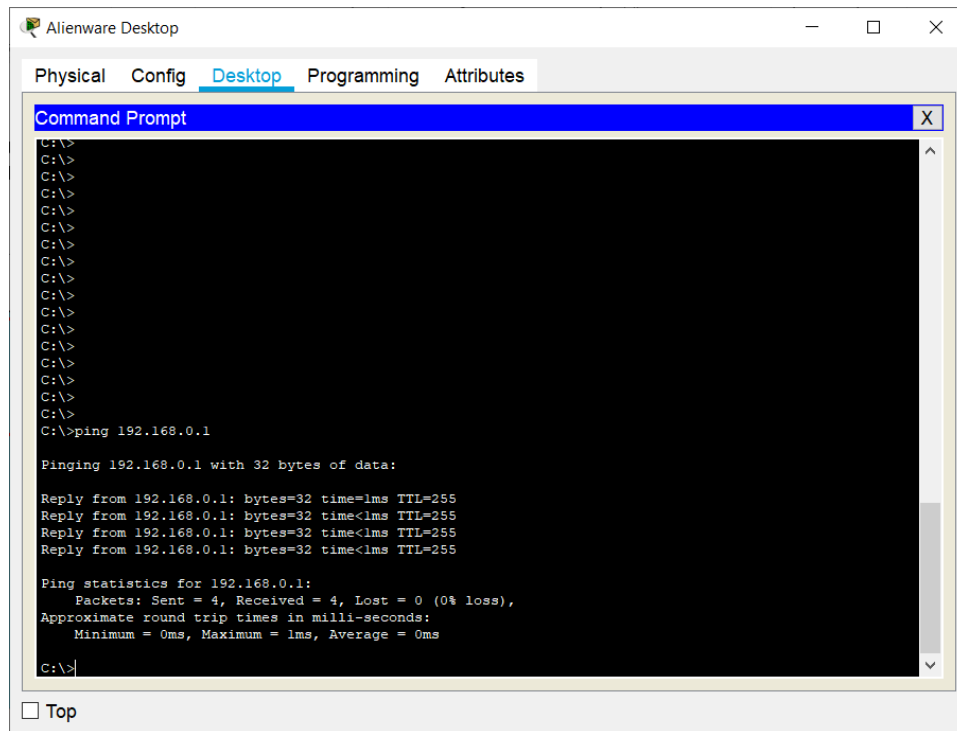
Figure 10: Using the `ping` command in Command Prompt.

c) Perform the ping test using the checklist in Table 4 to ensure that all your connections are done correctly.

Table 4: Connectivity checklist

Ping		Status
From	**To**	
Alienware Desktop	Wireless Router	PASS/FAIL
Dell XPS Laptop	Wireless Router	PASS/FAIL
Thingspeak Server	Wireless Router (Internet interface)	PASS/FAIL
iPhone 11 Pro	Wireless Router	PASS/FAIL

*All statuses should indicate **PASS**. There are errors in the configuration if there are FAIL statuses.

Are you able to obtain PASS for all the ping tests shown in Table 4?

d) Now, test the connections shown in Table 5.

Table 5: Connectivity checklist

Ping		Status
From	To	
Alienware Desktop	Motion Alarm	PASS/FAIL
Alienware Desktop	Thingspeak Server	PASS/FAIL
Dell XPS Laptop	Door Alarm	PASS/FAIL
Dell XPS Laptop	Thingspeak Server	PASS/FAIL
iPhone 11 Pro	Alarm	PASS/FAIL
Thingspeak Server	Dell XPS Laptop	PASS/FAIL
Thingspeak Server	Alienware Desktop	PASS/FAIL

*All statuses **EXCEPT TWO** should indicate **PASS**.

e) Indicate which two ping tests shown in Table 5 should fail.
Can you explain why you are able to ping in one direction but not in reverse for the two failed connections?

10. Enable IoT on Thingspeak Server

a) Watch the video at the link given on Page 2.

b) Enable the IoT service on the Thingspeak server using the same steps as shown in the video.

c) Describe how the IoT service is enabled.

11. Create Account with Thingspeak and Configure IoT Devices

a) We will now simulate the process of opening an account with Thingspeak and connect our IoT devices to it.

b) Go to the Alienware Desktop and click on Web Browser from the Desktop tab as shown in Figure 9. Type in the URL address of `www.thingspeak.com`. If you had configured the DNS correctly, a webpage similar to Figure 11 will appear.

c) Subsequently, follow the steps shown in the video on Page 2 to create an account on Thingspeak. Use the following username and password:

Username: admin
Passsword: admin

d) Now, configure the three IoT devices to connect to the Thingspeak Server using the video for guidance.

e) You should be able to see the dashboard shown in Figure 12 when the IoT devices have successfully connected to the Thingspeak Server.
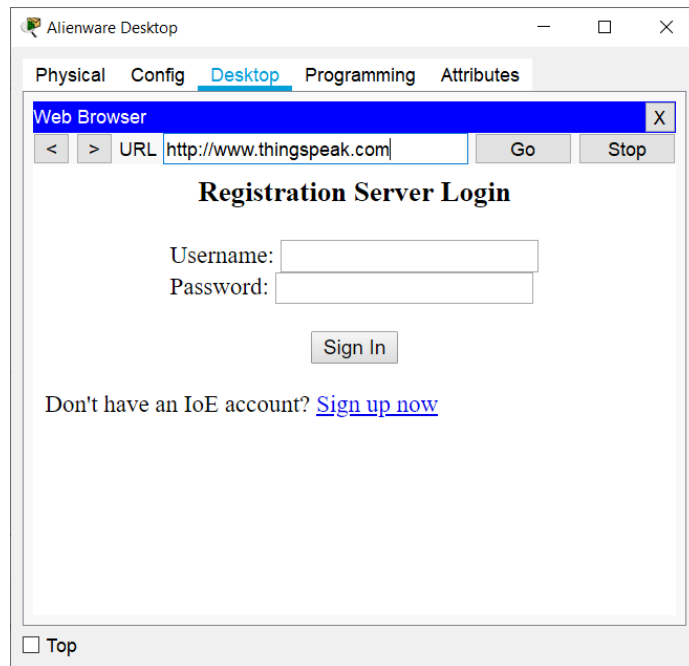

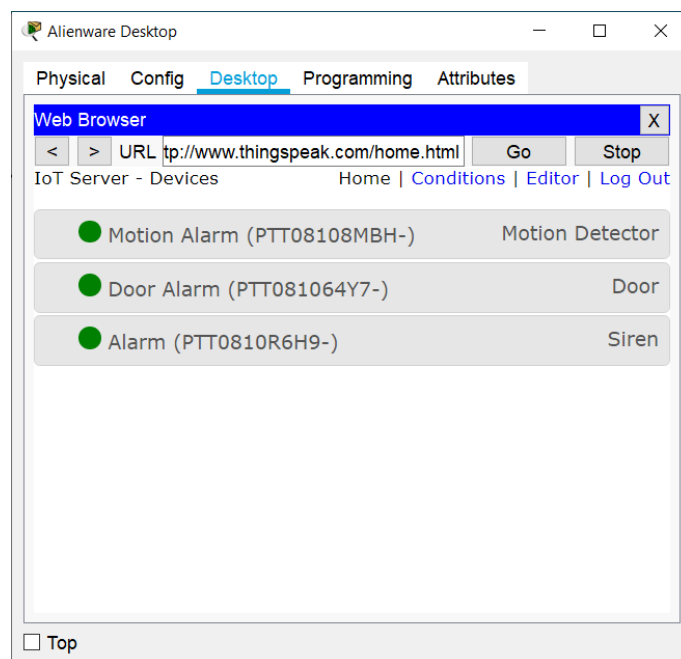Figure 11: Accessing the Thingspeak server.

Figure 12: All IoT devices have been successfully registered with Thingspeak Server.

f) View the Thingspeak Server from the iPhone 11 Pro. Do you see the same results as Step (e) above? Why is it so?

12. Configure IoT Devices to be Smart

a) The advantage of using IoT devices is that they can be programmed to be "smart" or more accurately, automation can be added with ease. In contrast, "dumb" devices cannot be automated or integrated with other "dumb" devices.

b) While connected to the Thingspeak server through the web browser, click on Conditions to program the IoT devices with some automation capabilities. Using the example shown in the same video on Page 2, configure the logic shown in Figure 13 and Figure 14 so that the results will look like the example in Figure 15.

```
If (Door Alarm is Open) or (Motion Alarm is On)
{
        Set Alarm to On
}
```

Figure 13: Logic to activate alarm.

```
If (Door Alarm is Close) and (Motion Alarm is Off)
{
        Set Alarm to Off
}
```

Figure 14: Logic to deactivate alarm.

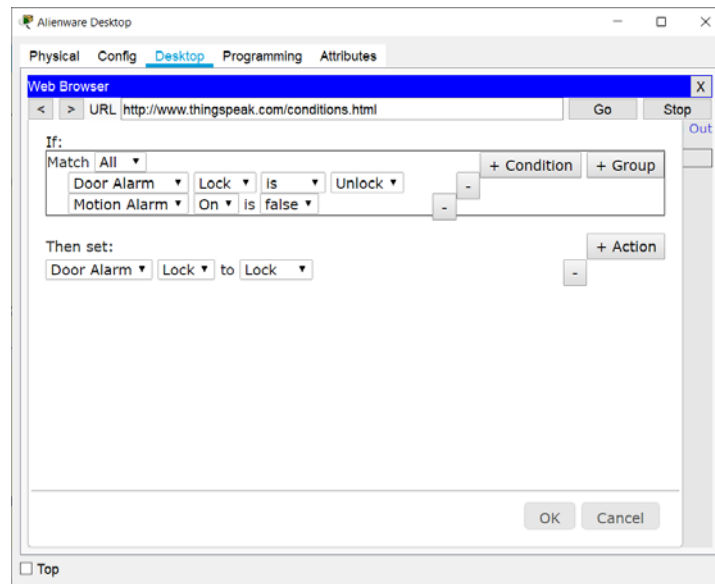c) Take a screenshot of your configuration such as shown in Figure 15.

Figure 15: Adding a condition to IoT devices.

13. Test Smart Alarm System

a) When operating under normal mode (i.e. Motion Alarm and Door Alarm are not triggered), the dashboard should be like Figure 16.
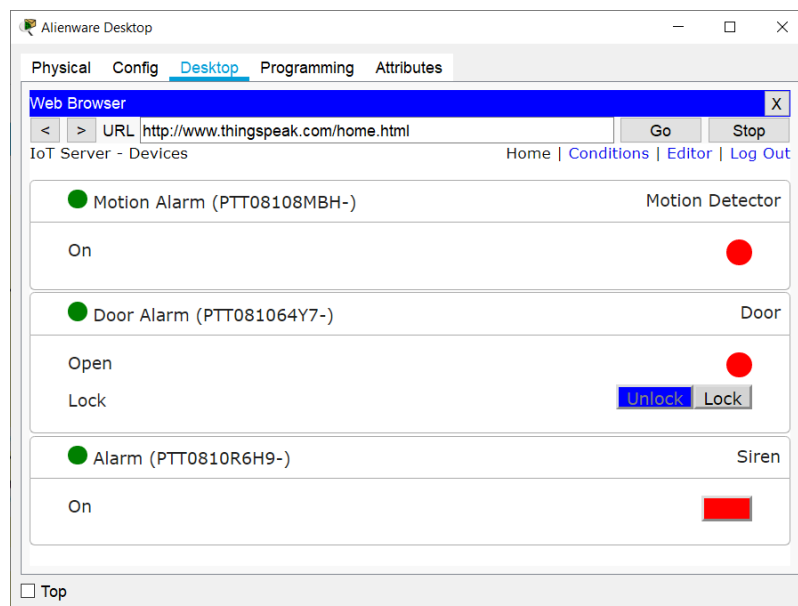

Figure 16: Thingspeak dashboard under normal mode.

b) You can trigger the Motion Alarm by pressing the ALT key and moving your mouse in front of the Motion Alarm.

On the other hand, the Door Alarm can be triggered by pressing the ALT key and clicking on the door.

14

When either alarm is triggered as shown in Figure 17, the dashboard will change to indicate which alarm was triggered. This can be seen in Figure 18.
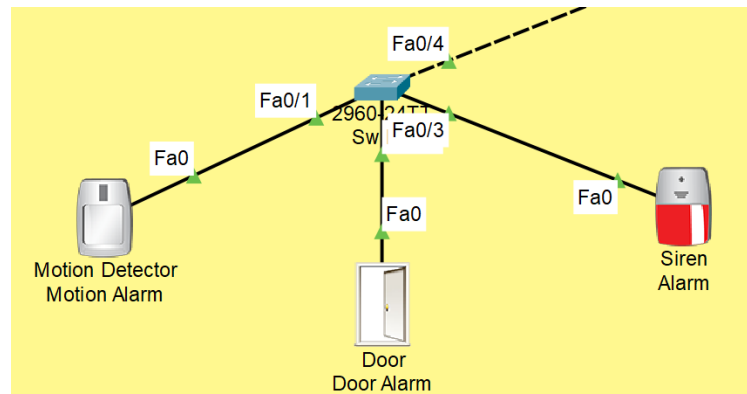

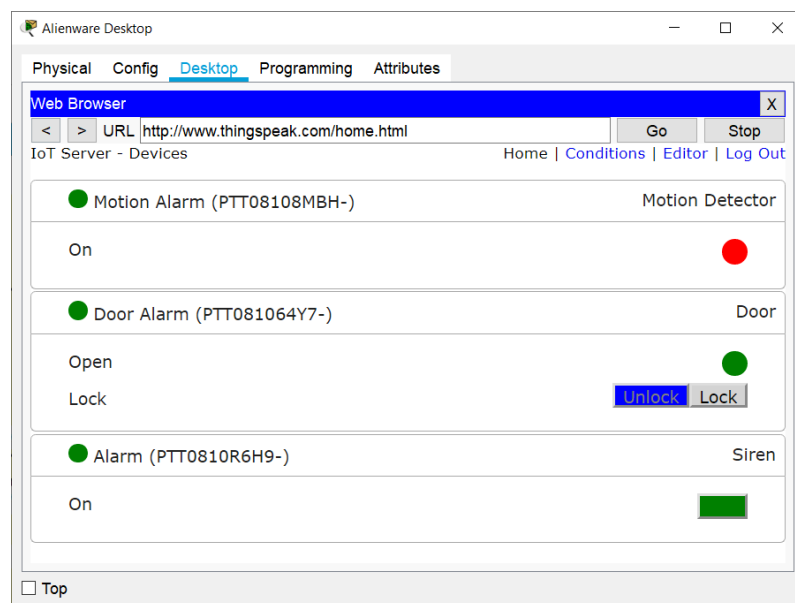Figure 17: Door Alarm has been triggered when door is opened.

Figure 18: Thingspeak dashboard when Door Alarm has been triggered.

c) Can you add an IoT input sensor (e.g. smoke detector, temperature monitor, humidity monitor, etc.) and an IoT output device (e.g. ceiling fan, light, home speaker, etc.) and create a new Condition to simulate an event? For example, if humidity monitor detects high humidity, open the window and turn on the fan. Briefly explain your ideas in the report.
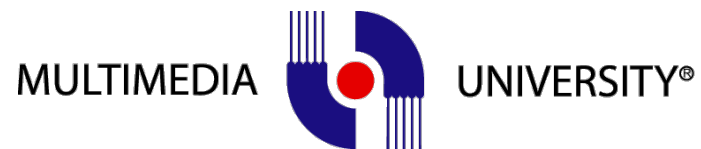
14. Preparing the Report

a) Prepare the report using the cover page shown in the next page. The report should contain all the screenshots as indicated by 📷 . Organise them neatly according to the sections. For example:

Figure 1: Renaming desktop to Alienware Desktop
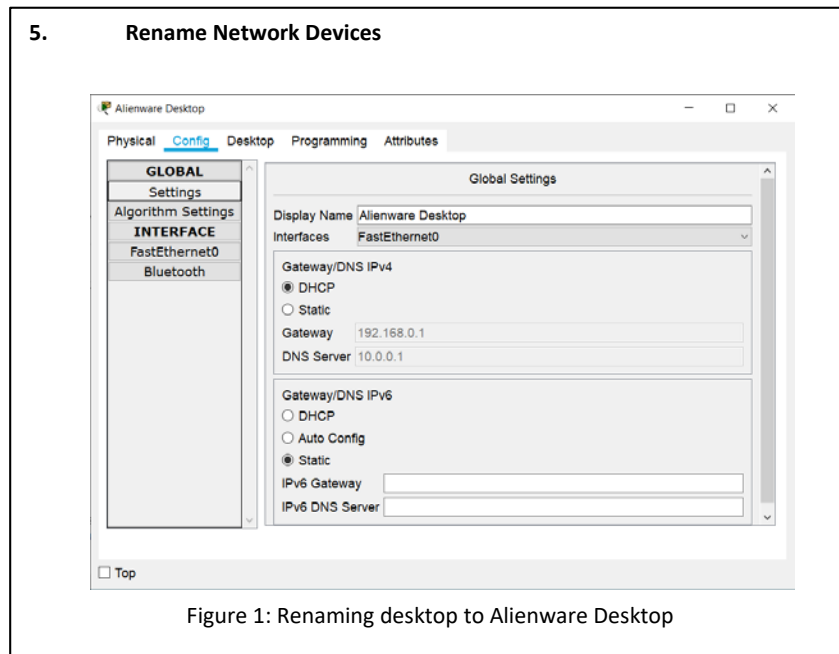
b) The report should also contain the discussions as indicated by ✏️

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Assignment

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No	Name	Student ID	Program
1			
2			
3			