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ROLL NO.: TCS2324045

SUBJECT: WSN JOURNAL

DEPARTMENT: TY BSC CS

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CERTIFICATE

This is to certify that Mr **NADAR KIBSON SAMUEL P JOSEPH** Roll No. **TCS2324045** has successfully completed the necessary course of experiments in the subject of **Wireless Sensor Networks & Mobile Communication** during the academic year **2023 – 2024** complying with the requirements of **University of Mumbai**, for the course of **TYBSc Computer Science [Semester-VI].**

Prof. In-Charge
JESICA D'CRUZ

Examination date:

Examiner's Signature & Date:

Head of the Department
Prof. Manoj Singh

College Seal

Name of Instructor: Ms. Jessica D'cruz

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Name of Instructor: Ms. Jessica D'cruz

Wireless Sensor Networks & Mobile Communication

Practical No.1

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Sensor Node Hardware	**Batch**	I
Date:	08th January 2024	**Practical No**	1

A) AIM:

Understanding the Sensor Node Hardware

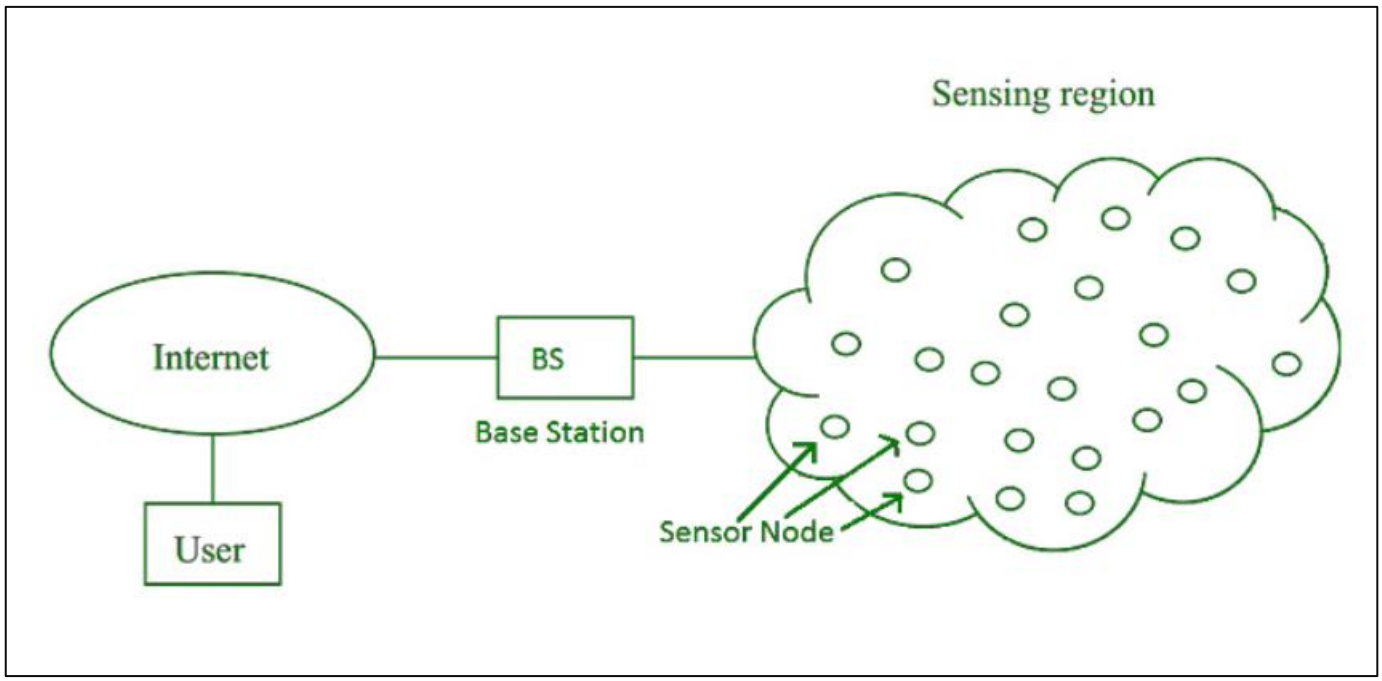
B) DESCRIPTION:

Wireless Sensor Network (WSN) is an infrastructure-less wireless network that is deployed in a large number of wireless sensors in an ad-hoc manner that is used to monitor the system, physical or environmental conditions.

Sensor nodes are used in WSN with the onboard processor that manages and monitors the environment in a particular area. They are connected to the Base Station which acts as a processing unit in the WSN System.
Base Station in a WSN System is connected through the Internet to share data.

Name of Instructor: Ms. Jessica D'cruz

C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:



Haedware of WSN:

1. **Sensors:**
   Sensors in WSN are used to capture the environmental variables and which is used for data acquisition. Sensor signals are converted into electrical signals.
   These components are responsible for data acquisition, i.e., they collect environmental data (variables) and convert it into electrical signals through a process known as transduction. In lay terms, sensors are tiny electric noses, ears, and fingers that 'feel' the environment and tell a computer what it 'senses' in a language it understands.

2. **Sensor Nodes:**
   A sensor node is a combination of different subunits and all they help to perform the functionality of the sensor node. Different units help to sense, record, monitor and analyze the data which is collected from physical conditions .Even though the name, a Sensor Node comprises not only the sensing component but also other important characteristics like processing of recorded data, communication with servers and storage units to store recorded data. With all these characteristics, components and enrichments, a Sensor Node takes responsibility for data collection, data correlation, and fusion of data from other sensors with its own data and network analysis.

3. **Radio Nodes**:

These components are equipped with a microcontroller for data processing, a transceiver for wireless communication, external memory for data storage, and a power source to remain operational. They receive the sensor's electrical signals and send this data to the WLAN access point.

4. **Wireless Access Point:**

A Wireless Access Point (WAP) is a networking device that allows connecting the devices with the wired network. A Wireless Access Point (WAP) is used to create the WLAN (Wireless Local Area Network), it is commonly used in large offices and buildings which have expanded businesses.

It is easier and simpler to understand and implant the device. It can be fixed, mobile or hybrid proliferated in the 21st century. The availability, confidentiality, and integrity of the communication and network are a responsibility and to be ensured about that.

A wireless AP connects the wired networks to the wireless client. It eases access to the network for mobile users which increases productivity and reduces the infrastructure cost.

5. **WLAN Access Point:**
   It receives the data which is sent by the Radio nodes wirelessly, generally through the internet.

6. **Evaluation Software:**
   The data received by the WLAN Access Point is processed by a software called as Evaluation Software for presenting the report to the users for further processing of the data which can be used for processing, analysis, storage, and mining of the data.

7. **Base Station:**
   A base station serves as a central connection point for a wireless device to communicate. It further connects the device to other networks or devices, usually through dedicated high bandwidth wire or fiber optic connections.
   The base station sends commands to the sensor nodes and the sensor node perform the task by collaborating with each other. After collecting the necessary data, the sensor nodes send the data back to the base station.
   A base station also acts as a gateway to other networks through the internet. After receiving the data from the sensor nodes, a base station performs simple data processing and sends the updated information to the user using internet.

   If each sensor node is connected to the base station, it is known as Single-hop network architecture. Although long distance transmission is possible, the energy consumption for communication will be significantly higher than data collection and computation.

8. **Graphical User Interface:**
   A graphical user interface (GUI) is a digital interface in which a user interacts with graphical components such as icons, buttons, and menus.

9. **Actuators:**
   Actuators allow a WSN node to influence its environment, providing a feedback channel through which its decisions can be enacted. Throughout the history of computing, there has been a trend for the ratio of processing elements to people to increase, resulting in the creation and popularization of new usage paradigms.

Wireless Sensor Networks & Mobile Communication

Practical No.2

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	TinyOs and Tossim	**Batch**	I
Date:	08th January 2024	**Practical No**	2

A) AIM:

1) Exploring and understanding TinyOS computational concepts: Events, Commands and Task

- nesC model

- nesC Components

2) Understanding TOSSIM for

- Mote-mote radio communication

- Mote-PC serial communication

B) DESCRIPTION:

TinyOS is an embedded, component-based operating system and platform for low-power wireless devices, such as those used in wireless sensor networks (WSNs), smartdust, ubiquitous computing, personal area networks, building automation, and smart meters. It is written in the programming language nesC, as a set of cooperating tasks and processes.

TOSSIM is a discrete event emulator for the execution of nesC model on TinyOS-Mica hardware [1]. In TOSSIM, an event is generated for each transmitted or received bit or packet.

C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:

A) Understanding TinyOS computational concepts: Events, Commands, Task, nesC components and model

A TinyOS program is a graph of components, each of which is an independent computational entity that exposes one or more interfaces. Components have three computational abstractions: commands, events, and tasks. Commands and events are mechanisms for inter-component communication, while tasks are used to express intra-component concurrency

Events:

An event in TinyOS is essentially a named placeholder for a function. It represents an occurrence or trigger that can be handled by the system. In TinyOS, events are a fundamental concept used for asynchronous programming. They provide a mechanism for handling and responding to external stimuli, such as sensor readings or incoming messages, in a non-blocking manner. Events are central to the event-driven programming paradigm in TinyOS, and they play a crucial role in managing the flow of execution in the system.

Commands:

A command is a named function or operation that a component provides to other components. It defines a specific action that can be requested by a client component. In TinyOS, commands are a mechanism for providing a standardized interface for components to interact with each other. Commands allow one component to request specific actions or services from another component in a well-defined manner. They are part of the component-based programming model used in TinyOS.

Tasks:

A task in TinyOS is a named function or operation that represents a unit of work to be performed. Tasks are used to structure the execution flow of the program and handle concurrent activities. A task in TinyOS is a named function or operation that represents a unit of work to be performed. Tasks are used to structure the execution flow of the program and handle concurrent activities.

NesC Components:

In TinyOS, components are a fundamental building block of the programming model. Components are modular units of code that encapsulate functionality, providing a way to structure and organize the software. Components are written in the nesC (pronounced "nes-C") programming language, which is specifically designed for developing embedded systems and wireless sensor networks. Here are key points about nesC components in TinyOS:

1. **Definition:** A nesC component is a self-contained unit of code that encapsulates a specific functionality or service. Components in TinyOS are designed to be modular and composable, promoting code reuse and maintainability.

2. **Interface-Implementation Separation:** Components in TinyOS follow the interface-implementation separation principle. An interface declares a set of commands, events, and functions that a component provides or expects from other components. The implementation contains the actual code that realizes the behavior defined in the interface.
3. **Interfaces:** Interfaces define the communication contract between components. They specify a set of commands, events, and functions that components can use to interact with each other. Interfaces allow for the decoupling of components and enable the development of interchangeable and interoperable software modules.
4. **Component Wiring:** Components can be connected or "wired" together to form an application. Wiring is the process of specifying how components are connected, determining how they communicate and collaborate. This wiring is often done in the configuration file of a TinyOS application.
5. **Configuration:** Components can be parameterized and configured, allowing for flexibility in adapting their behavior to different requirements. Configuration settings can be adjusted at compile time, providing a way to customize the behavior of the software.

B) Understanding TOSSIM for

- **Mote-mote_radio communication:**

Mote to mote communication is the radio communication in Tiny os. This introduces us the interfaces and components in Tiny os which supports the radio communication. And also we learn the basics how to use the message_ t that is a message buffer which is used to send the message buffer to the radio and receives the message buffer from the radio. Tiny os provides us with the interfaces and the components.

Interfaces are used to consider the existing communication services and the components are used to implement the interfaces. These components and interfaces use a message buffer called message_ t that is implemented as nesC structure. This message buffer message_ t was used as TOS_ Msg in the first version of Tiny os and in the latest version of it has been replaced as message_ t. In the first version of the tiny os the message buffers were accessed directly but in the latest version they cannot be accessed directly instead this function can be read and written in the form of mutator and accessor functions.

- Mote-PC serial communication

Mote-to-PC radio communication is a crucial aspect of wireless sensor networks (WSNs), facilitating the transfer of data between sensor nodes (motes) deployed in the field and a central personal computer (PC). This communication enables the collection, monitoring, and analysis of data generated by the sensor nodes. Here's a brief overview:

1. **Hardware Setup:**
   - Motes are equipped with radio transceivers for wireless communication, often following standards like IEEE 802.15.4 or Zigbee.
   - The PC may have a compatible radio interface or a dedicated gateway device to communicate with the sensor nodes.
2. **Communication Protocols:**
   - Motes and the PC use compatible communication protocols, defining how data is formatted, transmitted, and received.
   - Protocols may include addressing, synchronization, and error-handling mechanisms.
3. **Data Transmission:**
   - Motes periodically sense the environment, collect data, and transmit it wirelessly to the PC or through an intermediary gateway.
   - Data may include sensor readings, status information, or event notifications.
4. **Gateway Device:**
   - A gateway device may be employed to interface between the wireless sensor network and the PC. It receives data from sensor nodes, processes or aggregates it, and forwards it to the PC.
5. **PC Software:**
   - The PC runs software responsible for receiving, parsing, and processing data from the sensor nodes.
   - Communication drivers, middleware, and visualization components are commonly part of the software stack.
6. **Security Measures:**
   - Security measures, such as encryption and authentication, are often implemented to protect the communication between sensor nodes and the PC, ensuring data integrity and preventing unauthorized access.
7. **Data Analysis and Visualization:**
   - Once received by the PC, the data can be analyzed, visualized, and used for decision-making.
   - Visualization tools, databases, and analysis software help make sense of the collected data.
8. **Application Examples:**
   - Mote-to-PC communication is used in various applications, including environmental monitoring, industrial automation, healthcare, and smart agriculture.
   - It enables real-time tracking, control, and management of distributed sensor nodes.
9. **Energy Considerations:**

- Energy-efficient communication strategies, such as duty cycling and data aggregation, are often employed in mote-to-PC communication to maximize the lifespan of sensor nodes.

In summary, mote-to-PC radio communication is a foundational element in WSNs, enabling the seamless exchange of data between sensor nodes and central processing units for analysis, monitoring, and decision-making in diverse applications.

Wireless Sensor Networks & Mobile Communication

Practical No. 3A

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Smoke detection and fire prevention system	**Batch**	I
Date:	08th January 2024	Practical No	3A

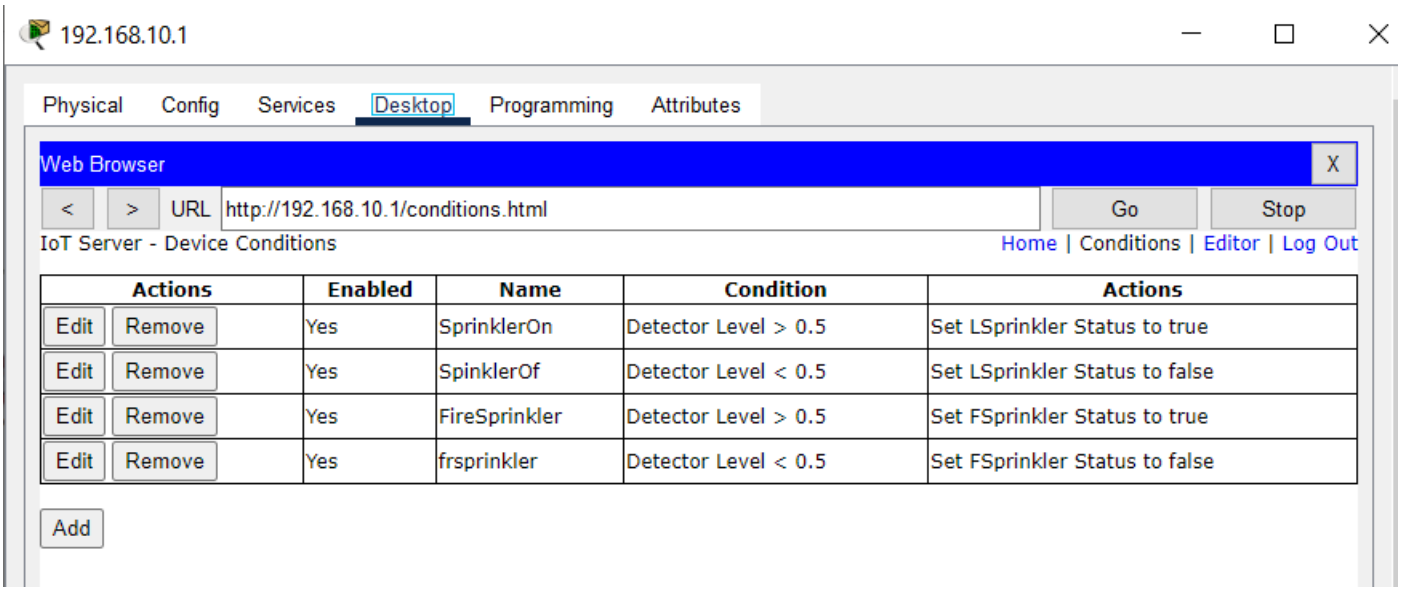
A) AIM: Design Smoke detection and fire prevention system using cisco packet tracer

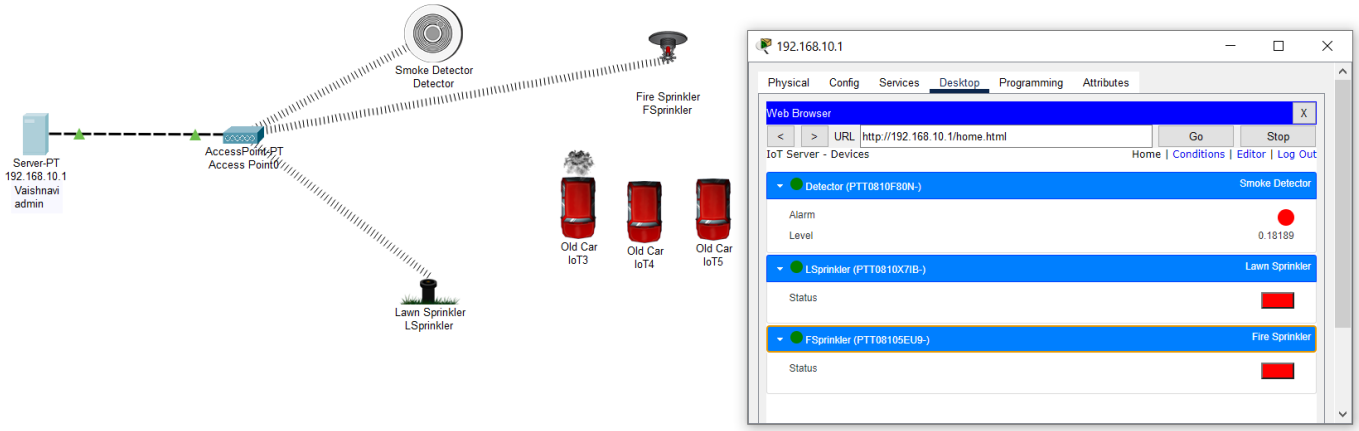
B) DESCRIPTION:

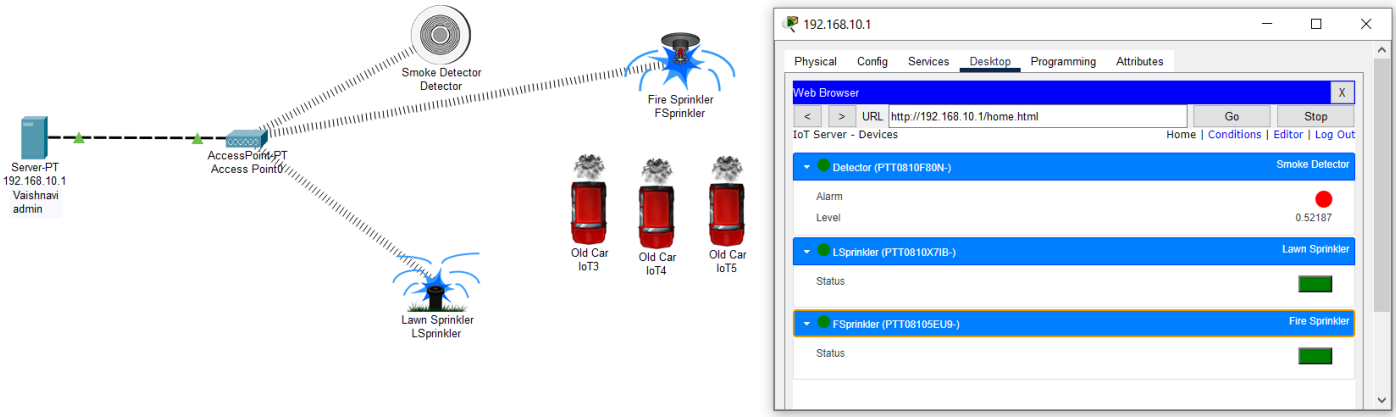
Sensor is a device that is used to gather information about a physical process or a physical phenomenon and translate it into electrical signals that can be processed, measured and analysed. The term physical process Sensor can be any real-world information like temperature, pressure, light, sound, motion, position, flow, humidity, radiation etc. **Here, Smoke Detector is a sensor.**

Actuator is a device that converts the electrical signals into the physical events or characteristics. It takes the input from the system and gives output to the environment. **Here, FireSprinkler and LawnSprinkler is the Actuator.**

C) CODE AND OUTPUT:

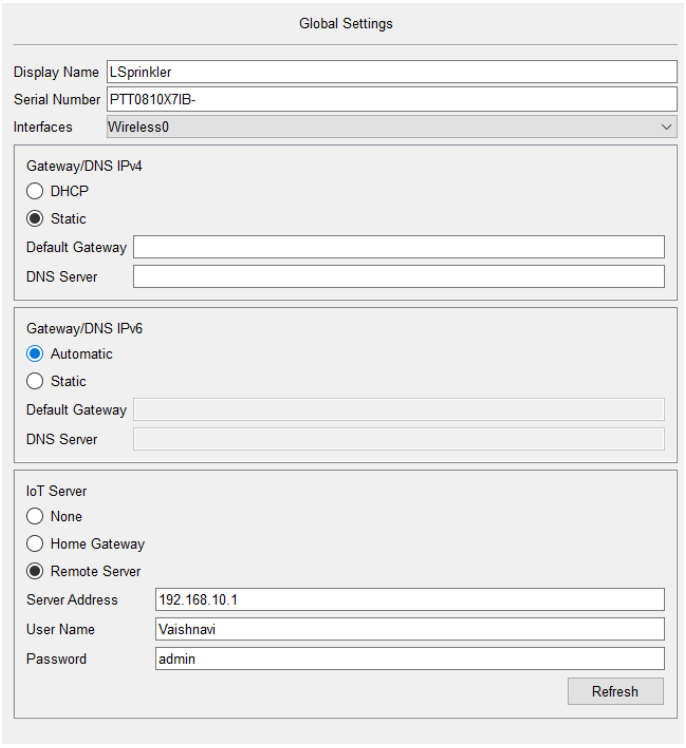




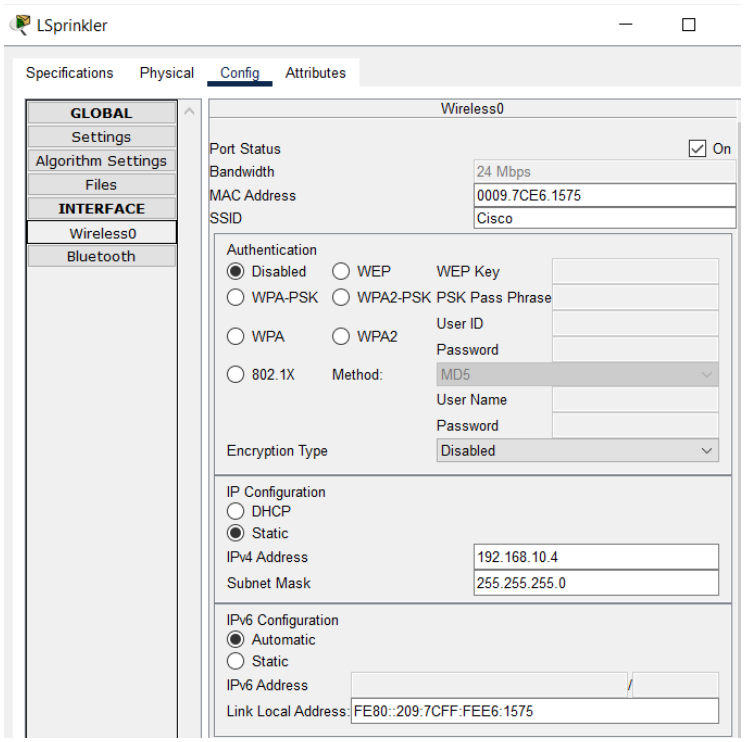


Name of Instructor: Ms. Jessica D'cruz

Global settings same for all



LSprinkler



Name of Instructor: Ms. Jessica D'cruz

Wireless Sensor Networks & Mobile Communication

Practical No. 3B

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Smart Garden System	**Batch**	I
Date:	15th January 2024	Practical No	3A

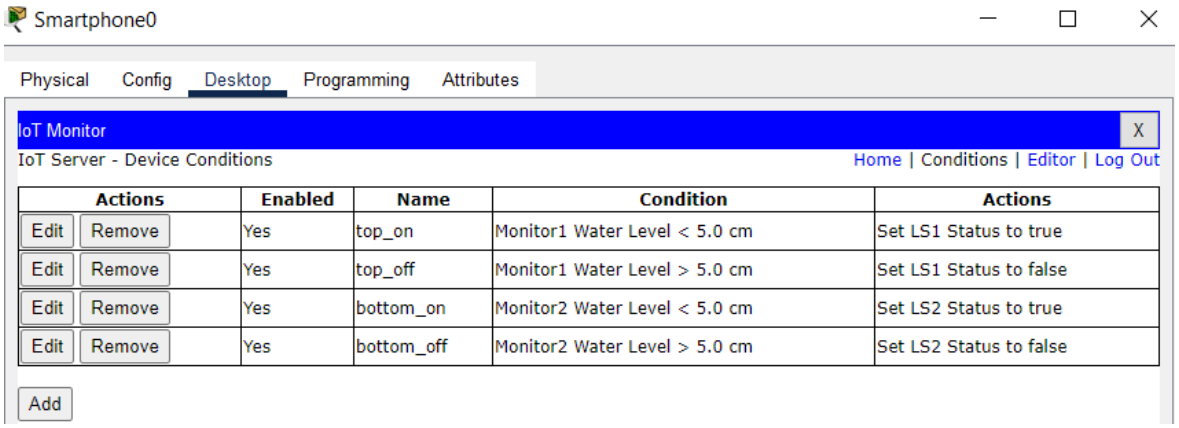
A) AIM: Design Smart Garden system system using cisco packet tracer

B) DESCRIPTION:

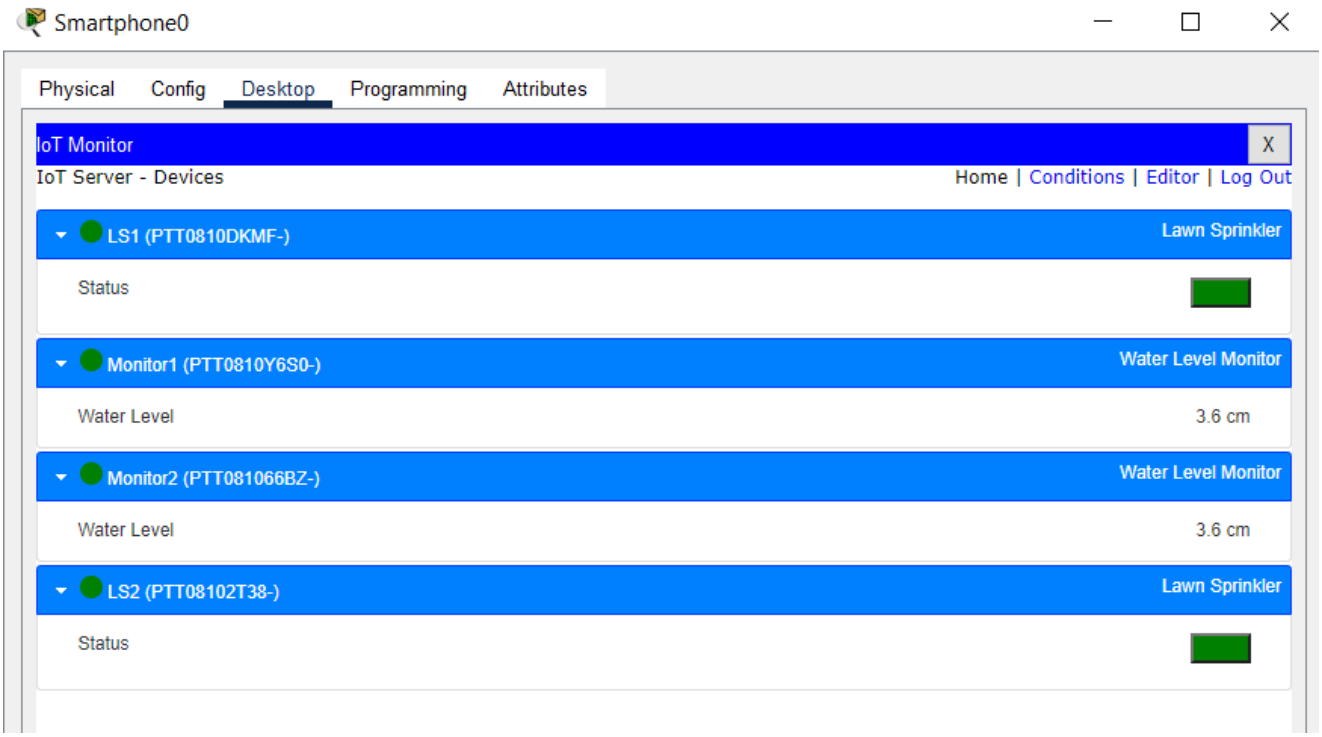
Sensor is a device that is used to gather information about a physical process or a physical phenomenon and translate it into electrical signals that can be processed, measured and analysed. The term physical process Sensor can be any real-world information like temperature, pressure, light, sound, motion, position, flow, humidity, radiation etc. **Here, Water Level Monitor is a sensor.**

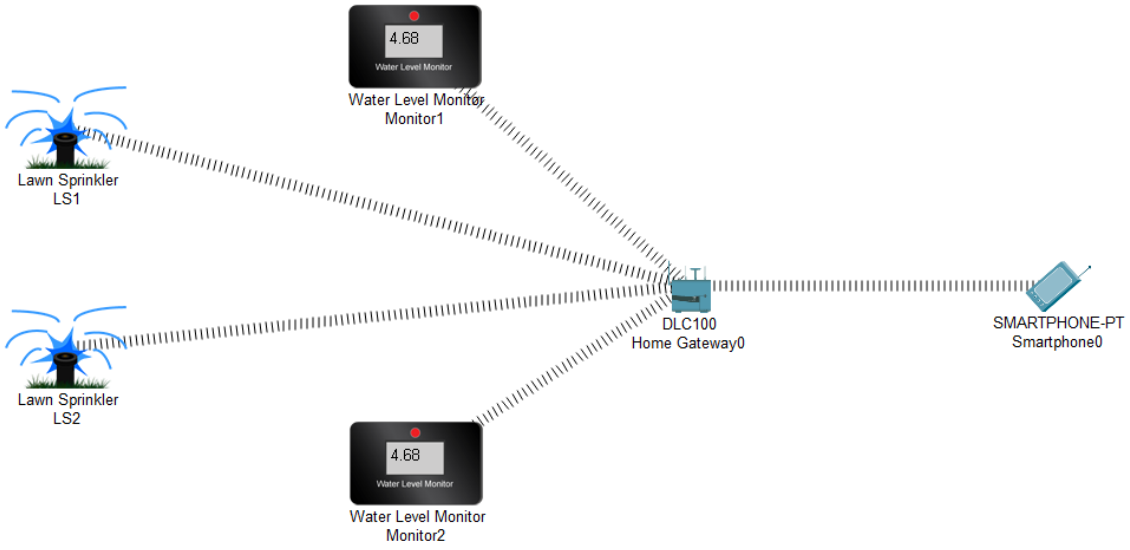
Actuator is a device that converts the electrical signals into the physical events or characteristics. It takes the input from the system and gives output to the environment. **Here, LawnSprinkler is the Actuator.**

C) CODE AND OUTPUT:

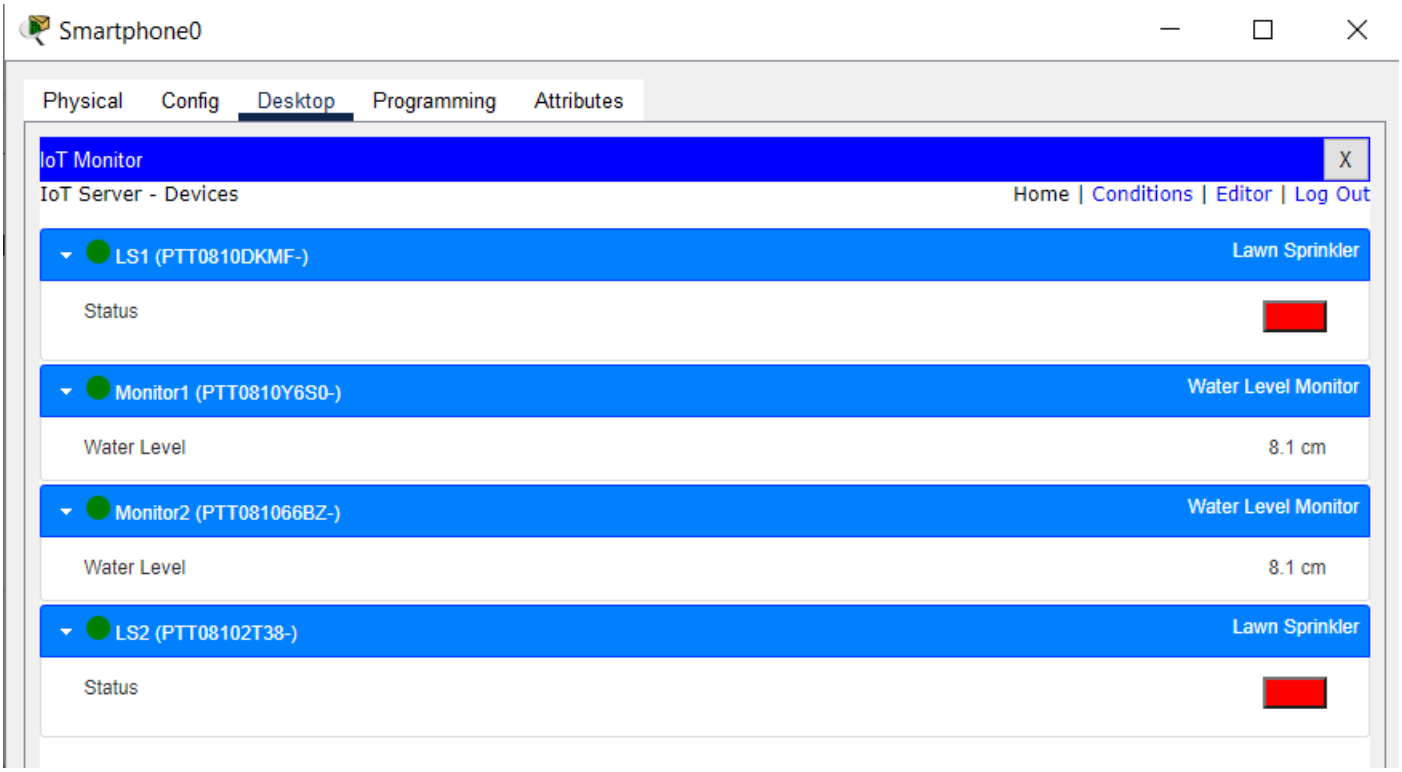


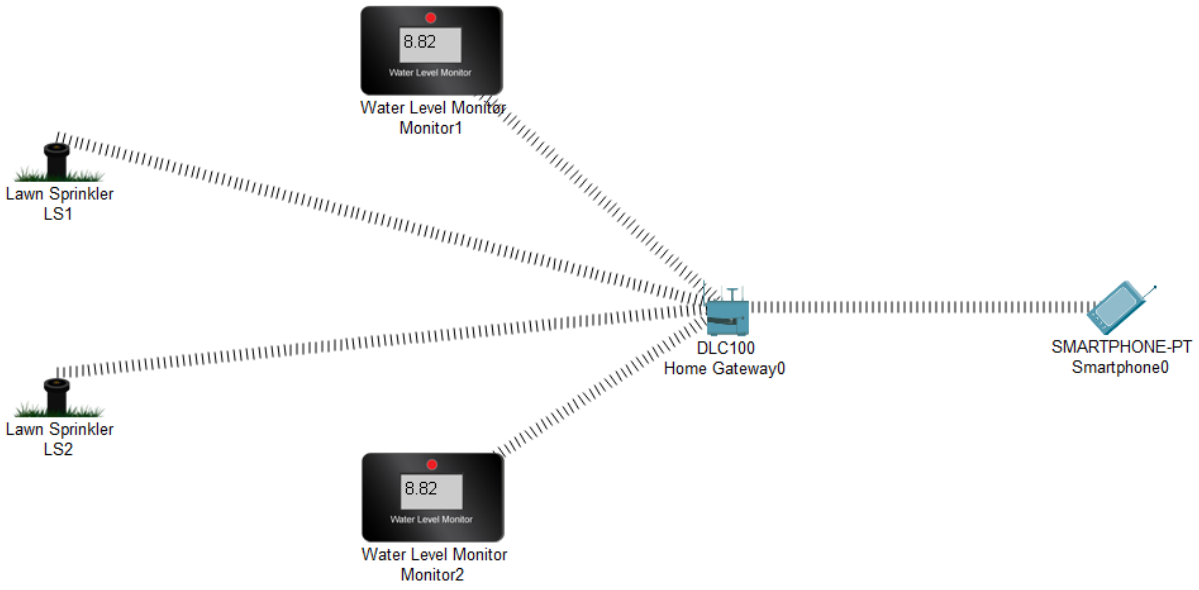
i) When water level goes below 5 cm : (LawnSprinkler is On)

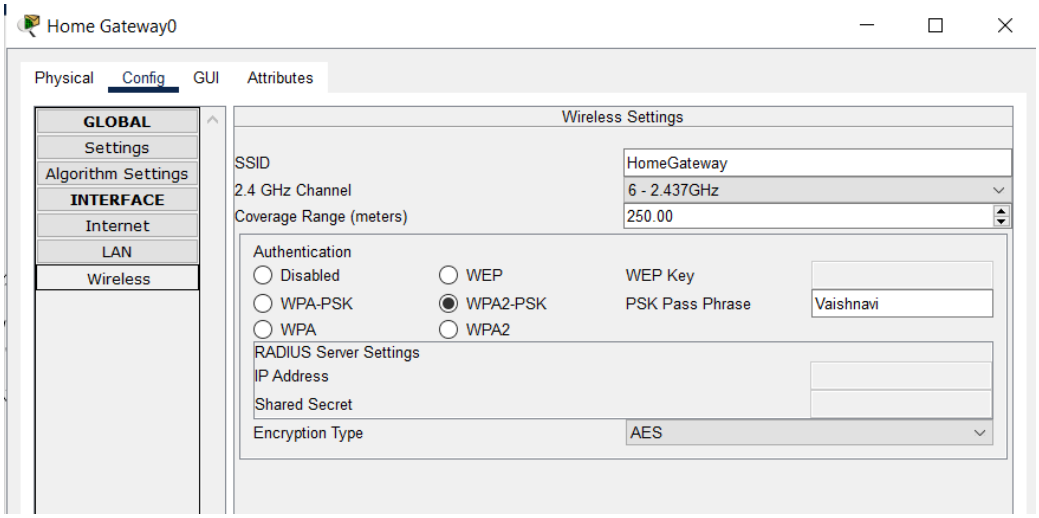




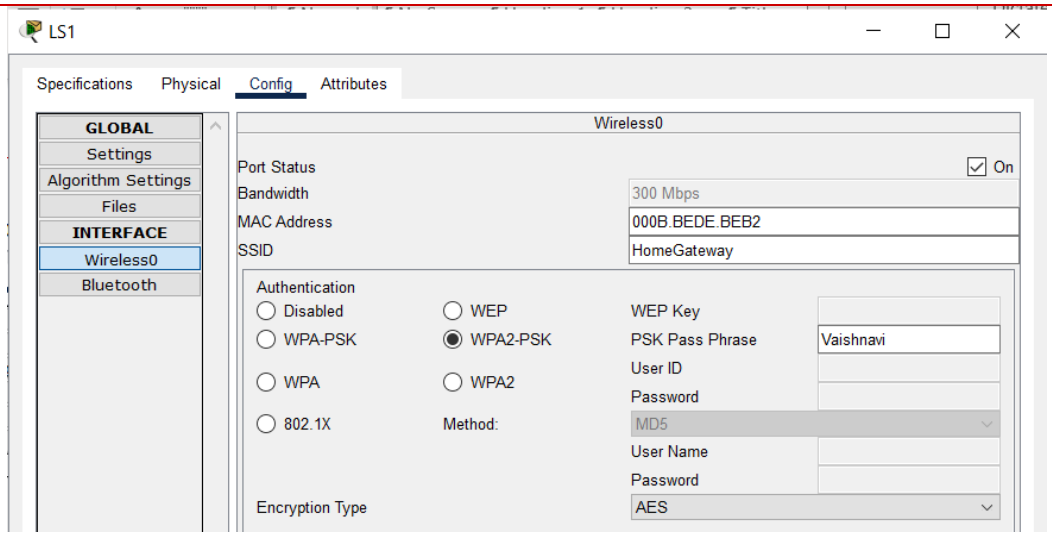
ii) when water level goes above 5cm : (LawnSprinkler is Off)

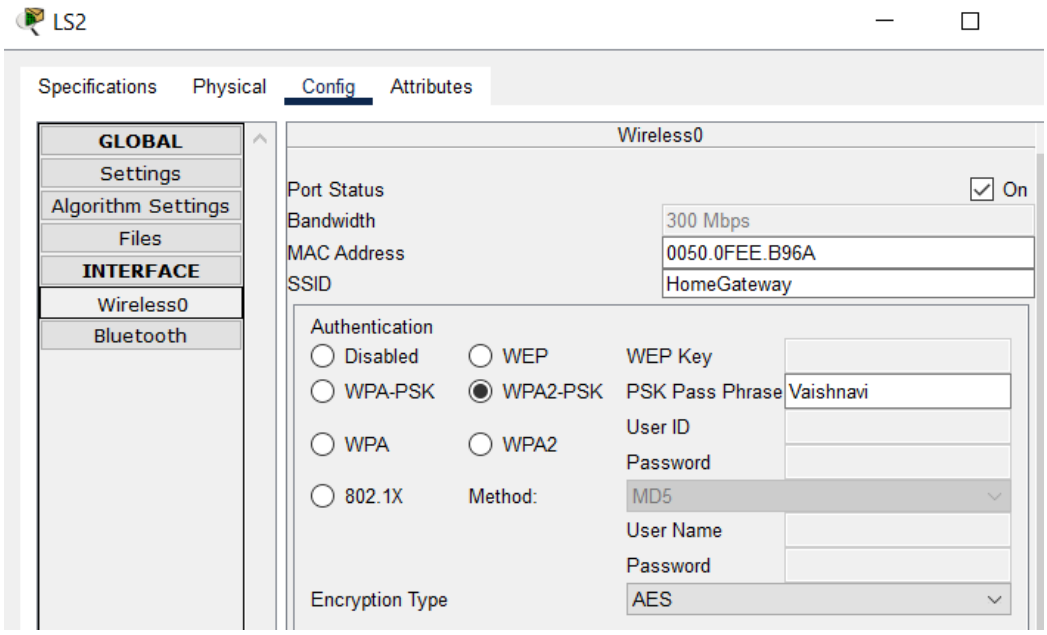




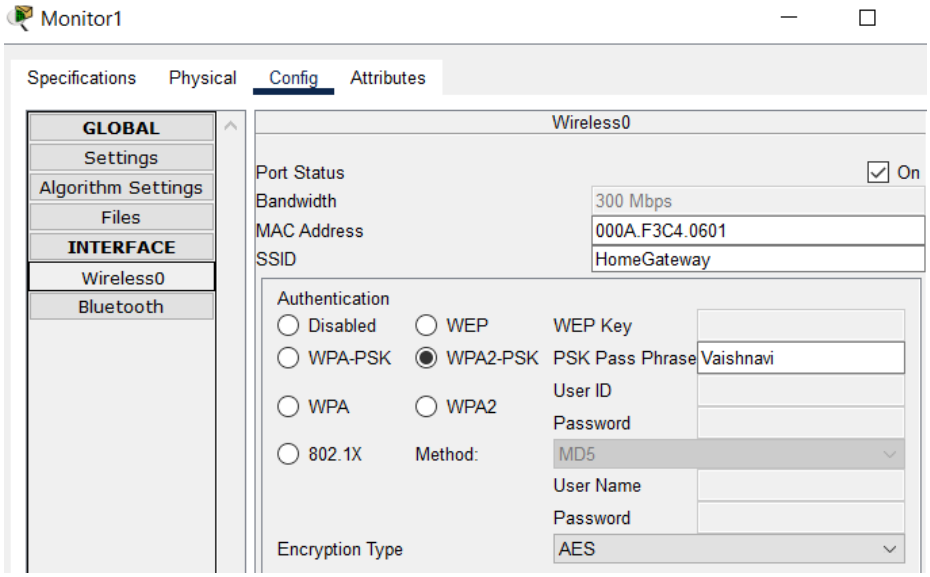


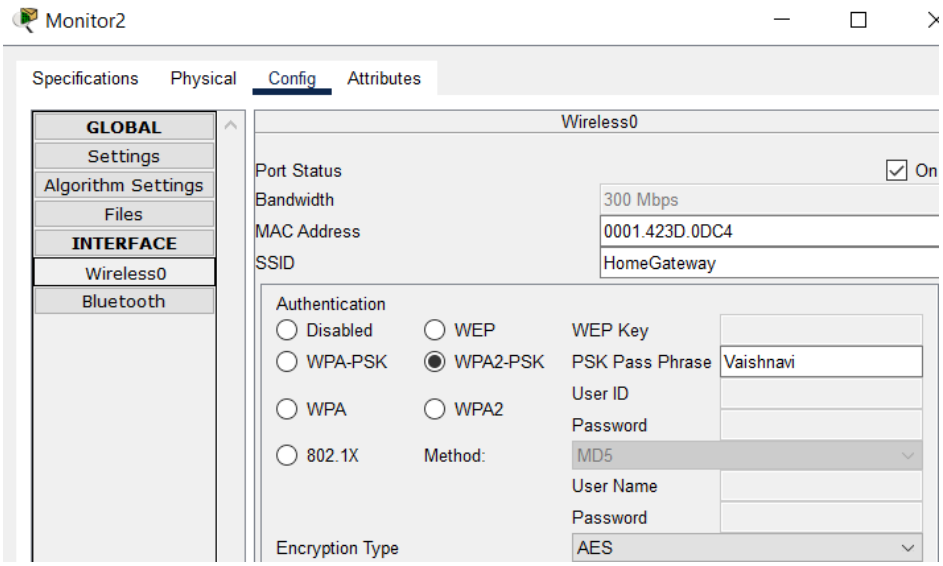
Name of Instructor: Ms. Jessica D'cruz

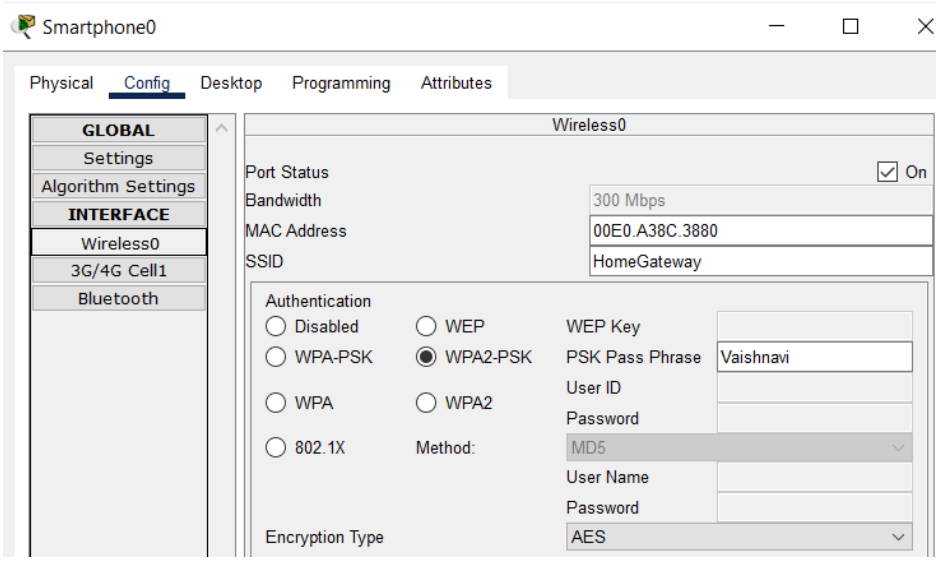




Name of Instructor: Ms. Jessica D'cruz







Name of Instructor: Ms. Jessica D'cruz

Wireless Sensor Networks & Mobile Communication

Practical No. 4

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Simple ADHOC Network	**Batch**	I
Date:	05th February 2024	Practical No	4

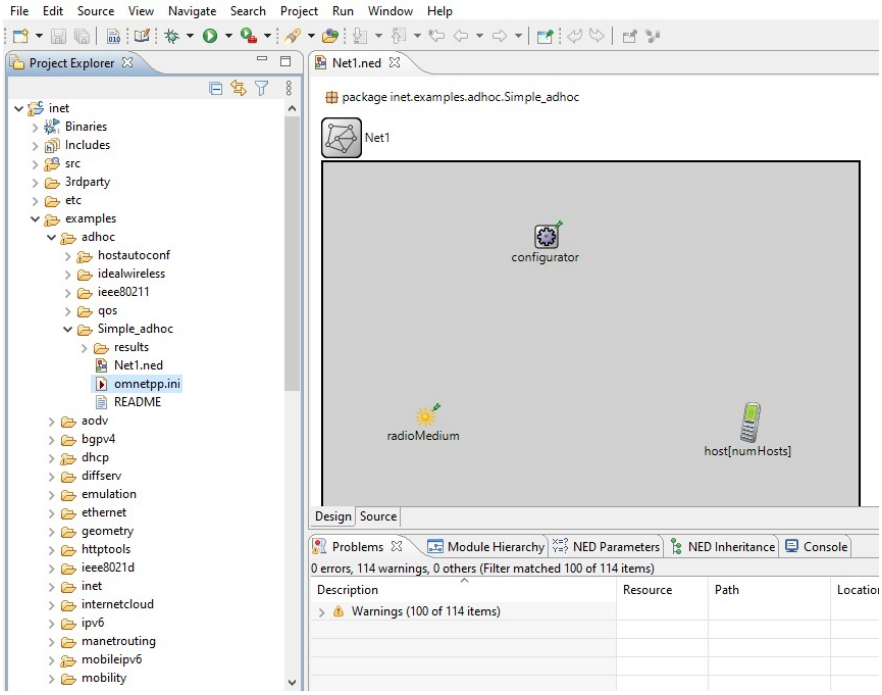
A) AIM: Create and simulate A SIMPLE ADHOC Network (OMNET)

B) DESCRIPTION:

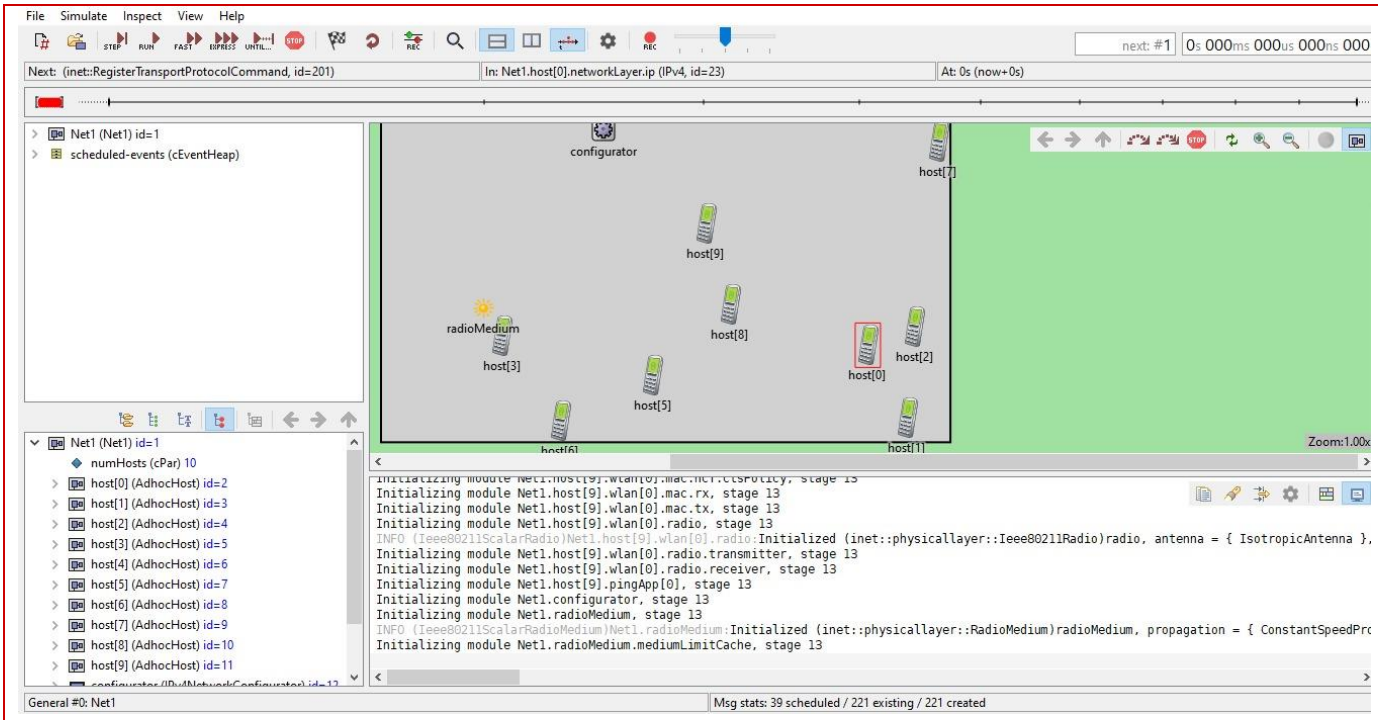
- An ad hoc network is a temporary network created between two devices without utilizing any other networking infrastructure. These networks exist for a single session, often for a specific purpose like transferring files or sharing an Internet connection. Ad hoc networks do not require a router or wireless access point.

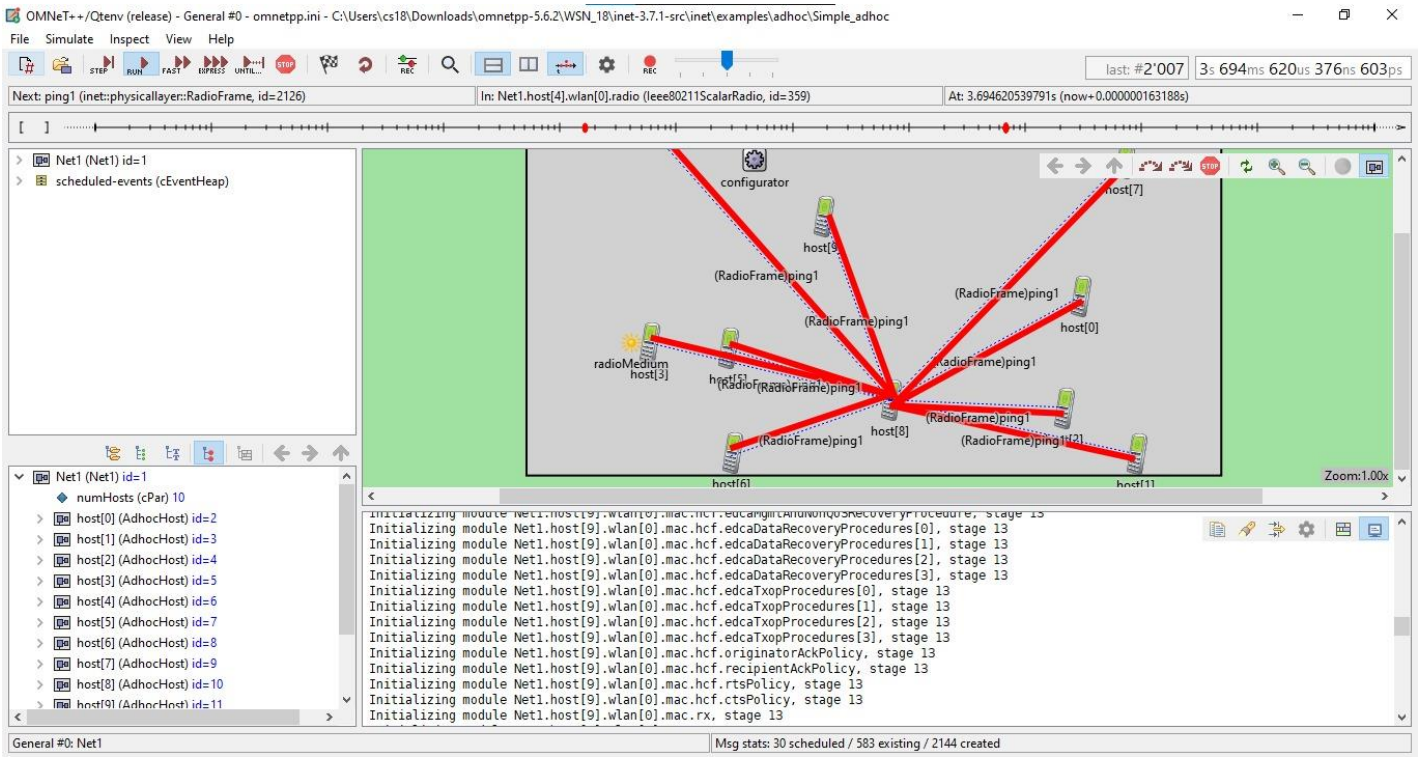
Code And Output :

```
package inet.examples.adhoc.Simple_adhoc;

// numOfHosts: 10
// parametric: true
// static:     false

import inet.networklayer.configurator.ipv4.IPv4NetworkConfigurator;
import inet.node.inet.AdhocHost;
import inet.physicallayer.ieee80211.packetlevel.Ieee80211ScalarRadioMedium;

network Net1
{
    parameters:
        int numHosts;
    submodules:
        host[numHosts]: AdhocHost {
            parameters:
                @display("r=,,#707070");
        }

        configurator: IPv4NetworkConfigurator {
            @display("p=219,73");
        }
        radioMedium: Ieee80211ScalarRadioMedium {
            parameters:
                @display("p=100,250");
        }
}
```

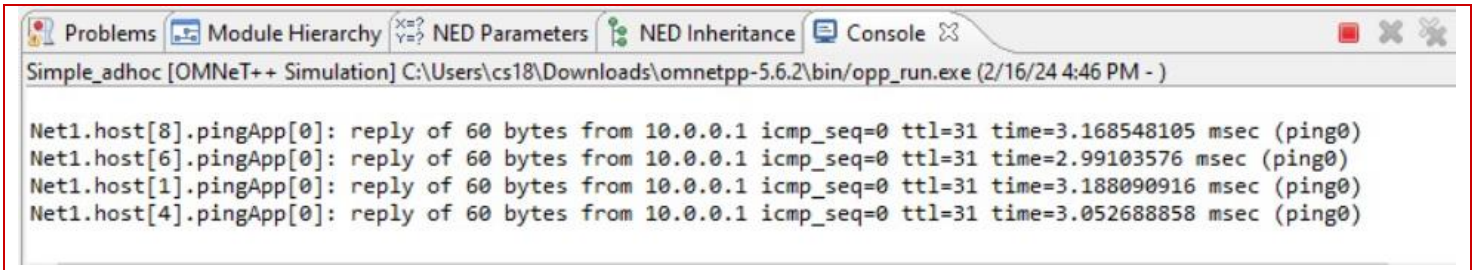


Name of Instructor: Ms. Jessica D'cruz





Name of Instructor: Ms. Jessica D'cruz



Wireless Sensor Networks & Mobile Communication

Practical No. 5

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	OSPF and RIP Protocol	**Batch**	I
Date:	29th February 2024	Practical No	5

A) AIM: Understanding, Reading and Analyzing Routing Table of Network

Name of Instructor: Ms. Jessica D'cruz

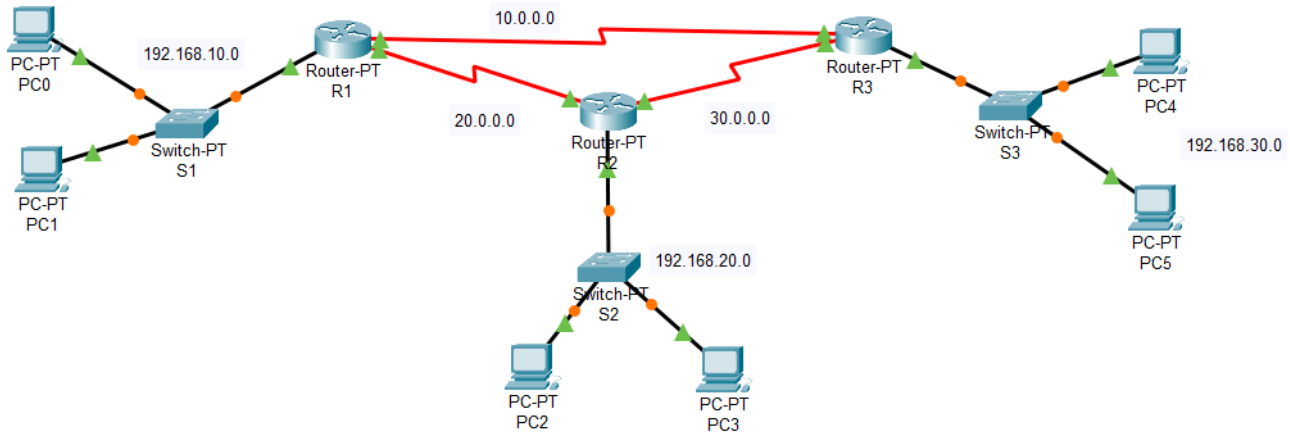
B) DESCRIPTION:

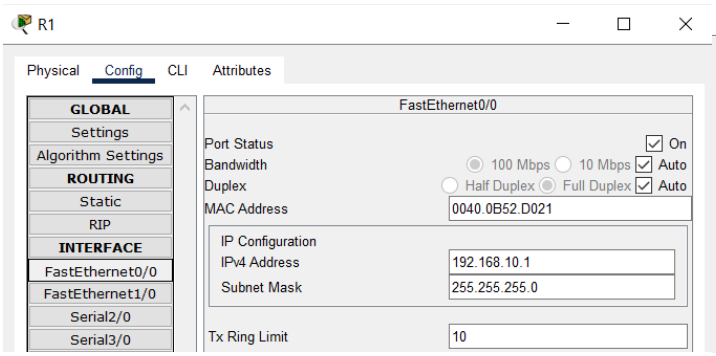
- RIP stands for Routing Information Protocol in which distance vector routing protocol is used for data/packet transmission. In the Routing Information Protocol (RIP), the maximum number of Hop is 15, because it prevents routing loops from source to destination. Compared to other routing protocols, RIP (Routing Information Protocol) is poor and limited in size i.e. small network. The main advantage of using RIP is it uses the UDP (User Datagram Protocol).

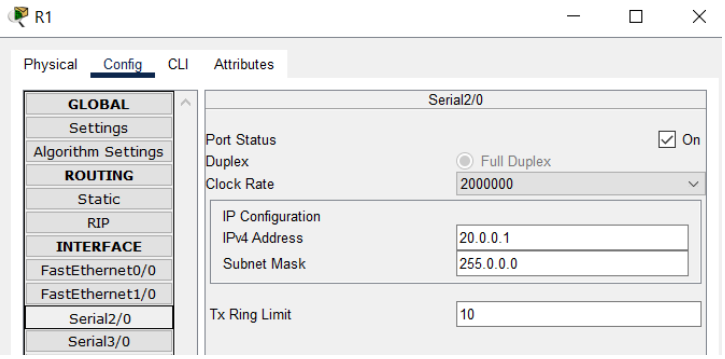
- OSPF stands for Open Shortest Path First which uses a link-state routing algorithm. Using the link state information which is available in routers, it constructs the topology in which topology determines the routing table for routing decisions. It is a router protocol which is used to find the best path for packets when they are passing through the set of connected networks simultaneously. The main disadvantage of OSPF is that it is difficult than other protocols.

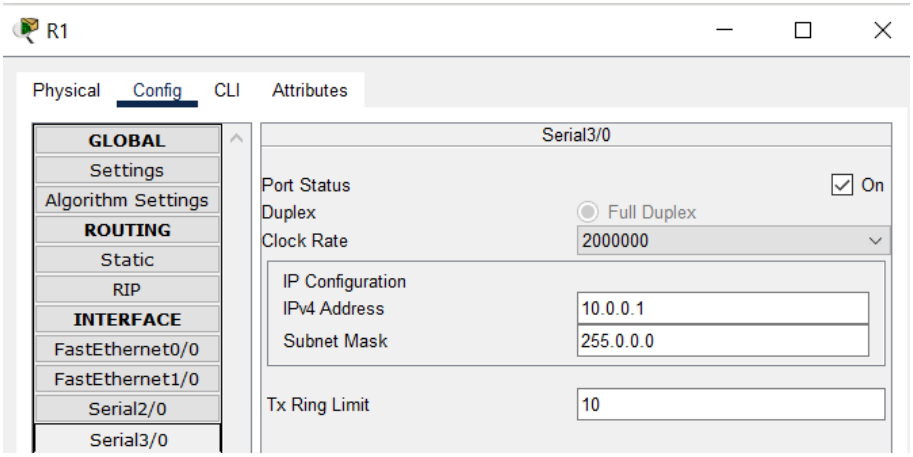
Code And Output :

A) RIP Protocol :









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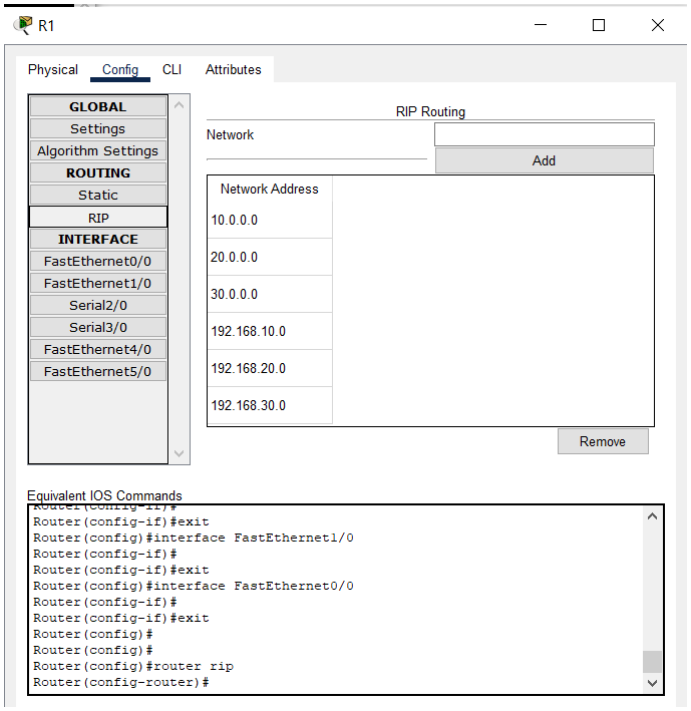
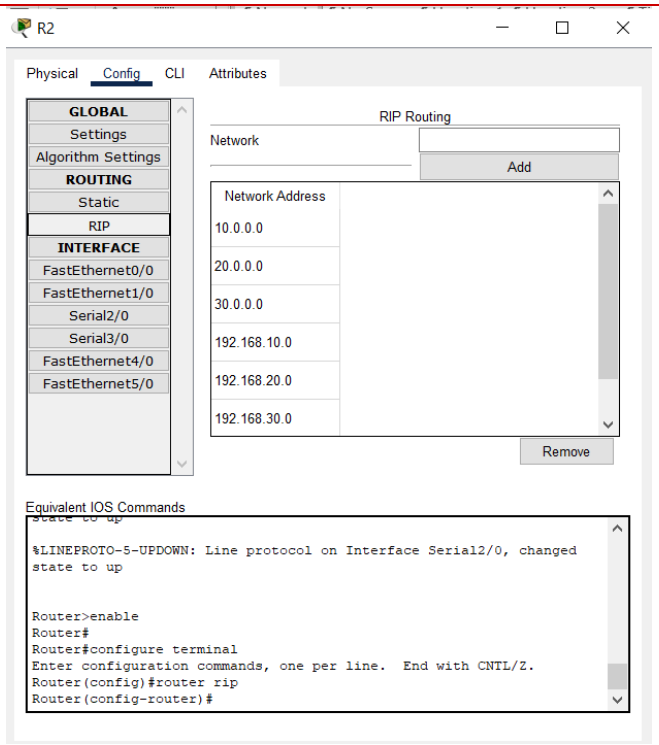
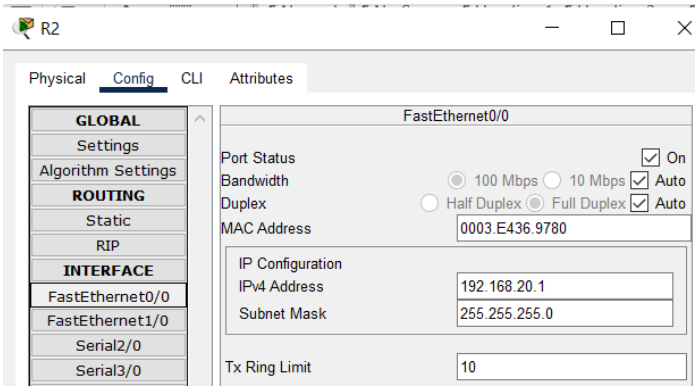
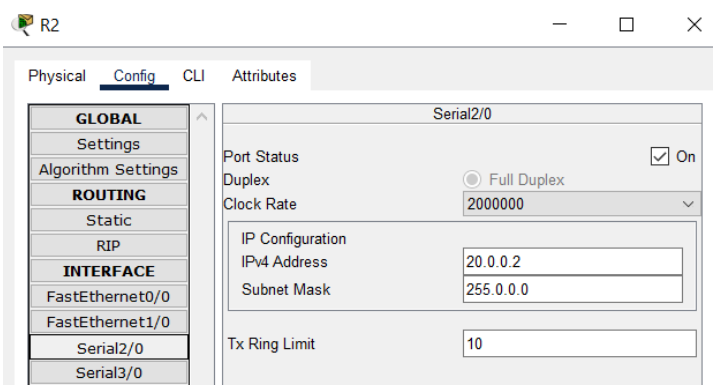
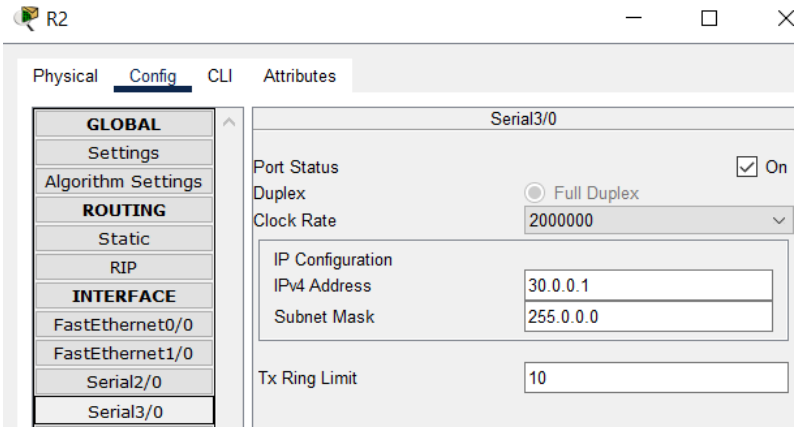


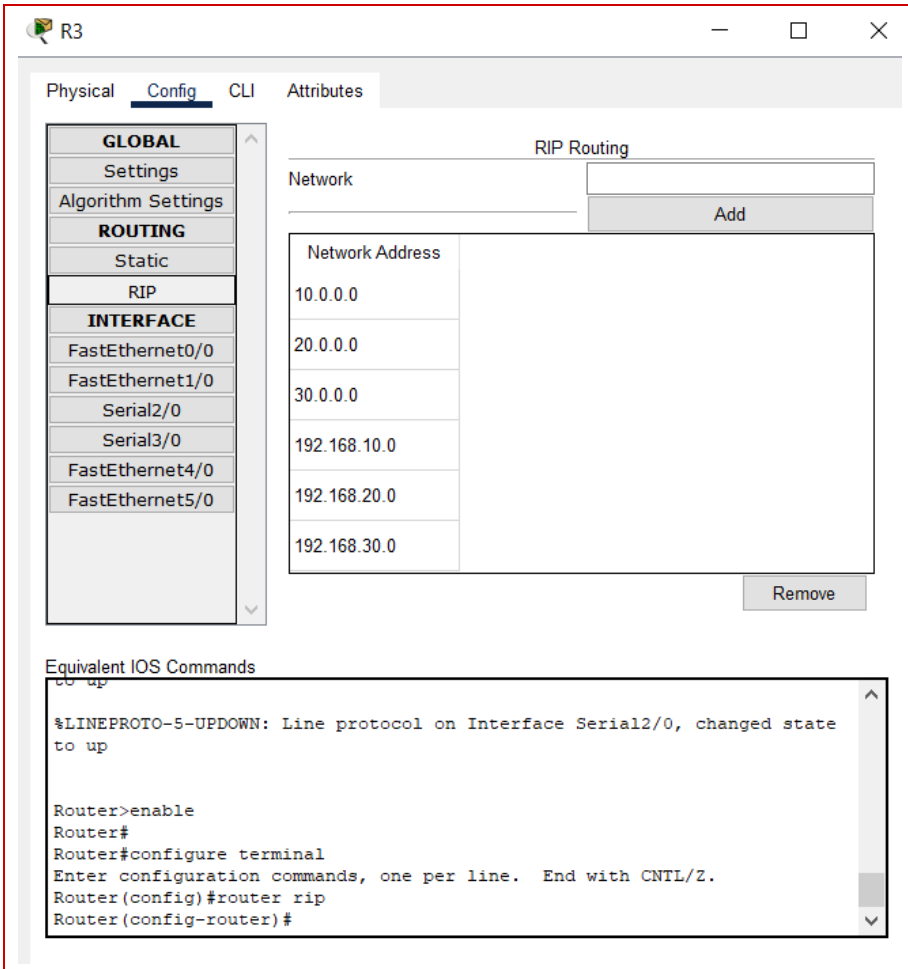


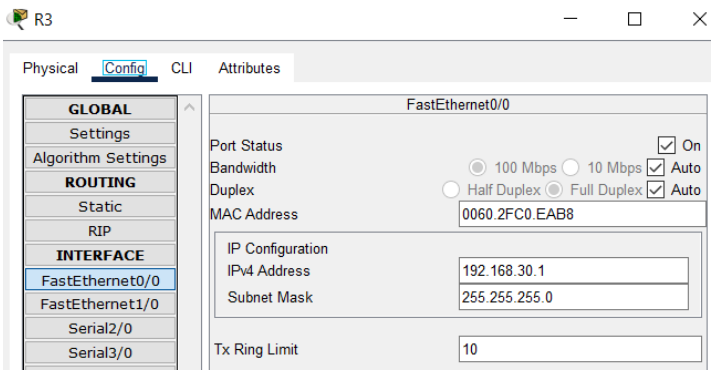


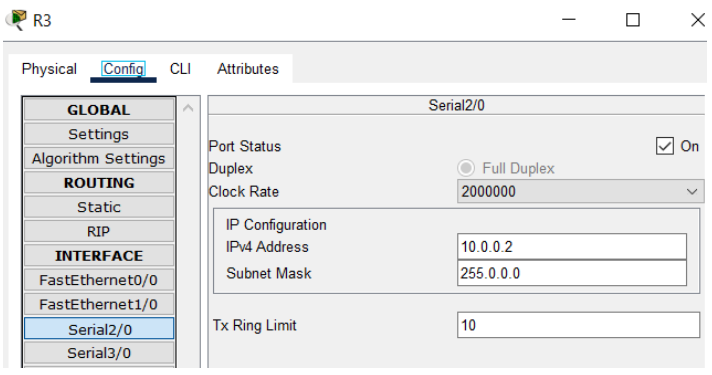




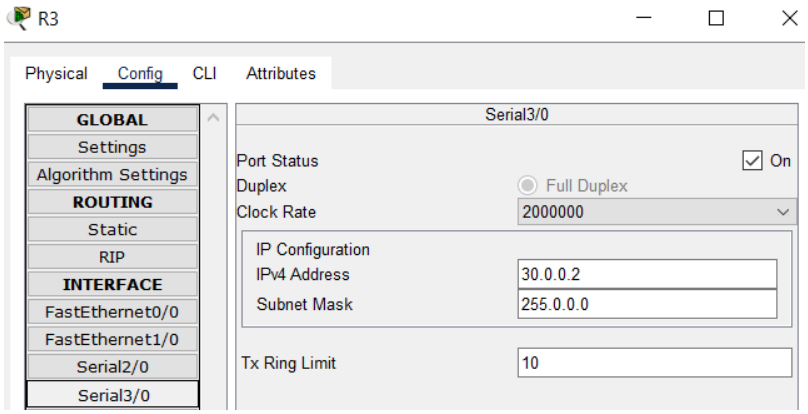
Name of Instructor: Ms. Jessica D'cruz





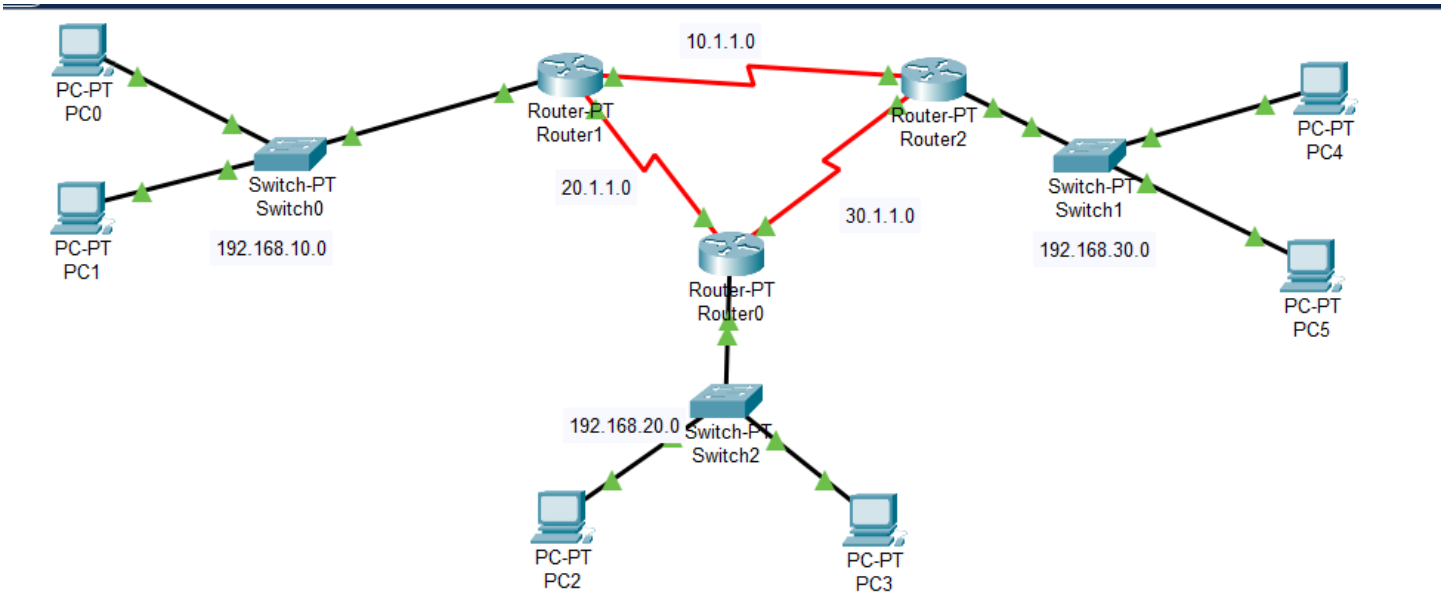


Name of Instructor: Ms. Jessica D'cruz

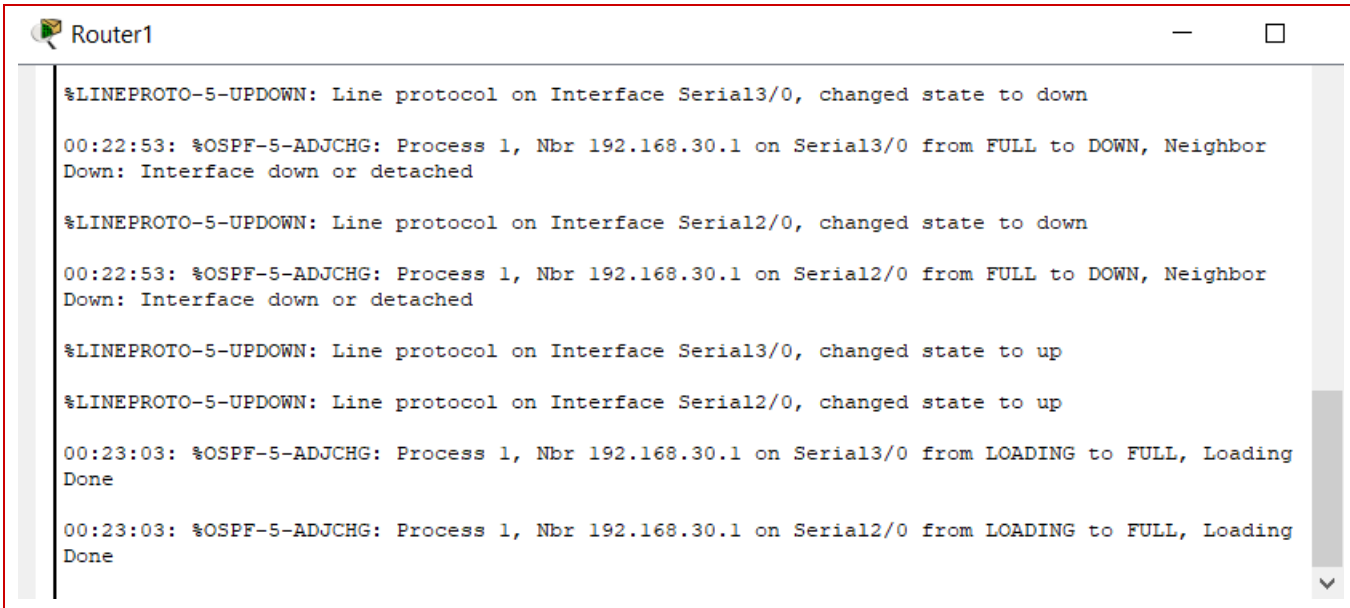


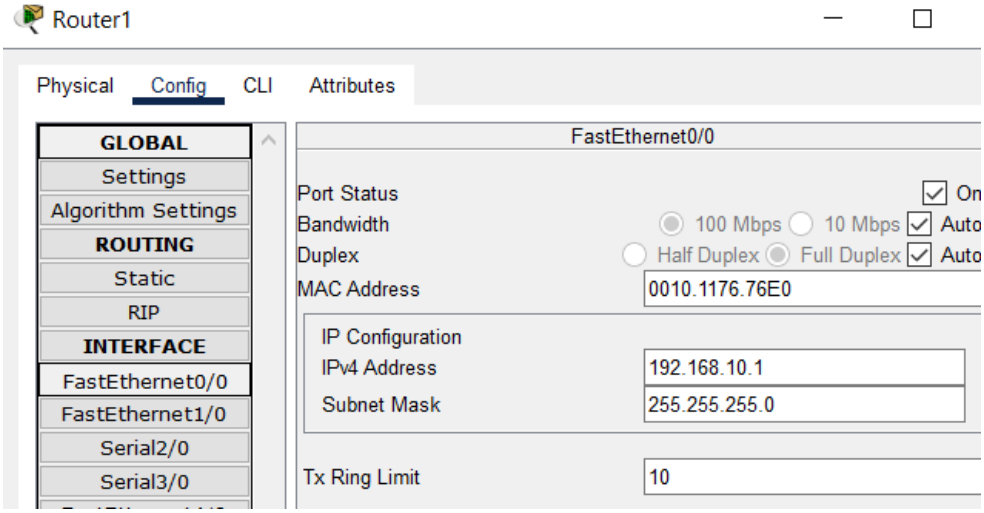
Code And Output :

B) OSPF Protocol :

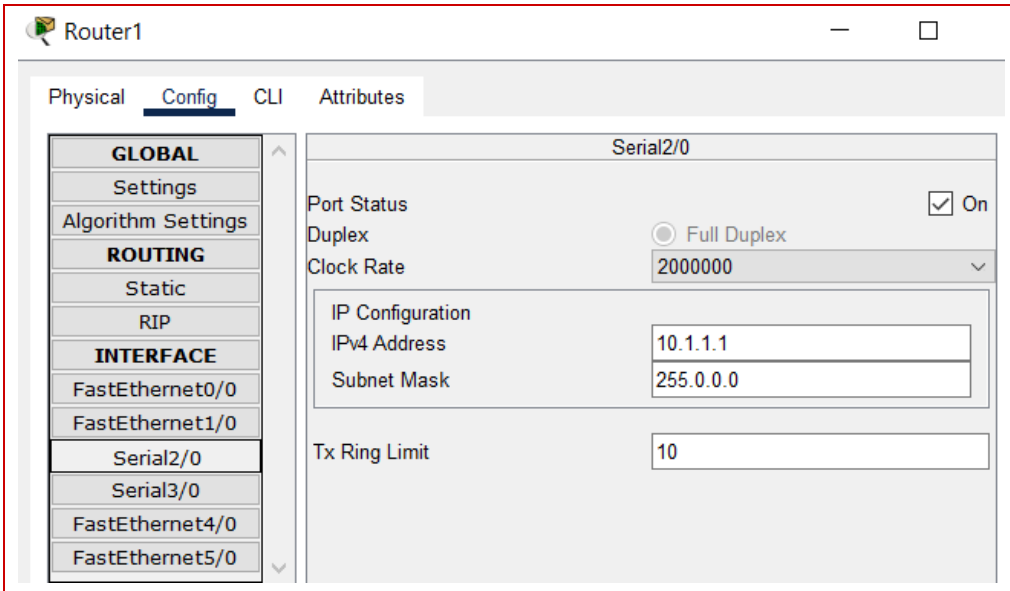


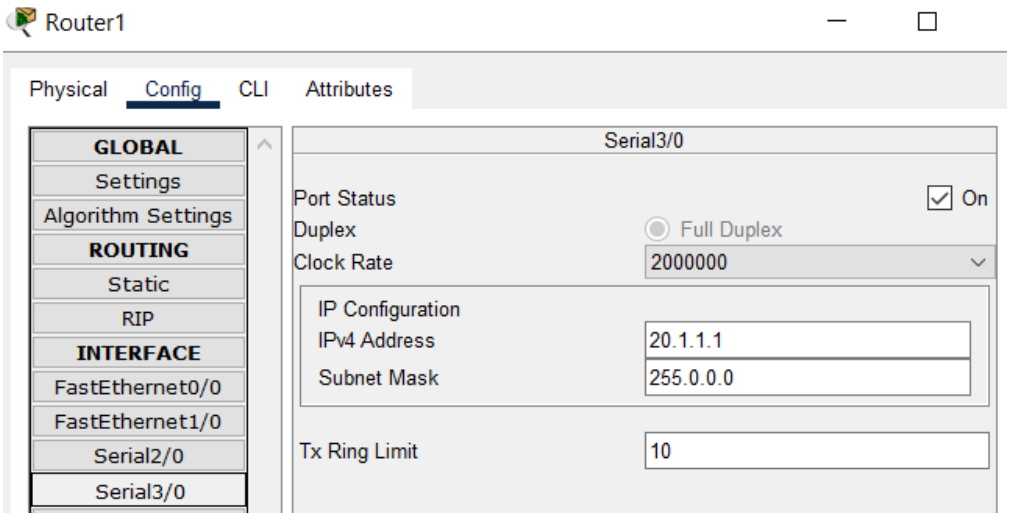
Name of Instructor: Ms. Jessica D'cruz

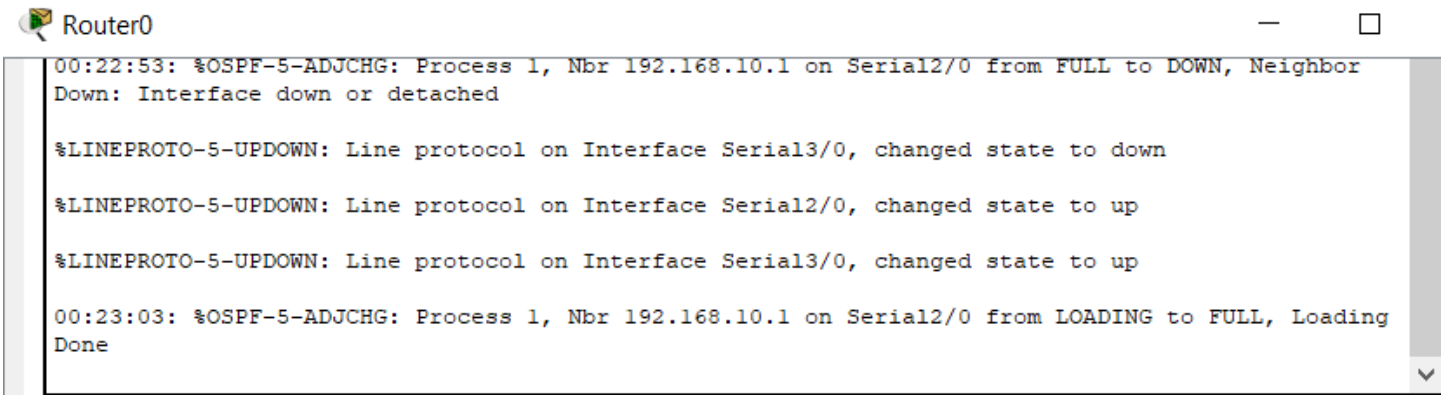




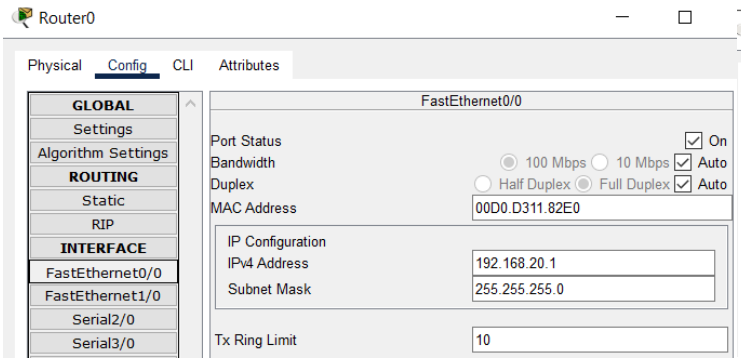
Name of Instructor: Ms. Jessica D'cruz

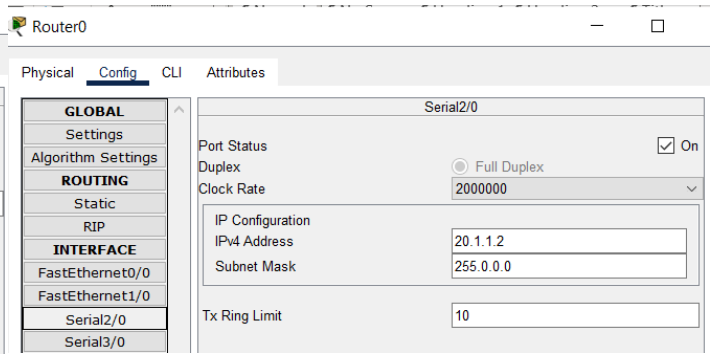


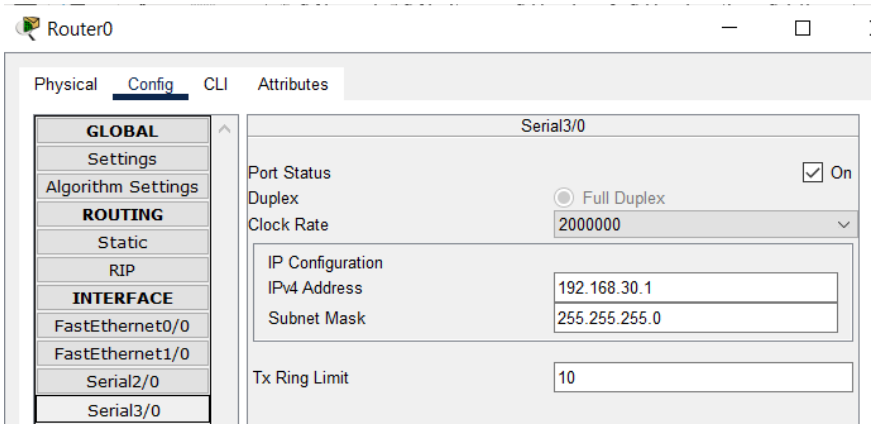


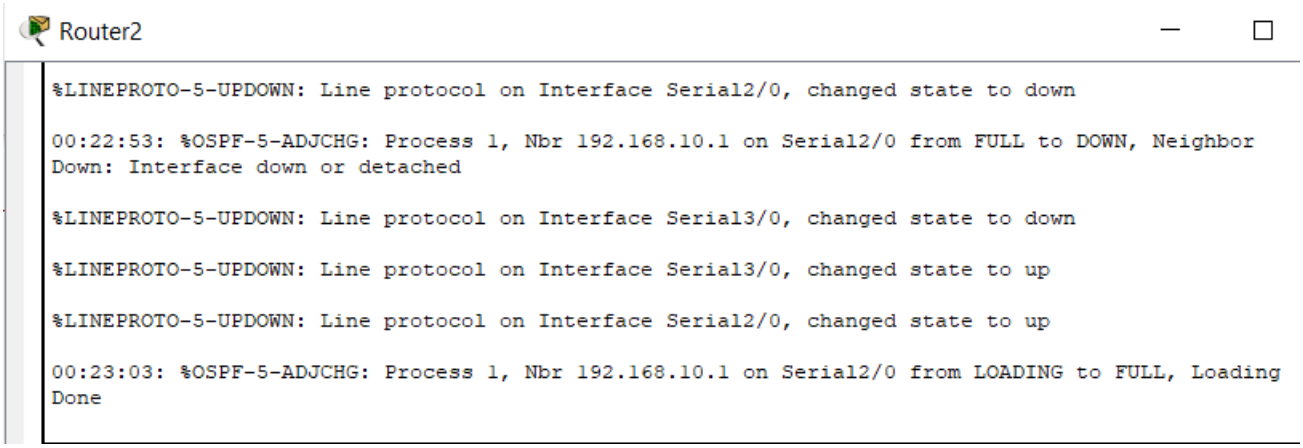


Name of Instructor: Ms. Jessica D'cruz









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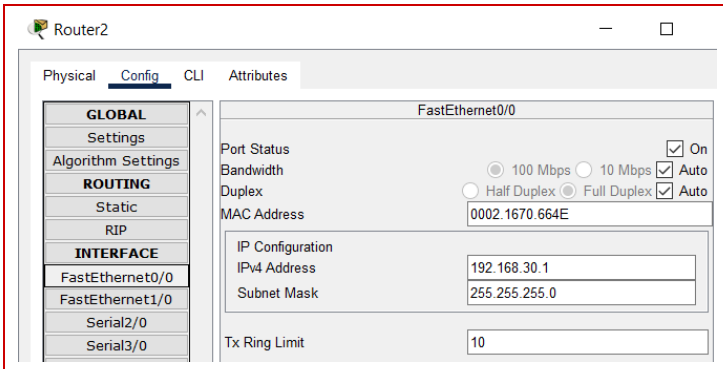
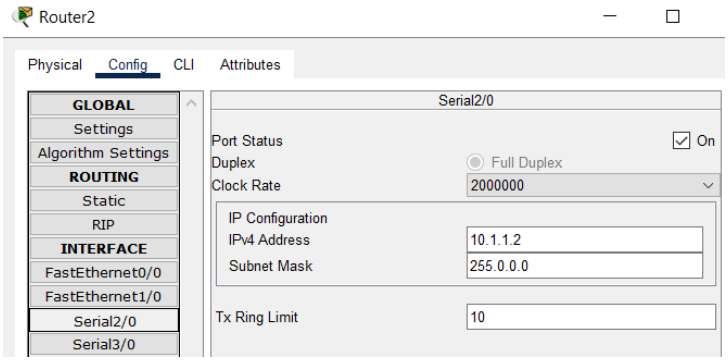
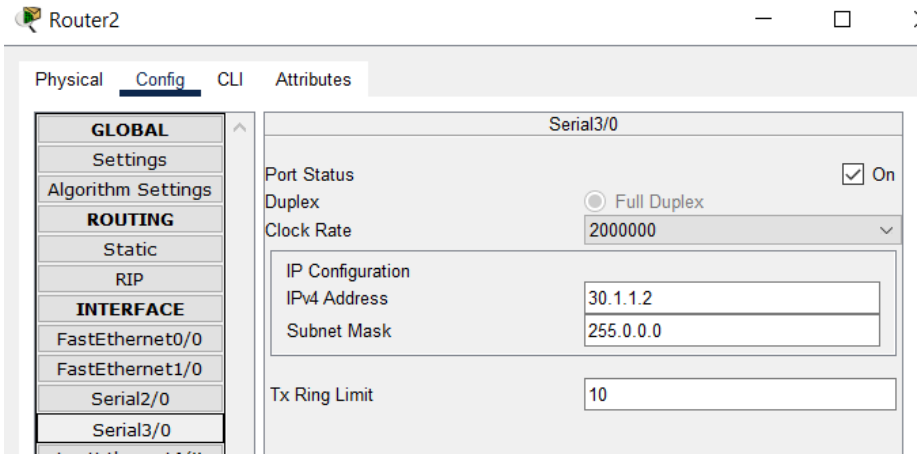






Name of Instructor: Ms. Jessica D'cruz

Wireless Sensor Networks & Mobile Communication

Practical No.6

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	T.Y. B.Sc. (Computer Science)
Topic:	Wireless network	**Batch**	1
Date:	05th February 2024	**Practical No**	6

A) AIM: Simulate a network for simple wireless network.

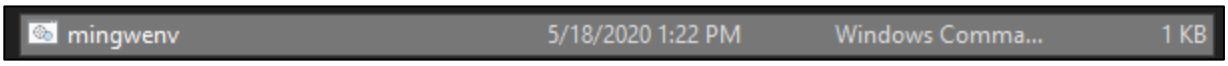
B) DESCRIPTION:

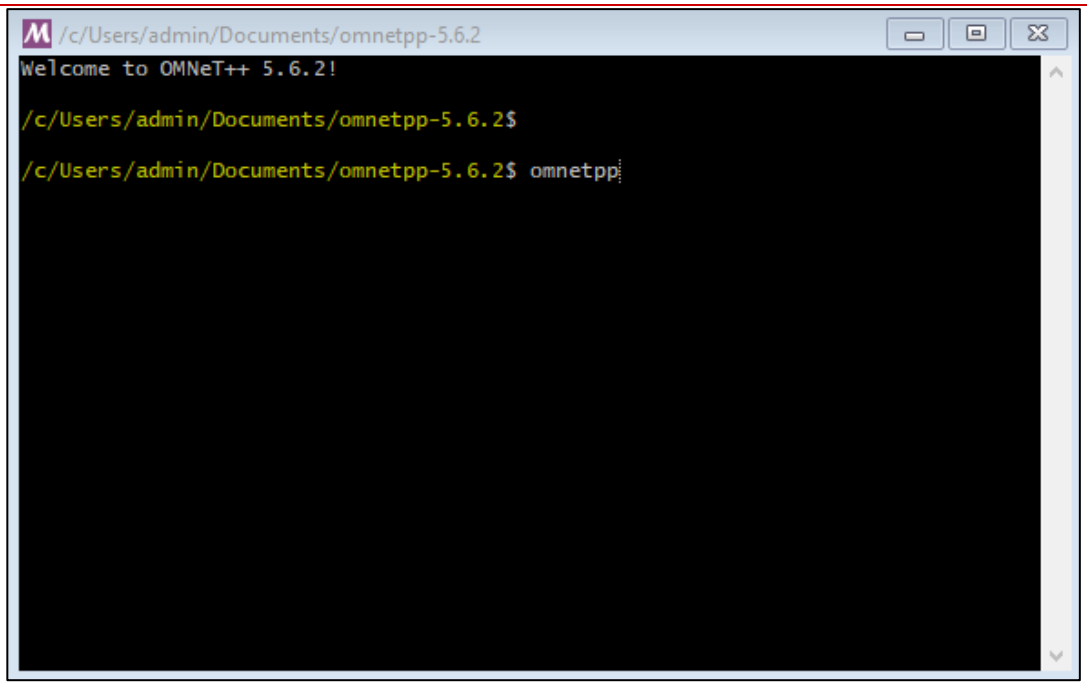
Computer networks that are not connected by cables are called wireless networks. They generally use radio waves for communication between the network nodes. They allow devices to be connected to the network while roaming around within the network coverage. It increases the mobility of network devices connected to the system since the devices need not be connected to each other. Types of Wireless Networks: Wireless LANs, Wireless MANs and Wireless WANs. Wireless networks require very limited or no wires. Thus, it reduces the equipment and setup costs.

C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:

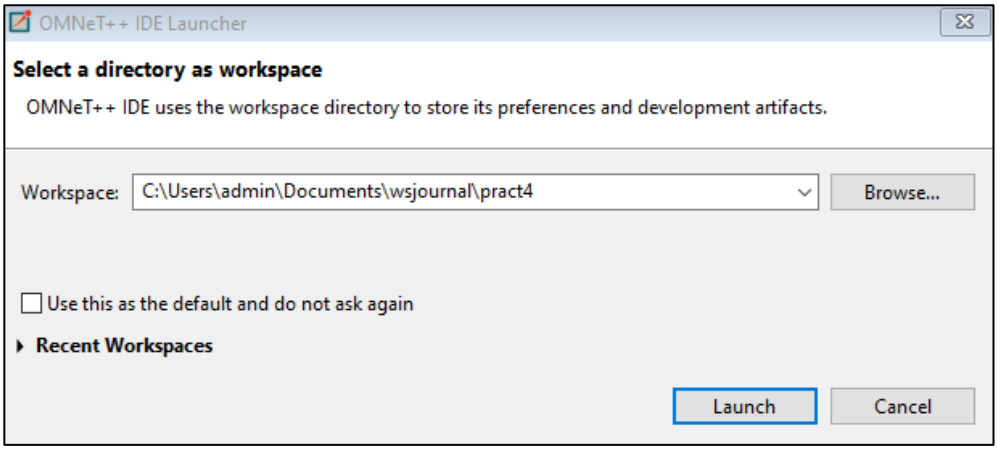
Configurations:

Step 1: Open omnet folder → Open mingwenv → Type omnetpp in console

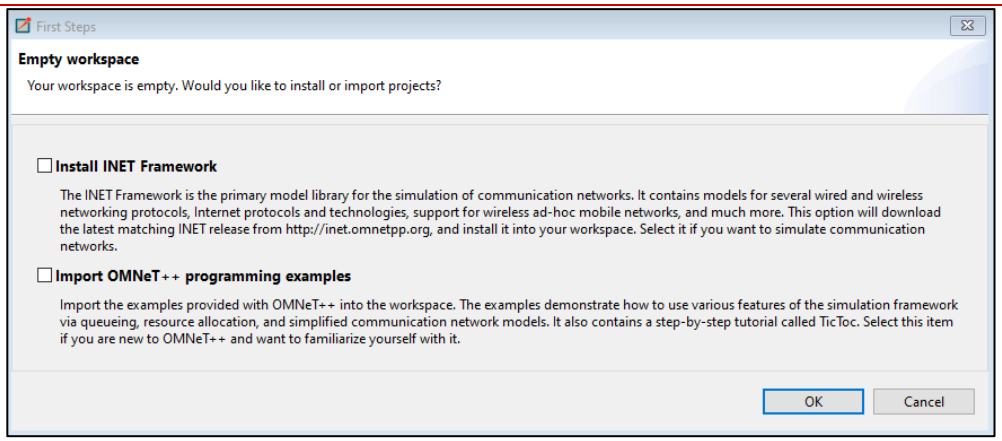




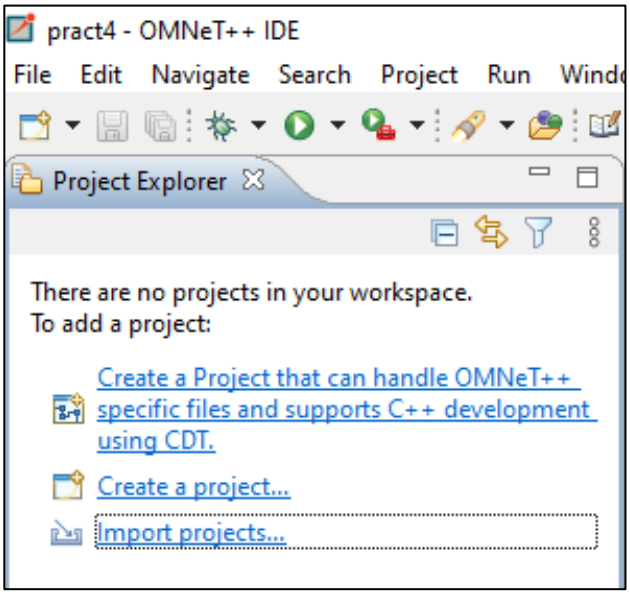
Step 2: Create workspace outside omnet and inet folder → Launch

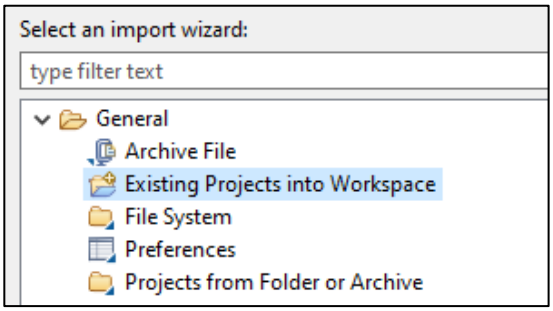


Step 3: Uncheck the boxes and click ok

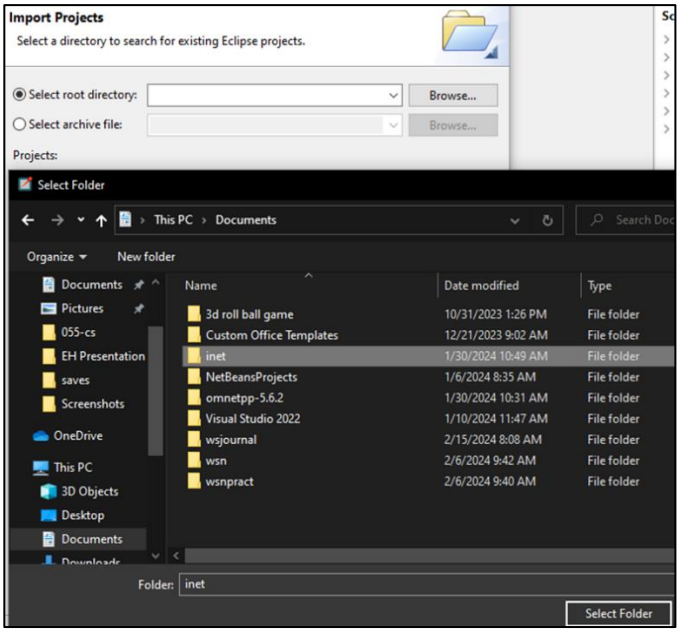


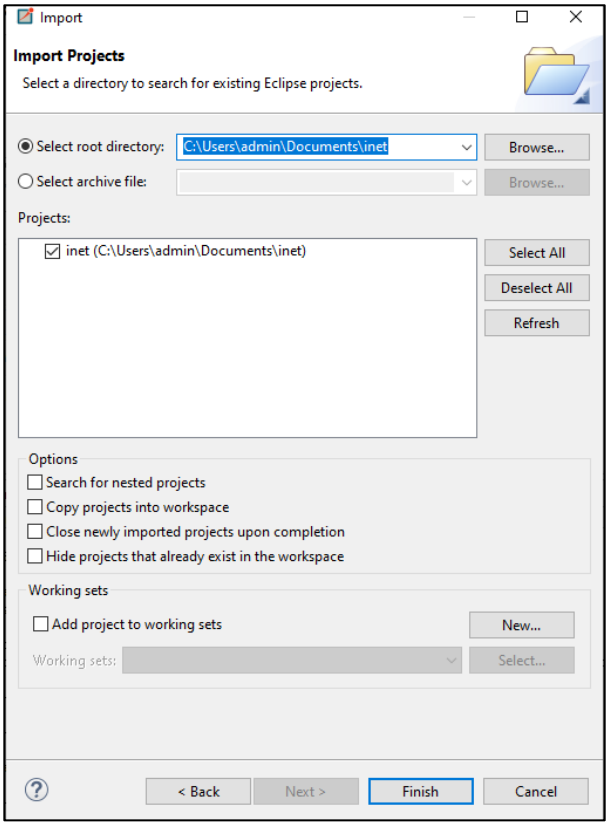
Step 4: Click import projects → General → Existing Projects into Workspace → Next → Browse inet folder location (under "select root directory") → Check inet → Finish





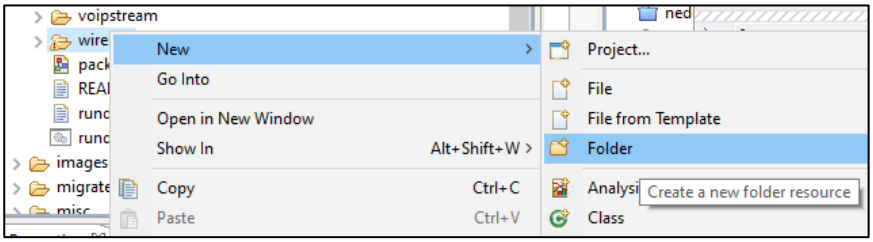
Name of Instructor: Ms. Jessica D'cruz

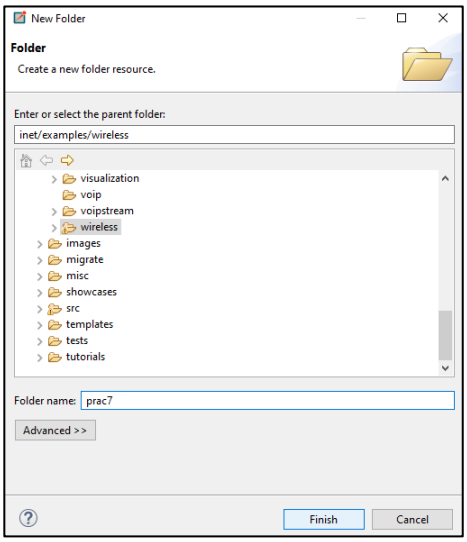




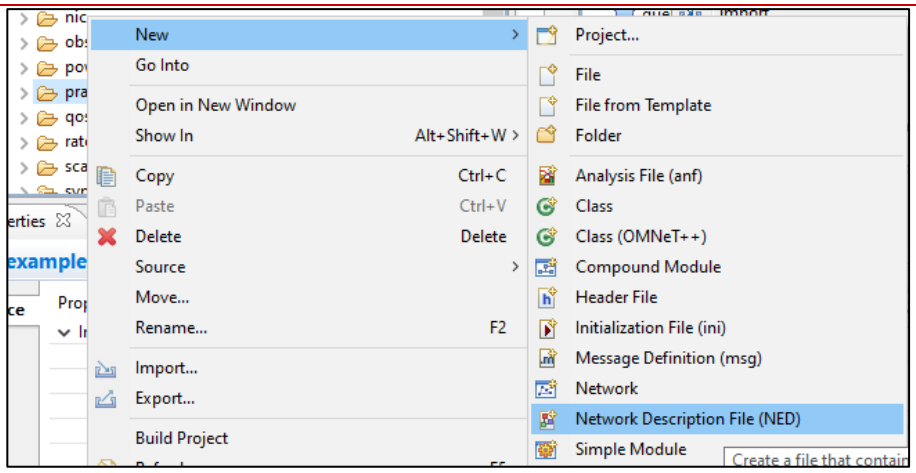
Name of Instructor: Ms. Jessica D'cruz

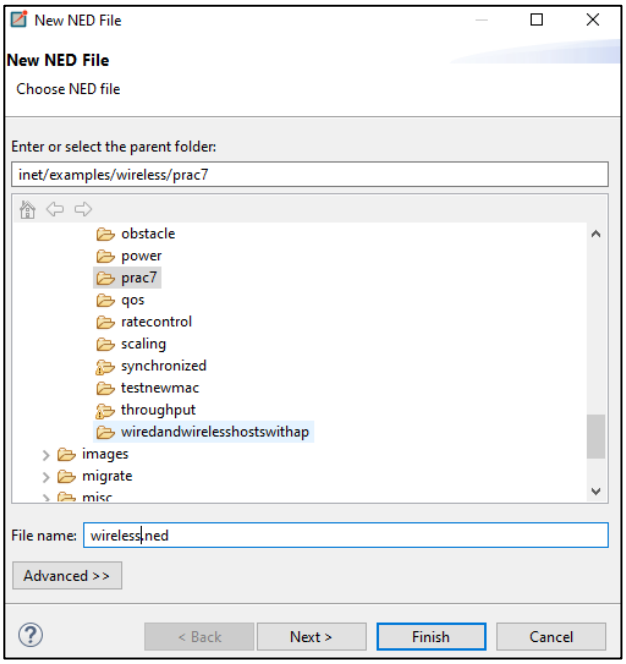
Step 5: Click inet folder → Examples → wireless → Right click → New → Folder → Provide folder name → Finish



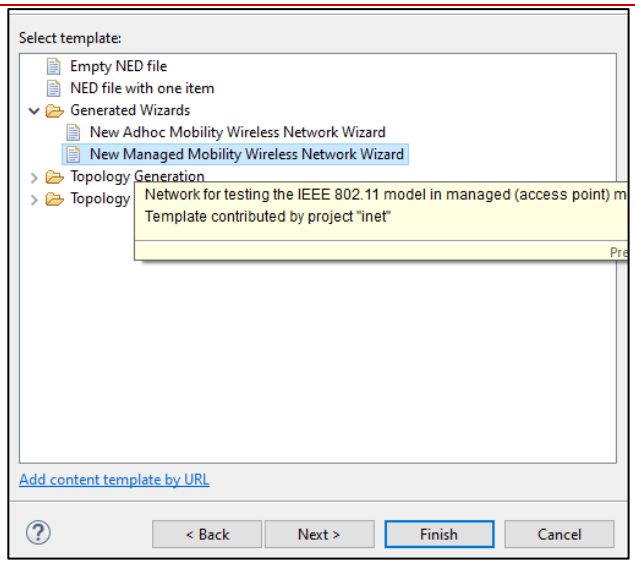


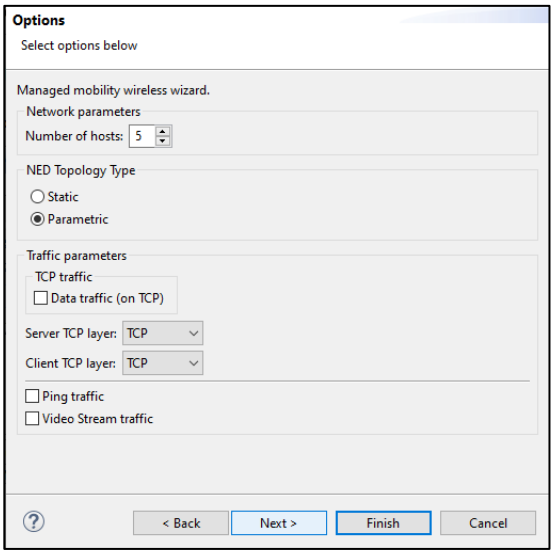
Step 6: Right click on the created folder → New → Select NED → Provide a name → Next → Click "generated wizards" → Select "New managed mobility wireless network wizard" → Next → Finish





Name of Instructor: Ms. Jessica D'cruz

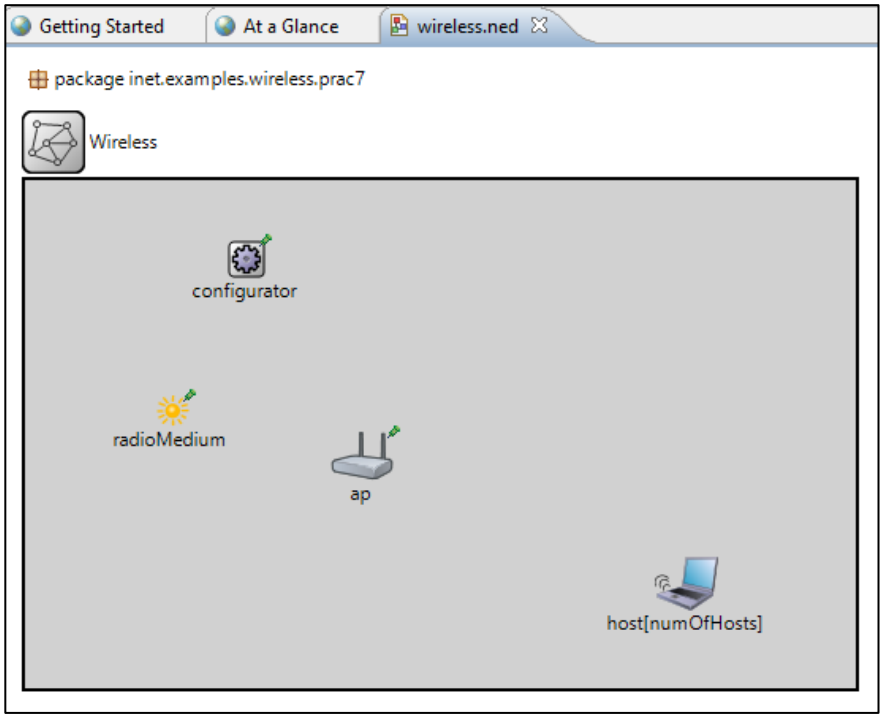




Step 7: Go to wireless.ned (of your created practical folder; under wireless folder) → Source → Do the following changes as mentioned below → Save the changes

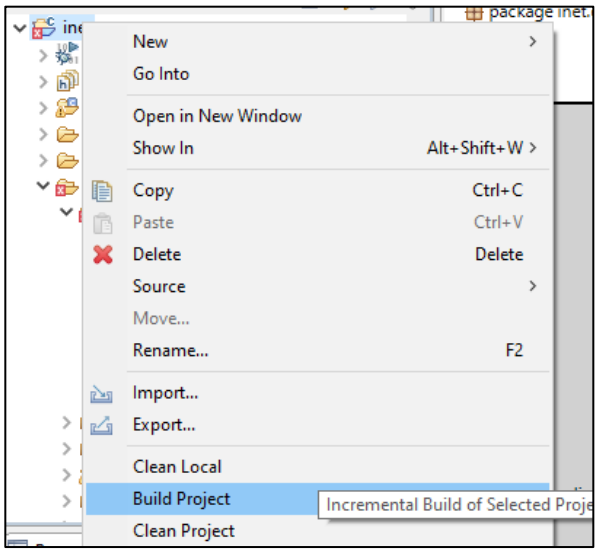
Getting Started | At a Glance | wireless.ned

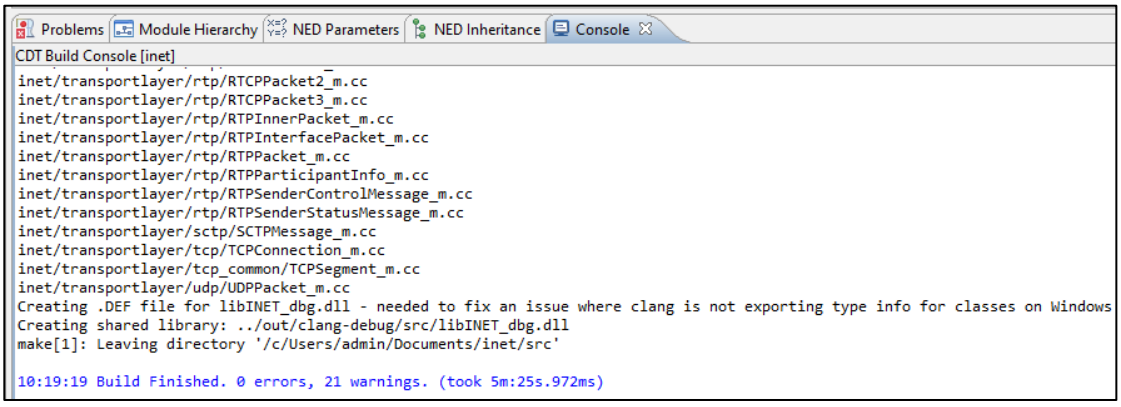
```
package inet.examples.wireless.prac7;

// numOfHosts: 5

import inet.networklayer.configurator.ipv4.IPv4NetworkConfigurator;
import inet.node.inet.WirelessHost;
import inet.node.wireless.AccessPoint;
import inet.physicallayer.ieee80211.packetlevel.Ieee80211ScalarRadioMedium;

network Wireless
{
    parameters:
        int numOfHosts;

    submodules:
        host[numOfHosts]: WirelessHost
        {
            @display("r=,,#707070");
        }

        ap: AccessPoint
        {
            @display("p=213,174;r=,,#707070");
        }

        configurator: IPv4NetworkConfigurator
        {
            @display("p=140,50");
        }
        radioMedium:Ieee80211ScalarRadioMedium
        {
            parameters:
                @display("p=93,146");
        }
}
```

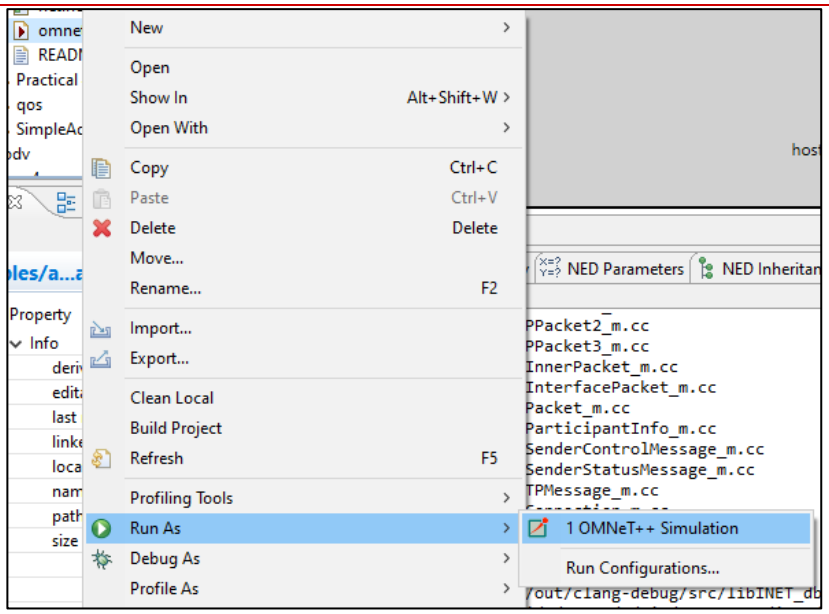


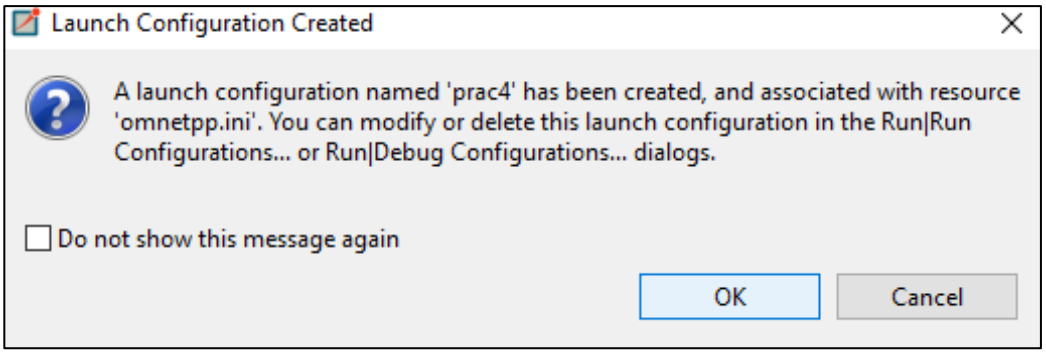
Name of Instructor: Ms. Jessica D'cruz

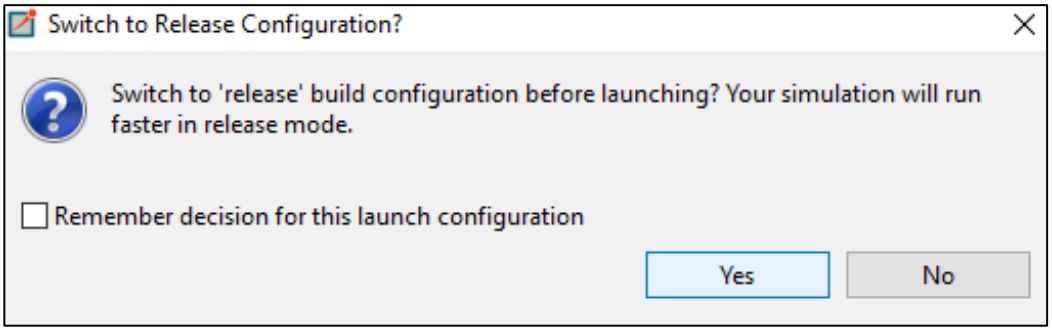
Step 8: Now, for testing our simulation: Right click on inet → Select build project → Right click on omnetpp.ini (present in your created practical folder) → Select "run as" → Select "omnet++ simulation → Click OK → Click Yes → Done



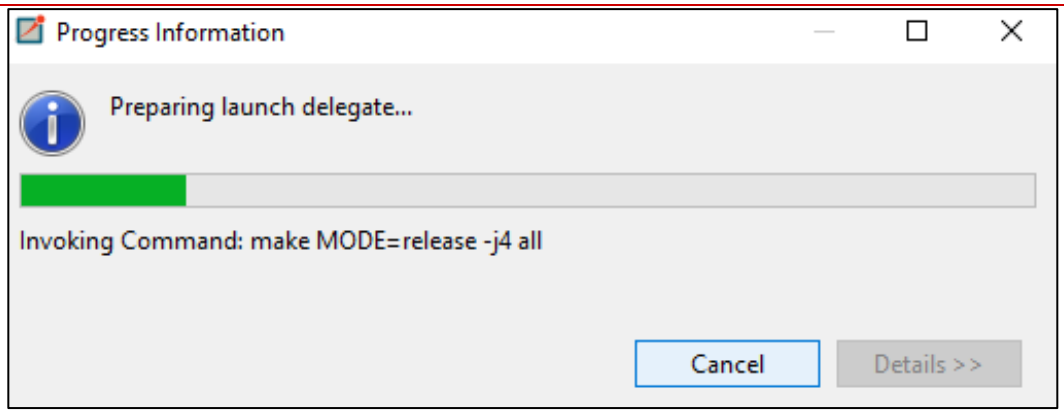




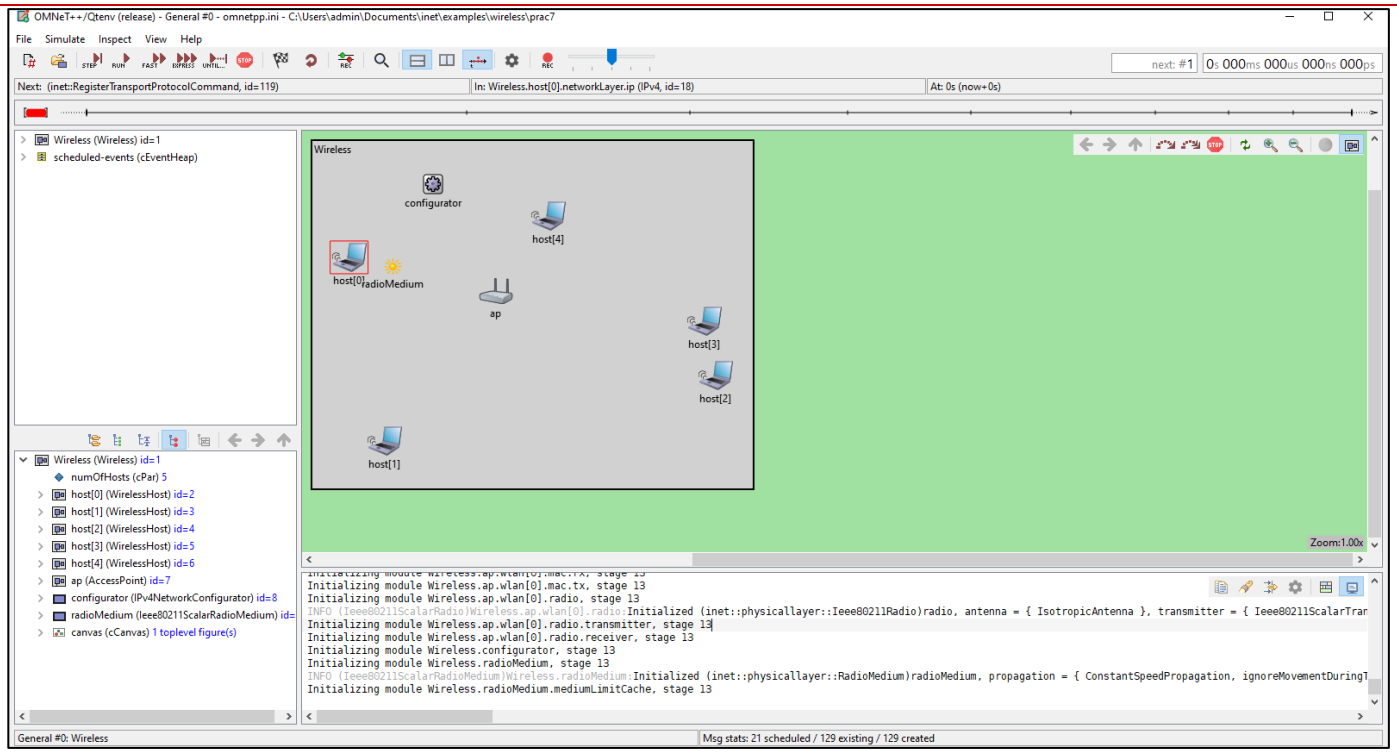


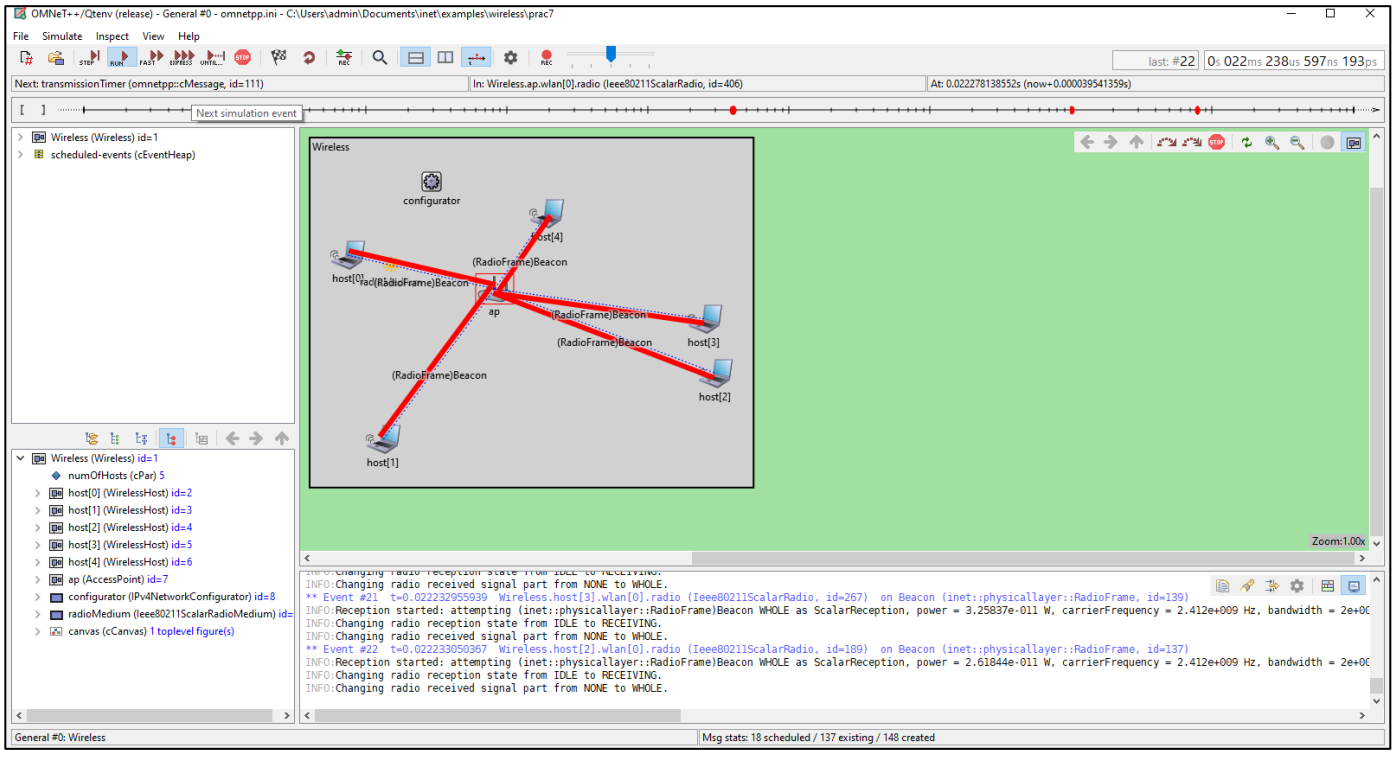


Name of Instructor: Ms. Jessica D'cruz


Progress Information
Preparing launch delegate...
Invoking Command: make MODE=release -j4 all
Cancel
Details >>

Output:





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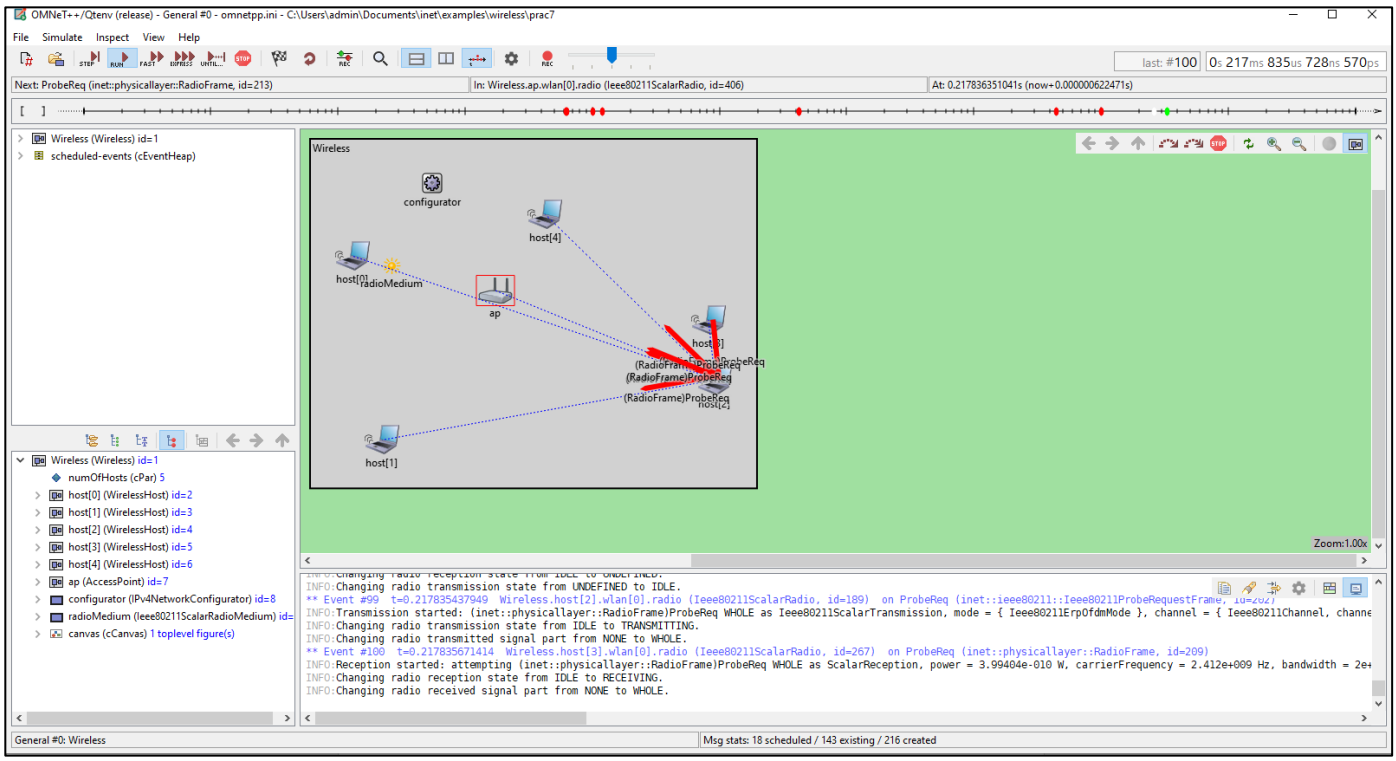


Name of Instructor: Ms. Jessica D'cruz

Wireless Sensor Networks & Mobile Communication

Practical No.7

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Mac Protocol	**Batch**	I
Date:	06th February 2024	**Practical No**	7

A) AIM:

Create a Mac protocol simulation implementation for wireless Sensor Networks

B) DESCRIPTION:

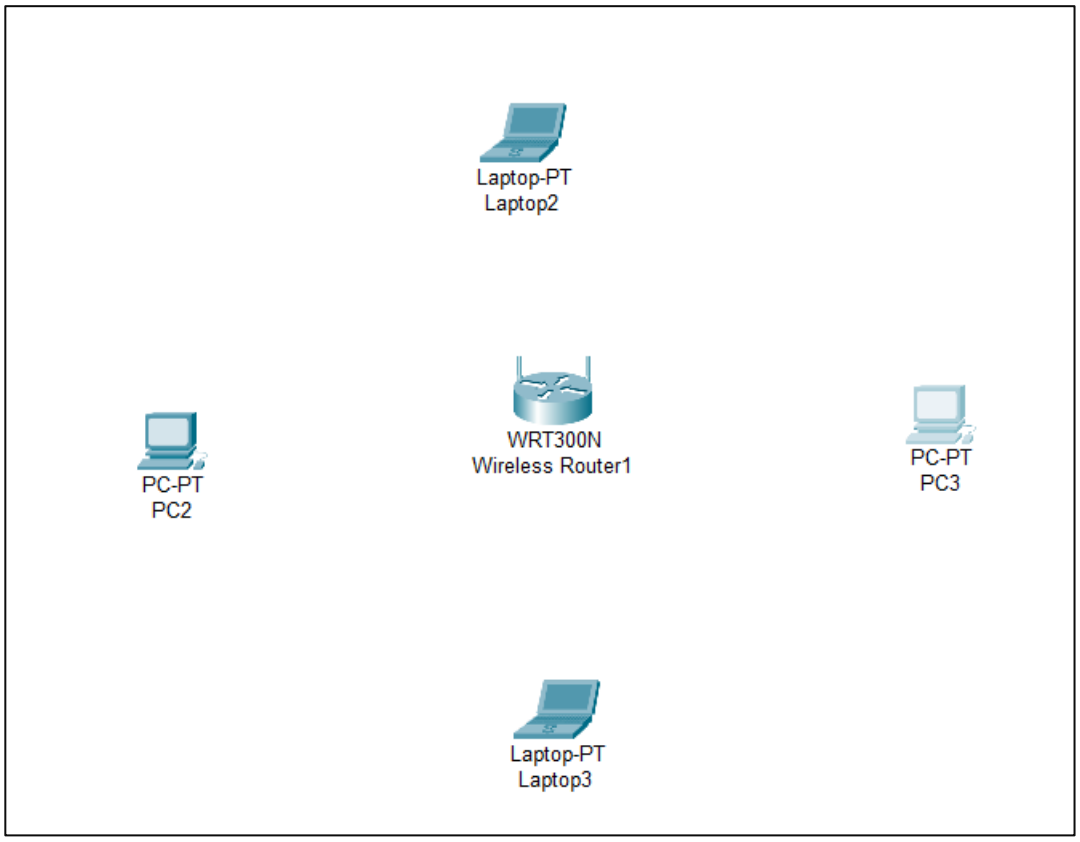
The Medium Access Control (MAC) layer is a sublayer of the data link layer that deals with the protocol access to the physical network medium. MAC protocols control how devices in a network access and use the shared communication medium to avoid collisions and ensure efficient communication.

1. **CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance):** Commonly used in wireless networks, CSMA/CA involves nodes checking for the channel's availability before transmitting to avoid collisions.
2. **CSMA/CD (Carrier Sense Multiple Access with Collision Detection):** Historically used in wired networks like Ethernet, CSMA/CD detects collisions and takes steps to resolve them.
3. **TDMA (Time Division Multiple Access):** In TDMA, time is divided into slots, and each node is assigned a specific time slot for transmission. This approach is often used in satellite communication and cellular networks.
4. **FDMA (Frequency Division Multiple Access):** FDMA allocates different frequency bands to different nodes for simultaneous transmission, commonly used in analog communication systems.

5. **CDMA (Code Division Multiple Access):** CDMA assigns a unique code to each node, allowing multiple nodes to transmit simultaneously on the same frequency band. It's widely used in digital cellular networks.

C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:

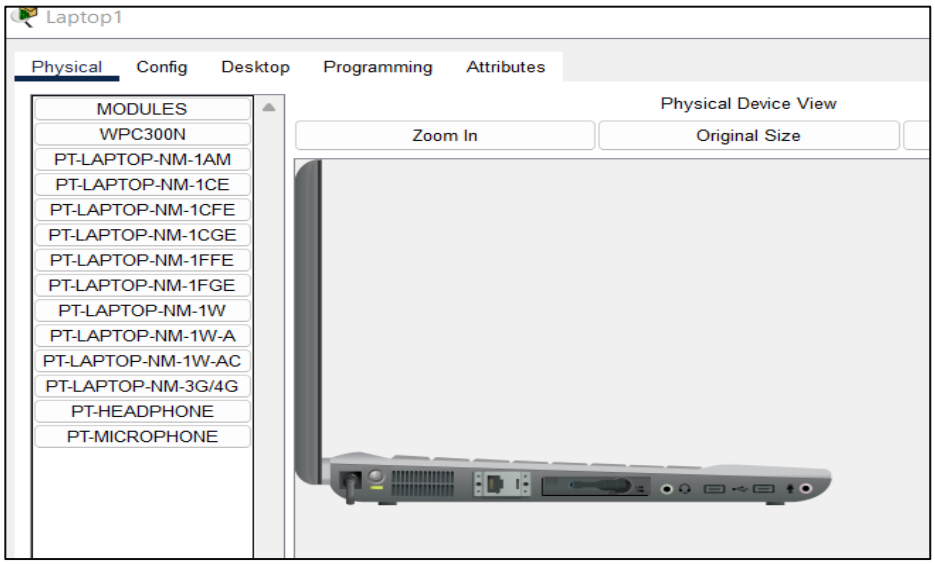
Network topology:



Configurations:

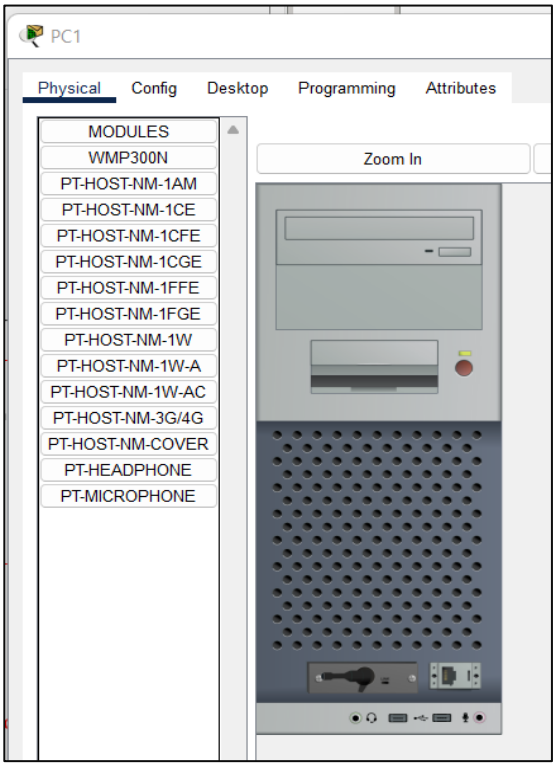
Configurations done on Laptops:

Physical configuration: Adding the wireless interface



Configuration done on PCs:

Physical configuration: Adding the wireless interface



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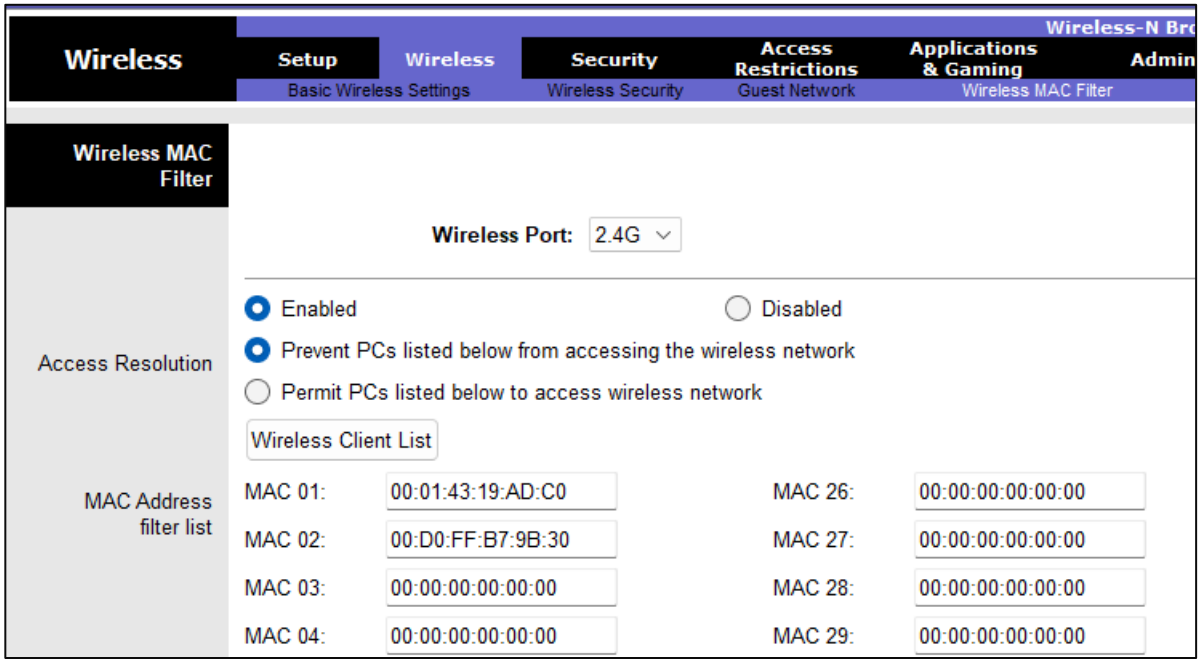
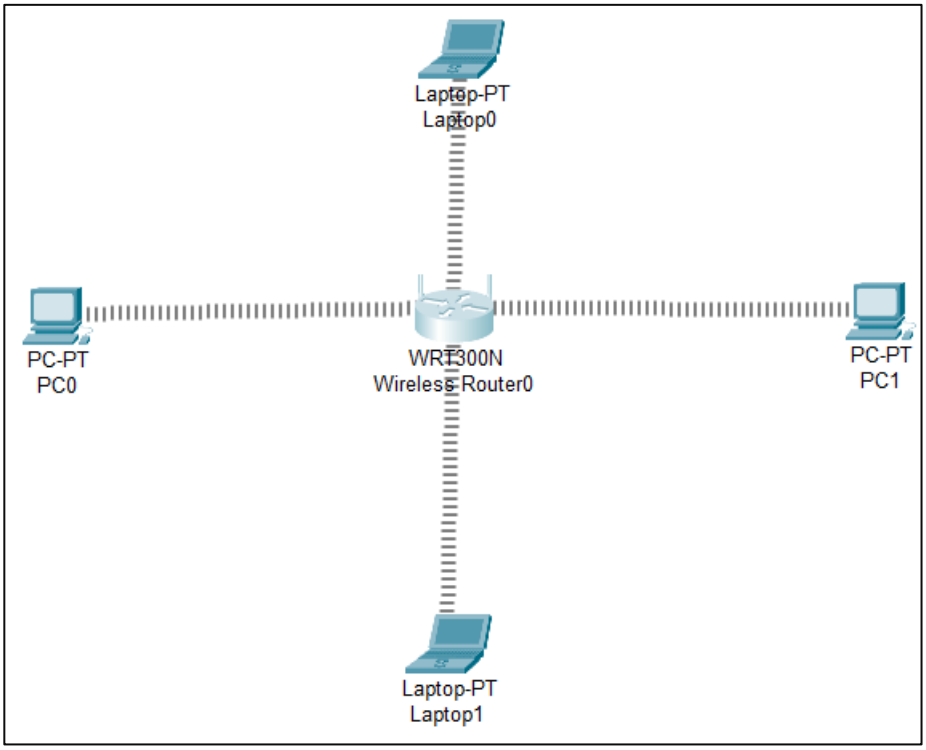
Configuration done on Router:

Adding the MAC Address of Pcs in the MAC Address filter list(present in the GUI)



Output



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Wireless Sensor Networks & Mobile Communication

Practical No.8

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Mobile Adhoc Network	**Batch**	I
Date:	06th February 2024	**Practical No**	8

A) AIM:

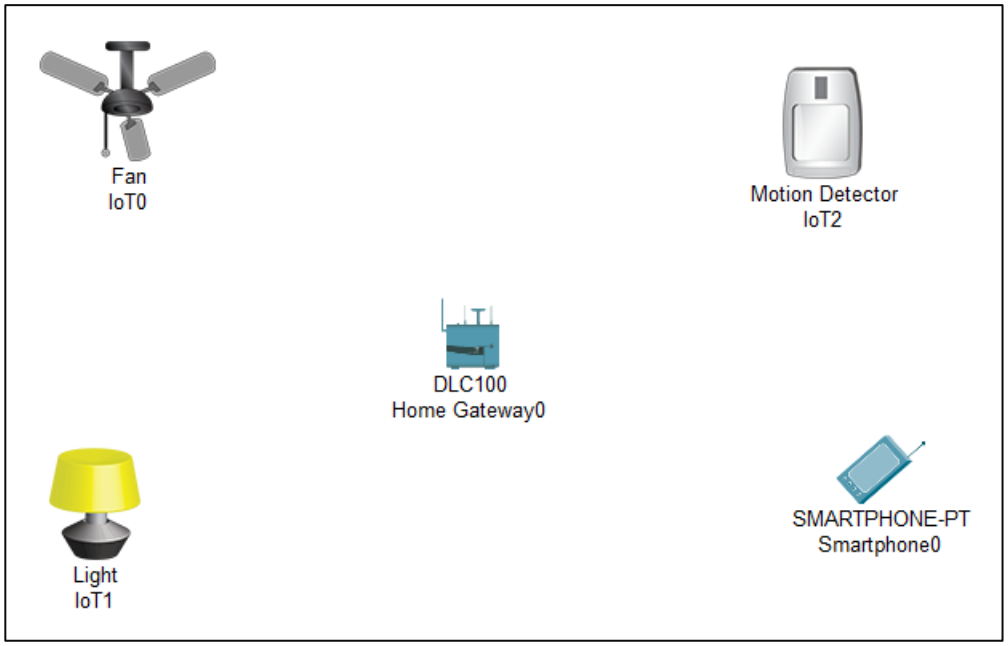
Simulate Mobile Adhoc Network with Directional Antenna

B) DESCRIPTION:

MANET stands for Mobile Adhoc Network also called a wireless Adhoc network or Adhoc wireless network that usually has a routable networking environment on top of a Link Layer ad hoc network.. They consist of a set of mobile nodes connected wirelessly in a self-configured, self-healing network without having a fixed infrastructure. MANET nodes are free to move randomly as the network topology changes frequently. Each node behaves as a router as they forward traffic to other specified nodes in the network.

C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:

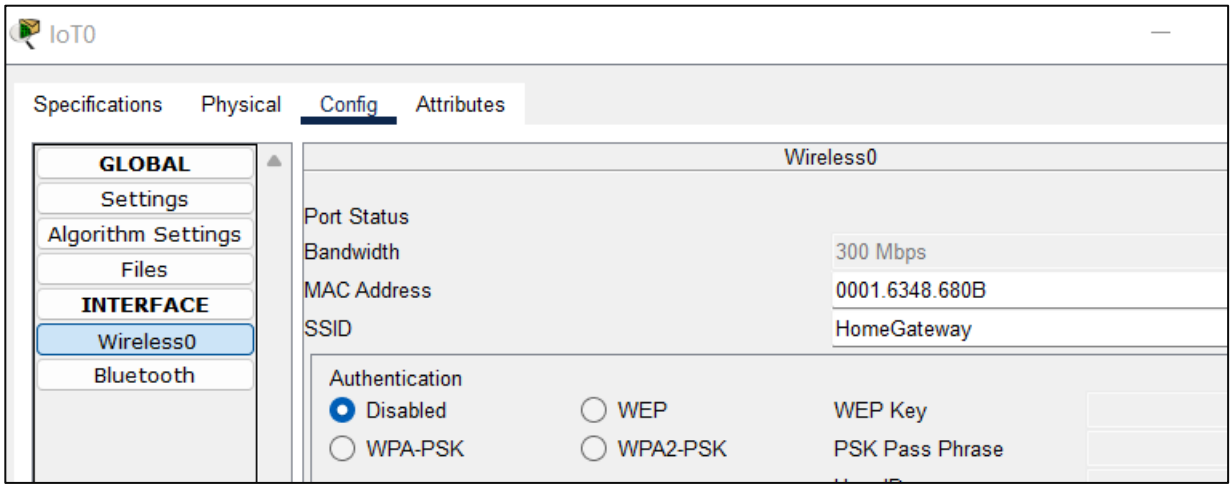
Network topology:



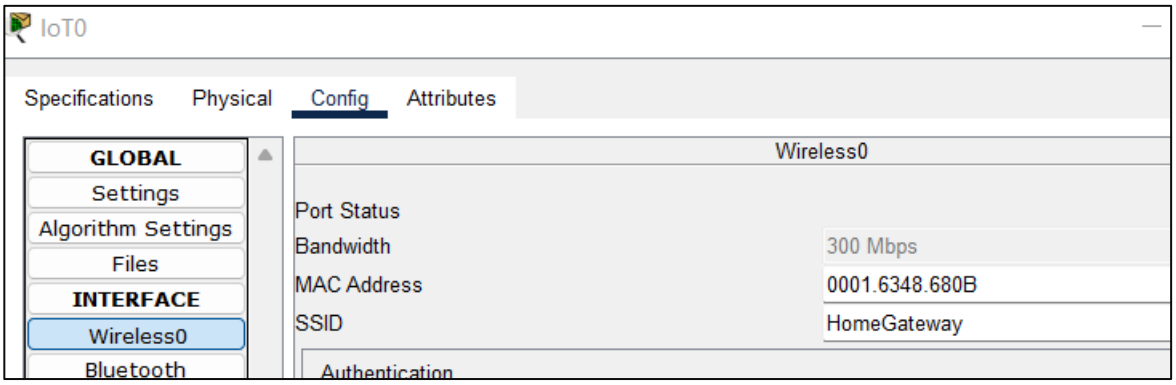
Configurations:

Copy the SSID of Homegateway and paste it to the ssid on fan, light and motion detector.

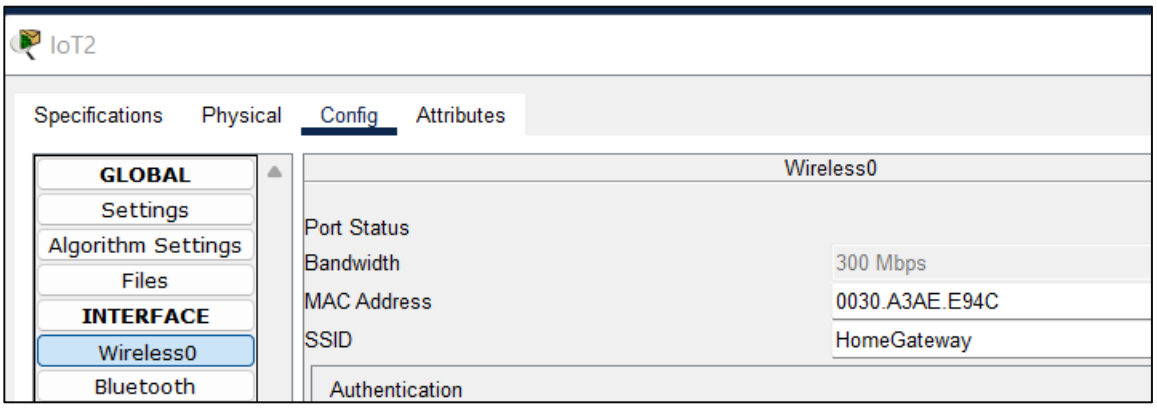
For Light:



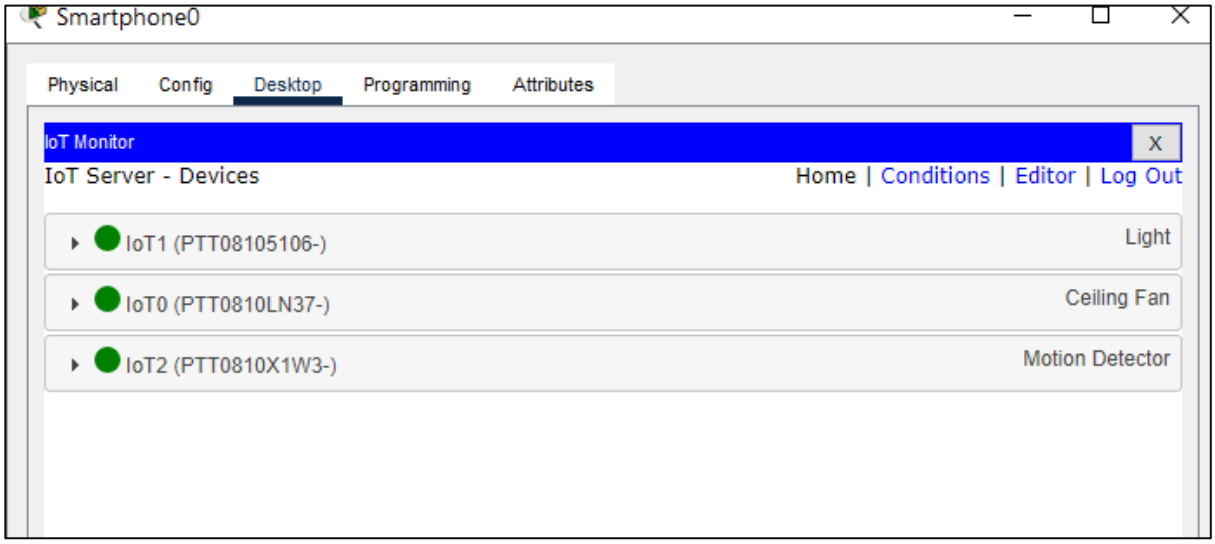
For fan:



For Motion detector:



For smartphone(Go to Desktop>>IOT monitor)



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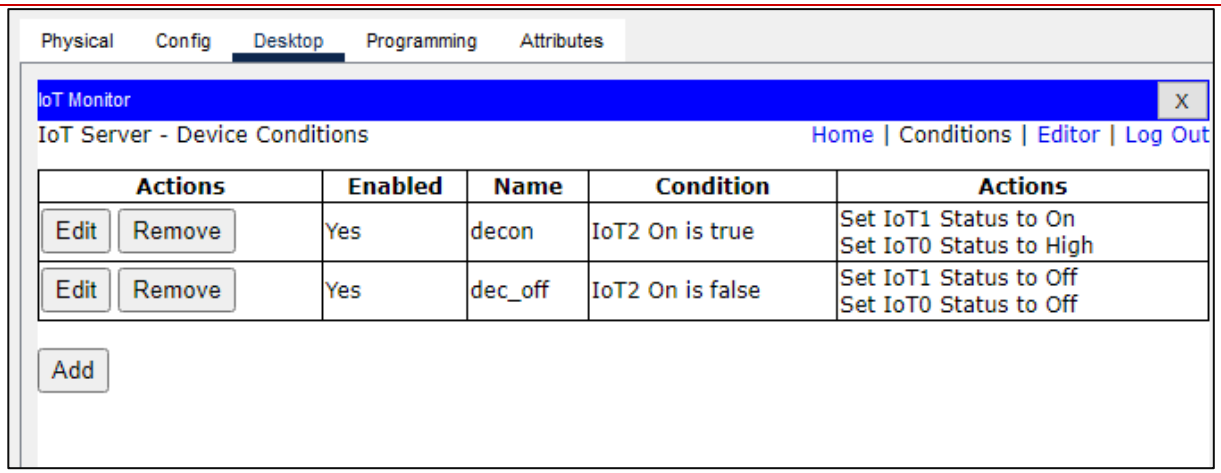
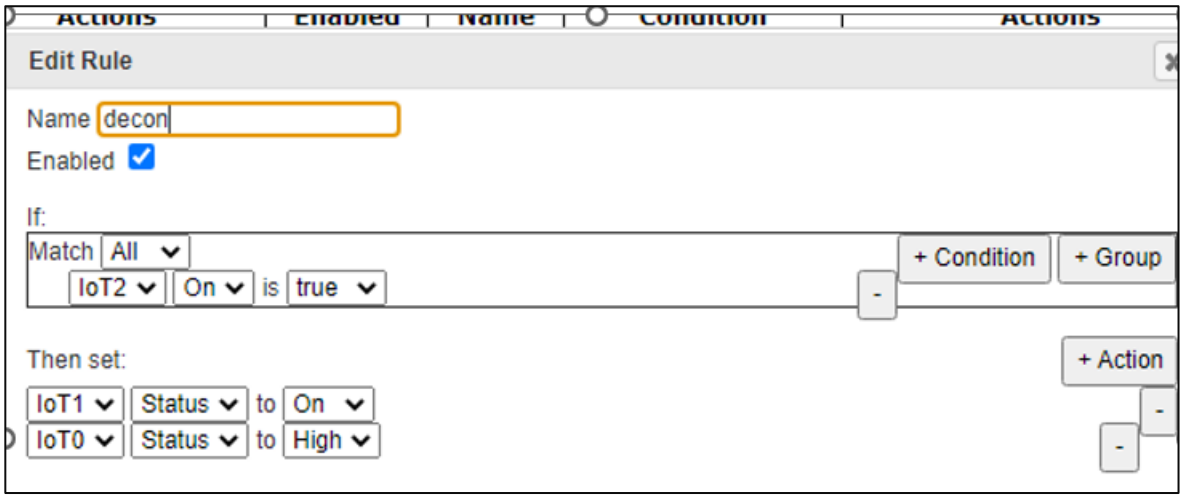
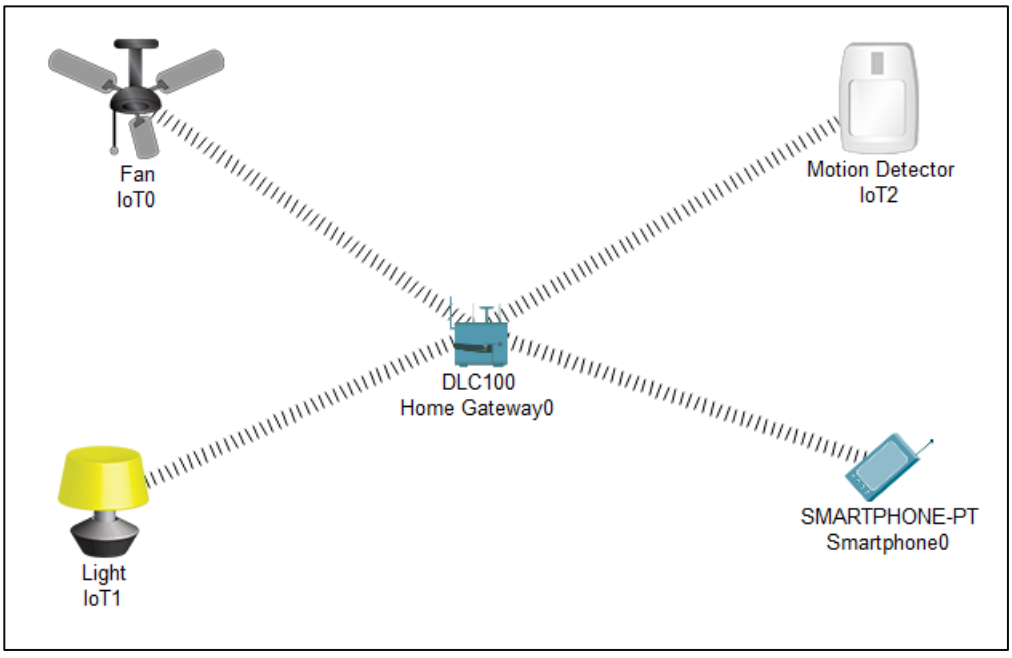




Output



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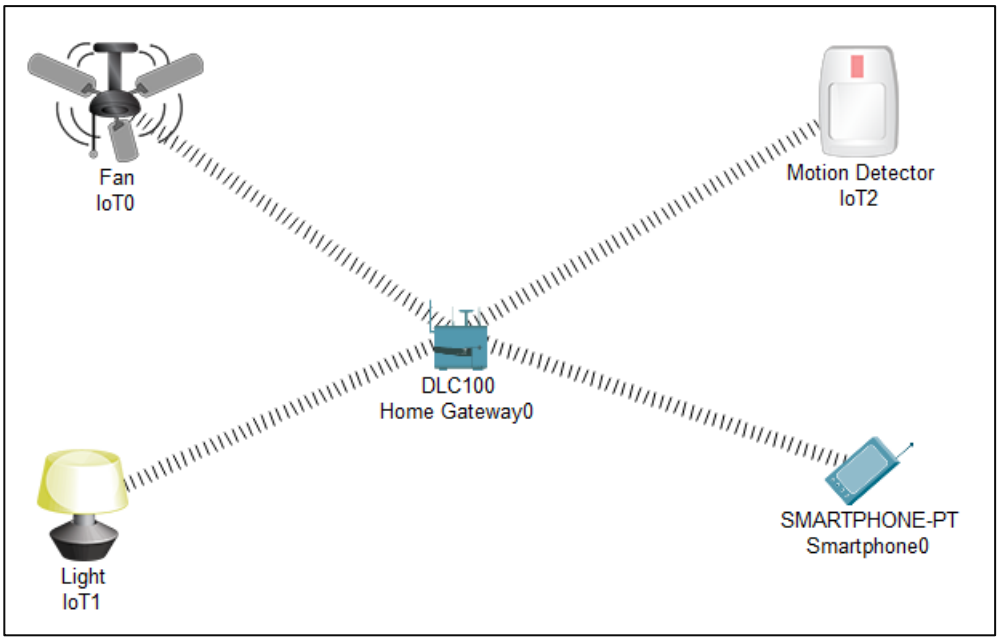
When motion detector is on(press alt with motion detector):



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Wireless Sensor Networks & Mobile Communication

Practical No.9

DEPARTMENT OF COMPUTER SCIENCE

Name:	NADAR KIBSON SAMUEL P JOSEPH	**Roll Number**	TCS2324045
Paper Code:	SIUSCS61	**Class**	TYBSc(Computer Science)
Topic:	Mobile Network	**Batch**	I
Date:	06th February 2024	**Practical No**	9

A) AIM:

Create a mobile network using Cell Tower, Central Office Server, Web browser and Web Server.

Simulate connection between them.

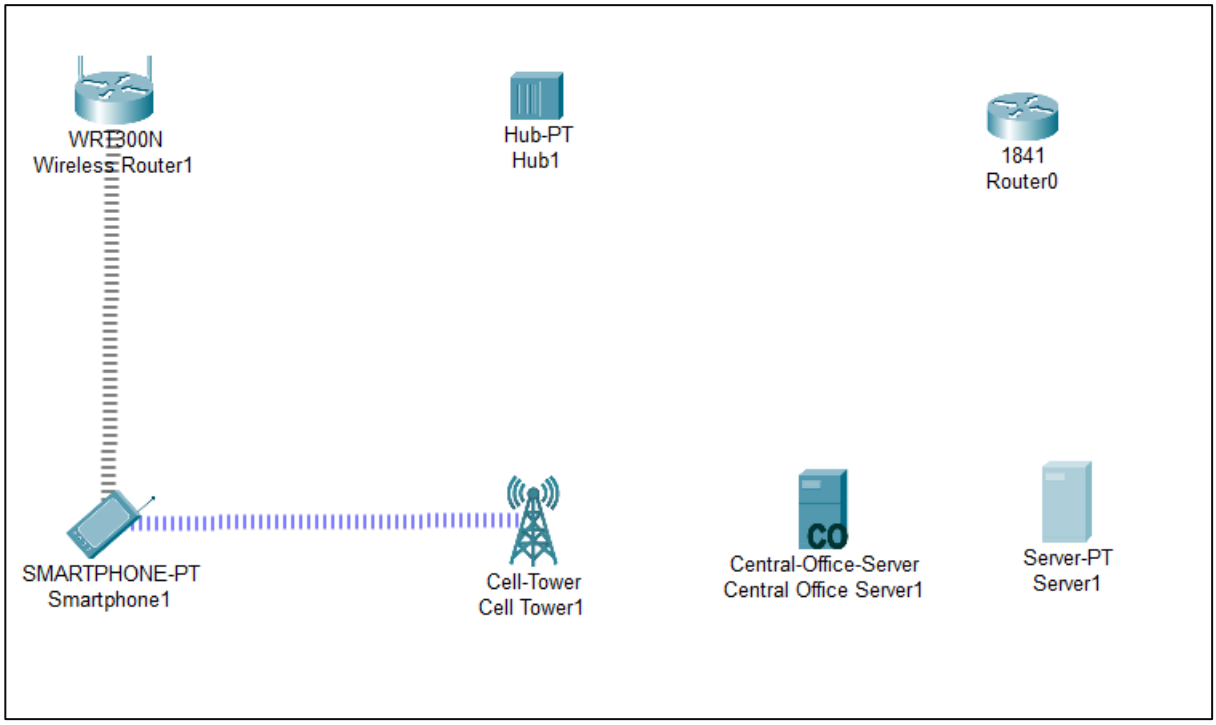
B) DESCRIPTION:

An ad hoc network is one that is spontaneously formed when devices connect and communicate with each other. The term ad hoc is a Latin word that literally means "for this," implying improvised or impromptu.

Ad hoc networks are mostly **wireless local area networks** (WLANs). The devices communicate with each other directly instead of relying on a base station or access points as in wireless **LANs** for data transfer co-ordination. Each device participates in routing activity, by determining the route using the routing algorithm and forwarding data to other devices via this route.

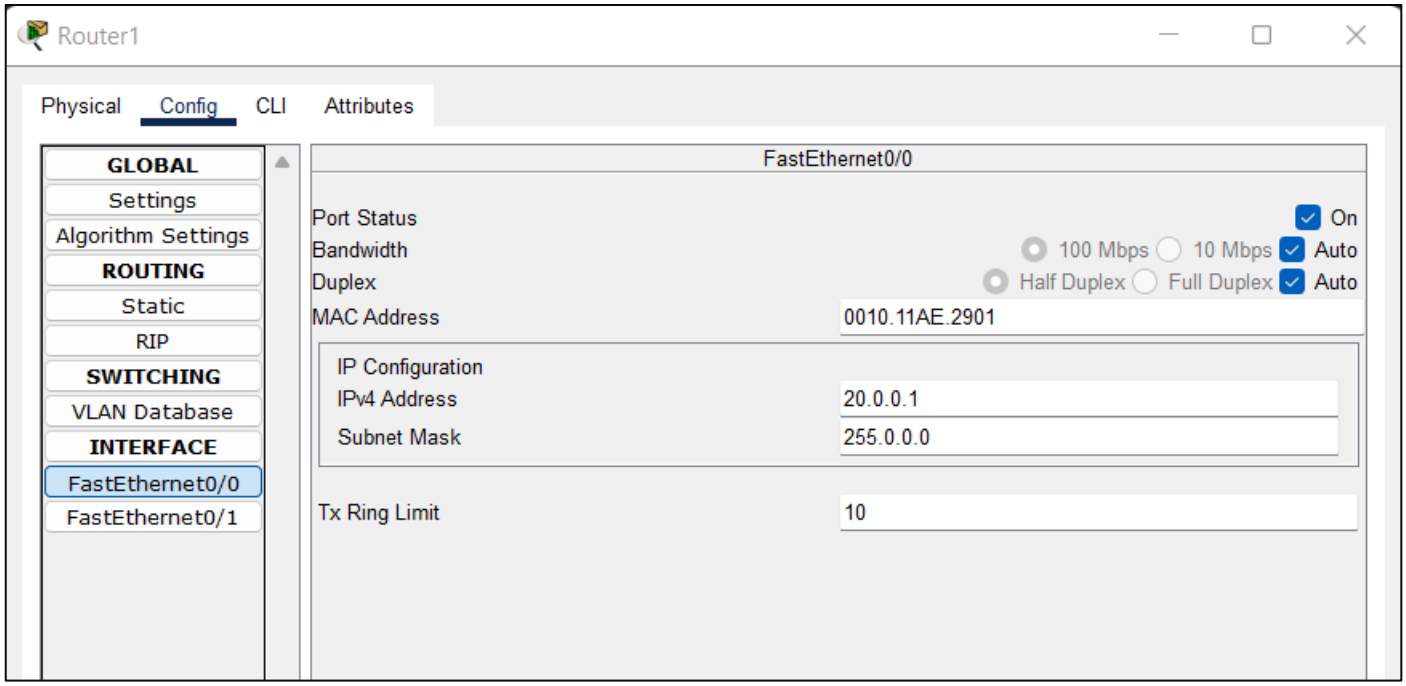
C) NETWORK TOPOLOGY, CONFIGURATIONS AND OUTPUT:

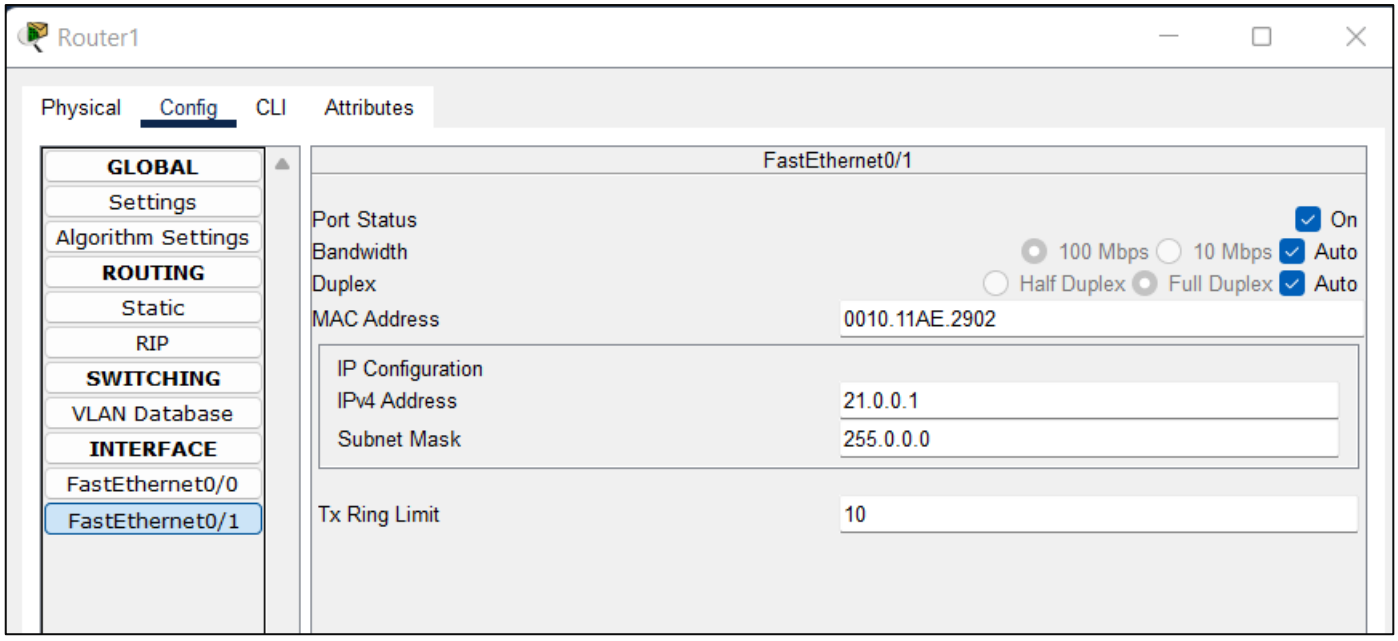
Network topology



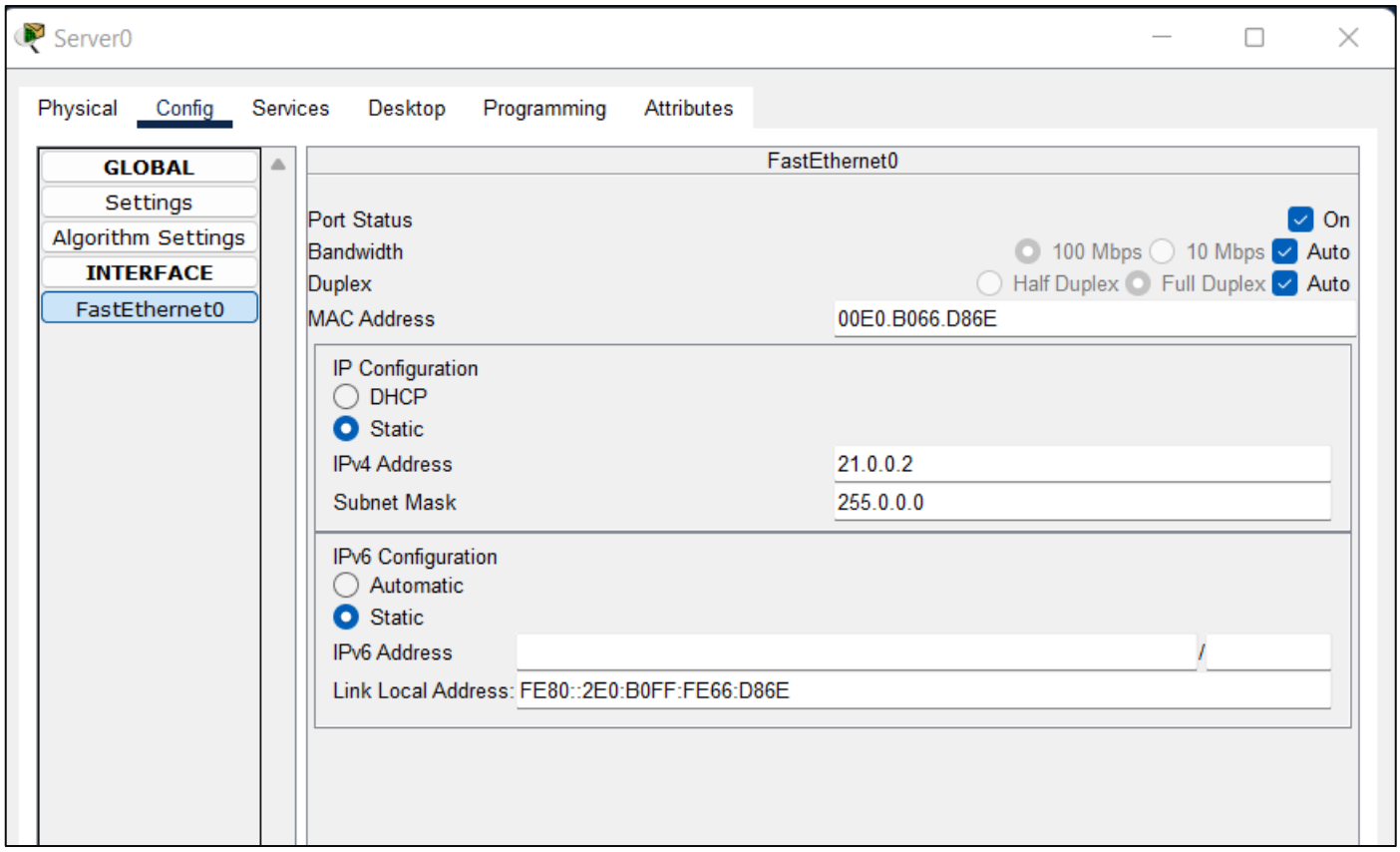
Configurations:

For 1841 Router:





For Server-Pt:



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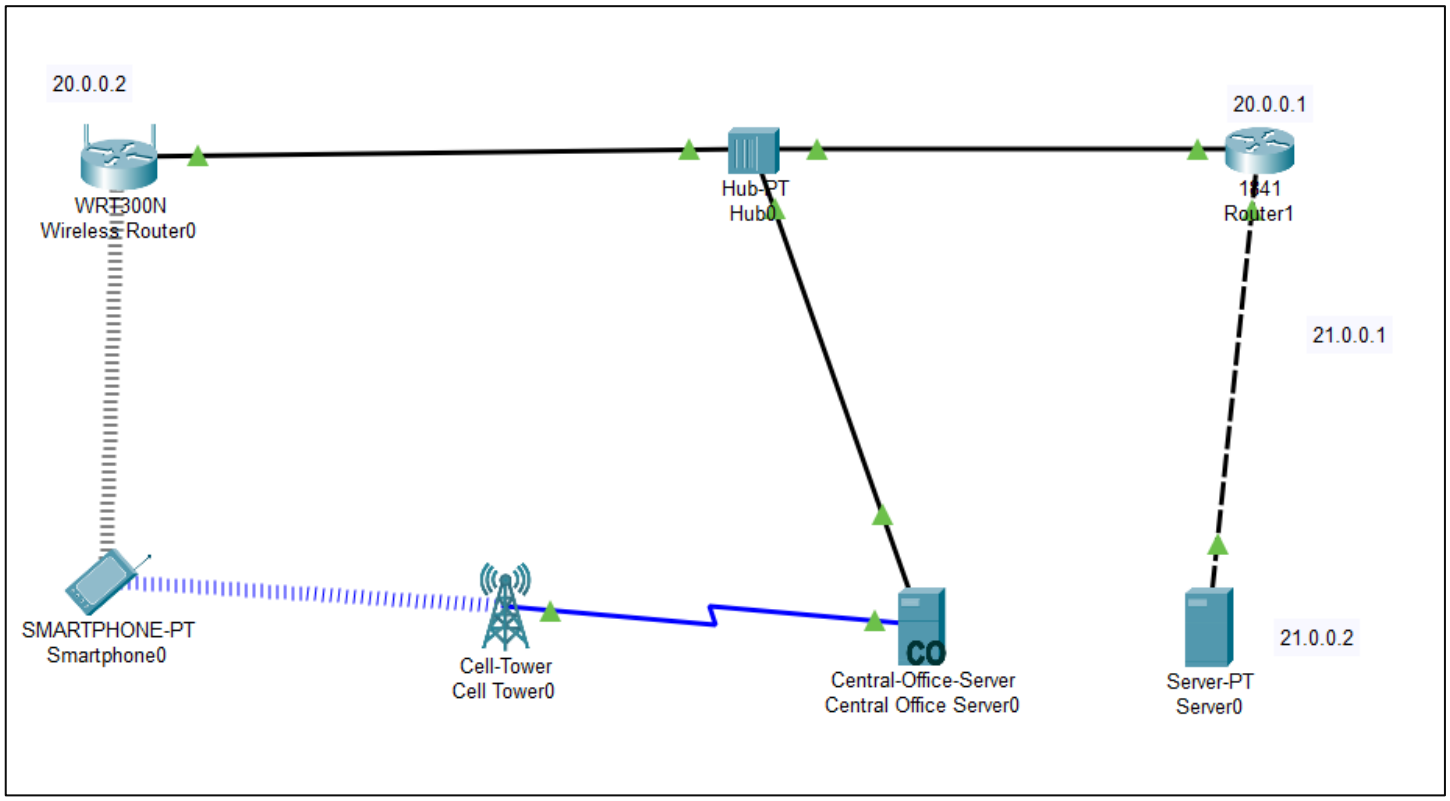
Output



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