Developing a Network Design for a Smart Airport Using Cisco Packet Tracer

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The fast-changing world is evolving towards automation rapidly every day, and a good network system is inevitable anywhere to properly manage an automated system. Before implementing a network system, it is necessary to visualize and learn a protocol to understand in depth about the network system and identify the issues among the system. Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. It helps network developers to design prototype models as well as provides a virtual network simulation platform that help to simulate projects and observe its efficiency in the real world. In this research, the authors have developed a prototype of network design of an airport using Cisco Packet Tracer. The process that depicts how network system will work in real life is explained and the simulation of data transmission is provided.
Keywords: *Data Transmission, Networking System, Network Design, Cisco Packet Tracer, Virtual Network Simulation*

1 Introduction

Computer networks is a demanding and important topic for any kind of networking and data communication. Nowadays, the need for developing a proper networking system for any infrastructure like office, school, airport, university etc. is rapidly increasing to conduct their day-to-day work. This research is based on developing a network design prototype for an airport [1] . It can vary from organization to organization since every organization implements a different network system as the interior and exterior do not match with one another [2]. To conduct this research, researchers have chosen to use Cisco Packet Tracer as it is a compact software by which researchers can develop models like real world and can implement the necessary changes required [3]. Jesin [4] stated in a paper that, Packet Tracer also supports virtual network simulation. For these large numbers of advantages, researchers have chosen to use Packet Tracer. The objectives of working on this research are as below:

- Gathering knowledge about computer network;
- Learning Cisco Packet Tracer in depth;
- Getting experience about how real-life projects work;
- Learning about networking systems and network design;
- Developing prototype of network design, suitable for an airport.

These issues faced during this network design are discussed below:

- Sometimes there are software issues, simulation does not work properly and after restarting it starts working properly;
- Cisco Packet Tracer has some issues in working on a lower performing device. It takes a long time to launch on laptops with lower RAM.
- There is a lack of online resources to learn about Packet Tracer. So, whenever the researchers have faced some problems regarding the software, it takes a long time to find the solution.

2 Review of the Literature

Human life is being shaped by technologies such as Machine Learning, Internet of Things (IoT), Block chain, Big Data and many other wonderful inventions of science these days [5]. From sentiment analysis to detect human behaviour in social media [6], [7], facial detection in exam invigilation, everywhere the use of IoT is there [8]. It is very important to make a design for a network in such a way that helps a system to perform without any workload. It should be ensured that the end devices, connected with a network system, have consistent performance. As stated by Kabir [9], good network design depends on the network performance, security, successful data transmission rate etc.

Cisco Packet Tracer has a vast number of components such as simulation, visualization, networking etc. It is an exploration and experimental software. So, anyone can develop a network for an organization similar as real life [10]. Another paper by Nazumudeen [11] mentioned that, it is possible to make simulation-based assessment in packet tracer for its wide number of available features that helps developer to understand a network design without working in real life.

The networking system technologies are improving rapidly every day. More advanced network topologies are being added to the system [12]. To connect the end devices such as PC, router, switch, smart devices, IoT devices etc. different networking technologies have been introduced. Local Area Network (LAN) is one of them. It helps to connect end devices in a shorter distance. [13] So, it works well in small to medium organizations. Another upgraded technology, came from LAN is Wide Area Network (WAN). WAN is better than many other similar technologies as it helps to connect different LAN into a network [14].

Computer networks is a very important term for data communication. Computer networks include routing, designing network system, developing network strategy, visual learning and so on [15]. Here, routing defines the path by which data transmits form one device to another. Visual learning refers to gathering knowledge by graphical interface such as image processing, the usage of graphics, images and animations etc. [16].

3 Research Methods

As earlier mentioned, to conduct this research, researchers have used Cisco Packet Tracer and its components. Background images have been collected from different online sources. Then all the images were edited as well as attached to make the background image using Adobe Photoshop and Adobe Illustrator. In this research, researchers have used some PCs, routers, switches, servers, laptops, IOE devices, smartphones and tablets. The connections that are used to develop this design are:

- Copper Straight-Through Cable.
- Serial DTE Cable.
- Wireless Connections.

In this research, there are six individual rooms. They are: Arrival Room, Departure Room, Air Control Room, Security Room and Server Room. In this design, the Arrival Room and the Departure Room have separate space for the guests and passengers. Here, researchers have built such a system where the employees in the arrival and Departure Room can communicate with the Air Control Room but the guests and passengers cannot do so. However, the data of the passengers and guests can be stored in the server for security reasons.

4 Research Analysis and Findings

In this research, researchers have developed a network design that includes all the basic components of an airport.

4.1 Air Control Room

The Air Control Room (Figure 1) is one of the most important places in an airport. Therefore, the network design of this room should be the most accurate as well as secure.

Fig. 1. Air Control Room

To make the Arrival Room secure, researchers have used static routing to control the data transmission system. By this system, only employees of the Arrival and Departure Room can retrieve data from the Air Control Room. This process is shown in Figure 2.
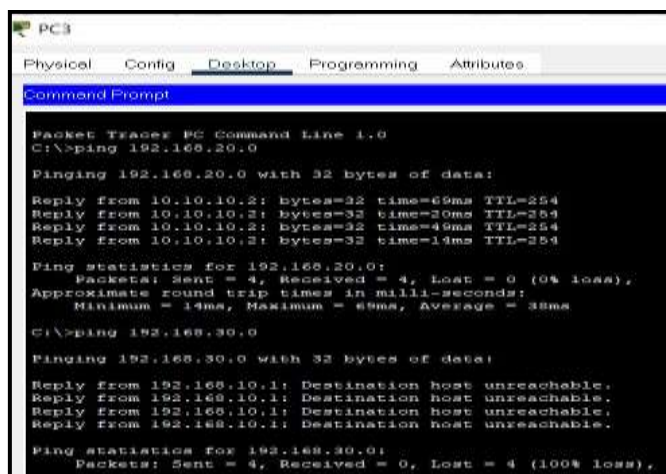

Fig. 2. Air Control Room Data Transmission System

In Figure 2, it is shown that data transmission between the Air Control Room's PCs and Arrival Room employee's PC has become successful. On the other hand, data transmission between the Air Control Room PC and the guests end devices has not been successful. Here, 192.168.20.0 is the IP address of the network of the employees' PC. And 192.168.30.0 is the IP address of the network that is connecting guests' end devices.

4.2 Arrival Room

In the Arrival Room there are two parts. First one is for the employees and the other one is for the guests. Here, both parts are divided through two different routers. The router for the employees, can transmit data to the Air Control Room. So that the employees can be informed with the flight updates and other necessary data from air control. And guests cannot transmit data to/from the Air Control Room for security purposes. We have shown the configuration of the Arrival Room in Figure 3.

Fig. 3. Arrival Room

4.2.1 Employee Department
Here, a total number of nine PC's connected to a router through a switch have been added.

These PC's can communicate with the Air Control Room directly through the router.
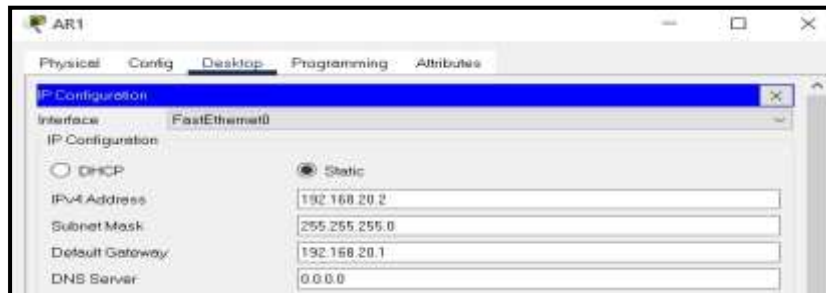
Fig. 4. Arrival Room PC configuration

The IP Address for the Arrival Room PCs from 192.168.20.2 to 192.168.20.10 have been configured and The Subnet Mask, Default Gateway and DNS Server are the same in all the PCs as shown in the Figure 4. No DNS Server had been used, that's why the value for DNS Server is 0.0.0.0 in all the PCs.

The Default Gateway IP is basically the IP for the router connecting the PCs with the Air Control Room. Default Gateway should be the same in all the PCs as all are transmitting data through the same router. And the Subnet will be auto generated according to the IP class.
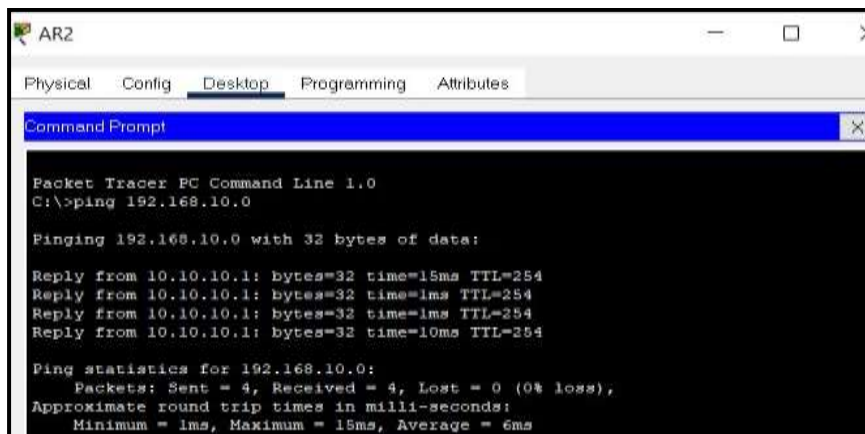
Fig. 5. Checking Connection between Arrival PC & Control Room

The IP of the Air Control Room falls under the series 192.168.10.0. That is why, it has been pinged 192.168.10.0 from Arrival Room PC to see the connection. Here, it can be seen that the Arrival Room PC sent 4 messages and got replies for all of the messages. Figure 6 shows that the data transmitting is working well.
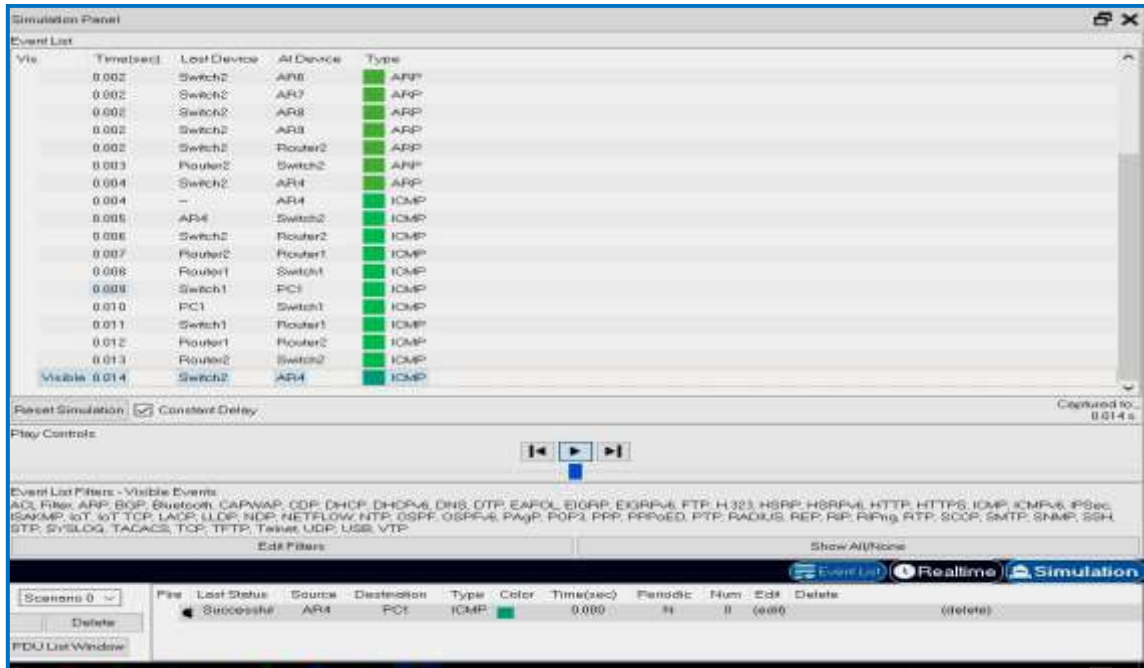
Fig. 6. Simulation from the Arrival Room to the Air Control Room

4.2.2 Guest Department
In the guest department, there is a wireless router connected with a guest router. This wireless router is connecting the end devices of the guests. The researchers have connected possible 3 devices with the wireless router. The devices are laptop, mobile and tablet.

Fig. 7. Guest Department (Arrival Room)

In Figure 7, there are three end devices, connected through Wi-Fi and transmitting data to the Arrival Room server. But they cannot transmit data to/from the Air Control Room as mentioned above.
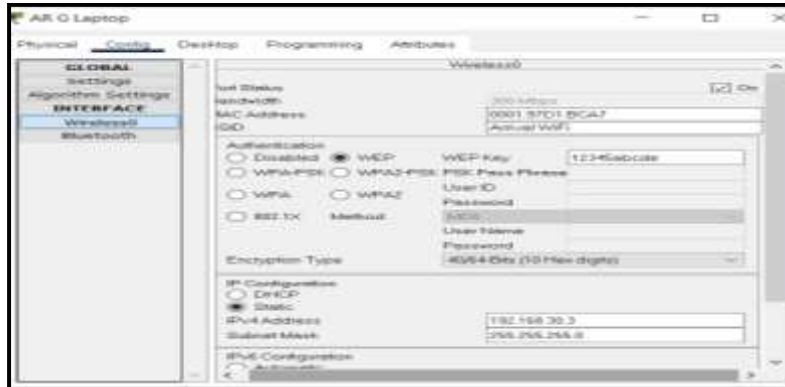
Fig. 8. End Devices Configuration

Here, the researchers have set the IP for the laptop and connected it to the Wi-Fi. The connection is shown in Figure 8.
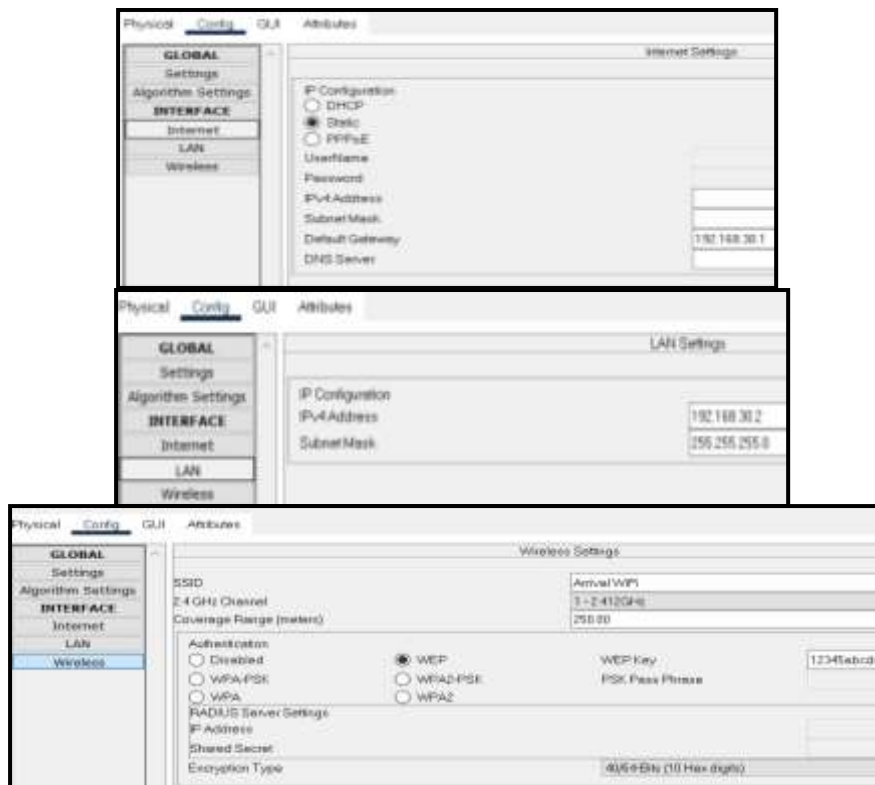
Fig. 9. Wi-Fi router Configuration (Arrival Room)

Here, the Wi-Fi router will get internet from the guest router of the Arrival Room through the route '192.168.30.1'. The IP of the Wi-Fi router is set as '192.168.30.2' and the subnet mask is set as '255.255.255.0'. The Wi-Fi router name is set as 'Arrival Wi-Fi' and the password is set as '12345abcde'. This Wi-Fi router can transmit data in any range between 0-250 meters and it will use 2.4 GHz of wireless channel to avoid conflict (Figure 9).
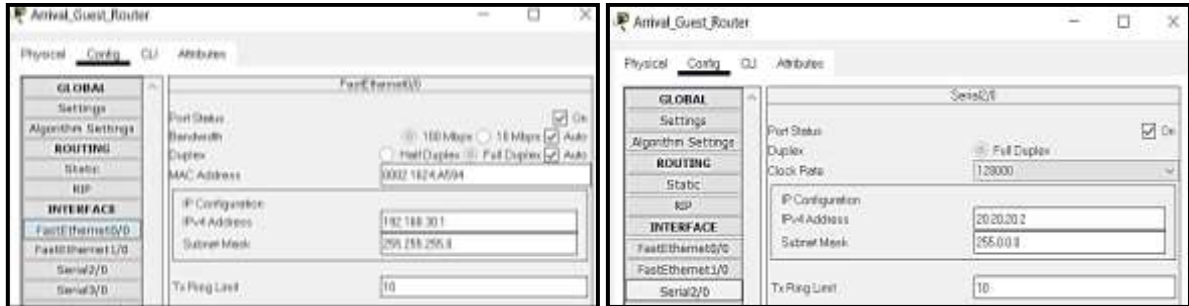
Fig. 10. Arrival Room Guest Router Configuration

The Arrival_Guest_Router is connected with two devices through two ports. The ethernet port is connected to the Wi-Fi router and supplies the internet to it. And the serial port is connecting the server through the arrival router. The IP configuration is as shown in Figure 10.

4.3 Departure Room
There are two parts in the Departure Room (Figure 11) and they are for employees and guests. So, both parts have two different routers.
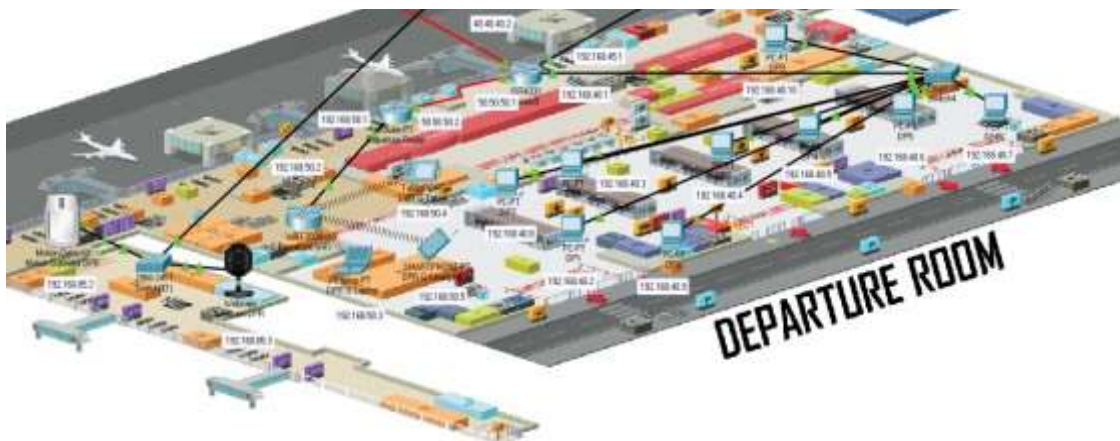
Fig. 11. Departure Room

As mentioned in the Arrival Room, the employees' router can also transmit data to the Air Control Room so that they can be updated with the latest flight information but guests cannot send/receive data from the Air Control Room for security purposes.
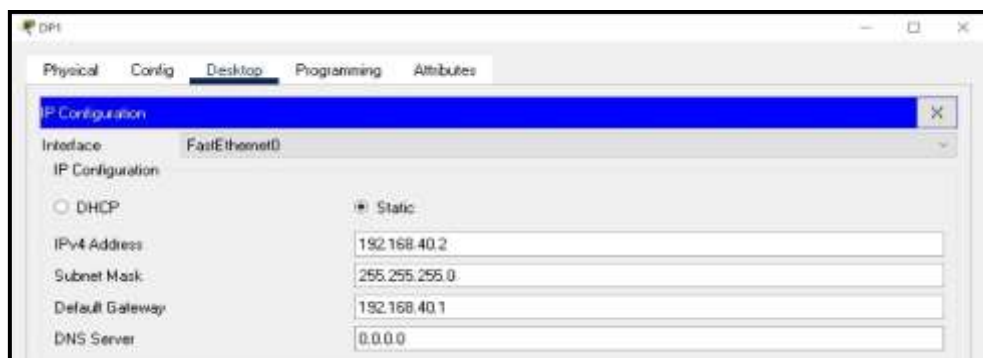
Fig. 12. Departure Room PC configuration

In Figure 12 is depicted the configuration of the Departure Room.
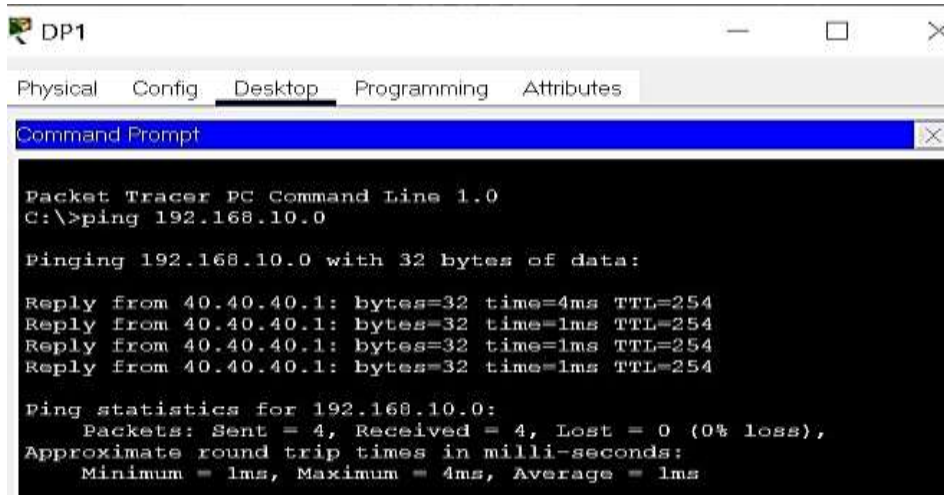
4.3.1 Employee Department
A router has been connected with nine PCs through a switch. These PCs can transmit data

to/from the Air Control Room directly through the router.

The IP address has been configured for the Departure Room PCs from 192.168.40.2 to 192.168.40.10. The Subnet Mask, Default Gateway and DNS Server are the same in all the PCs as shown in the Figure 12. Since no DNS server has been used, so the value for DNS Server is 0.0.0.0 in all the PC's. The Default Gateway IP is basically the IP for the router connecting the PCs with the Air Control Room. Default Gateway should be the same in all the PCs as all are transmitting data through the same router and the Subnet will be auto generated according to the IP class.

Fig. 13. Checking Connection between Departure PC & Control Room

The IP of the Air Control Room falls under the series 192.168.10.0. So, we have pinged 192.168.10.0 from our Departure Room pc to see the connection. From Figure 13 it is seen that Departure Room PC sent four messages and got replies for all of the messages. It shows that the data transmitting is working well. This can be better represented with a real time simulation as shown Figure 14.

Fig. 14. Simulation from the Departure Room to the Air Control Room

4.3.2 Guest Department

There is a wireless router connected with a guest router in the guest department. This wireless router connects the end devices of the guests. The researchers have connected possible 3 devices with the wireless router. The devices are laptop, mobile and tablet.
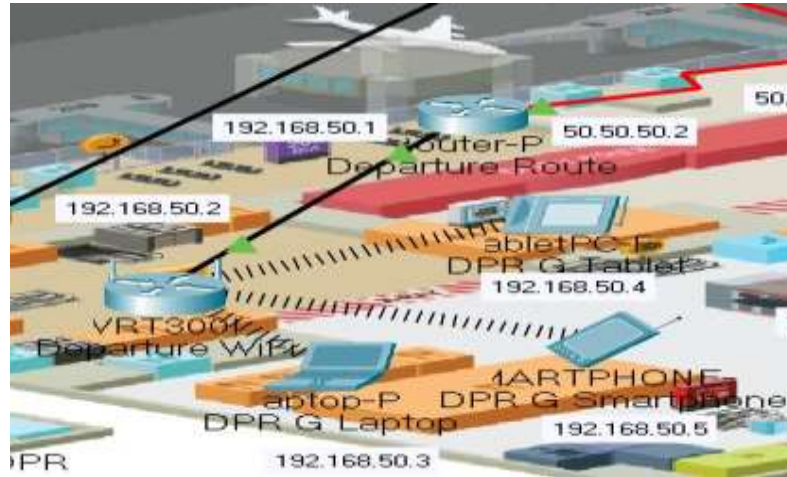
Fig. 15. Guest Department (Departure Room)

In Figure 15, three end devices are transmitting data to the Arrival Room server and they are connected through Wi-Fi. But they cannot transmit data to/from the Air Control Room.
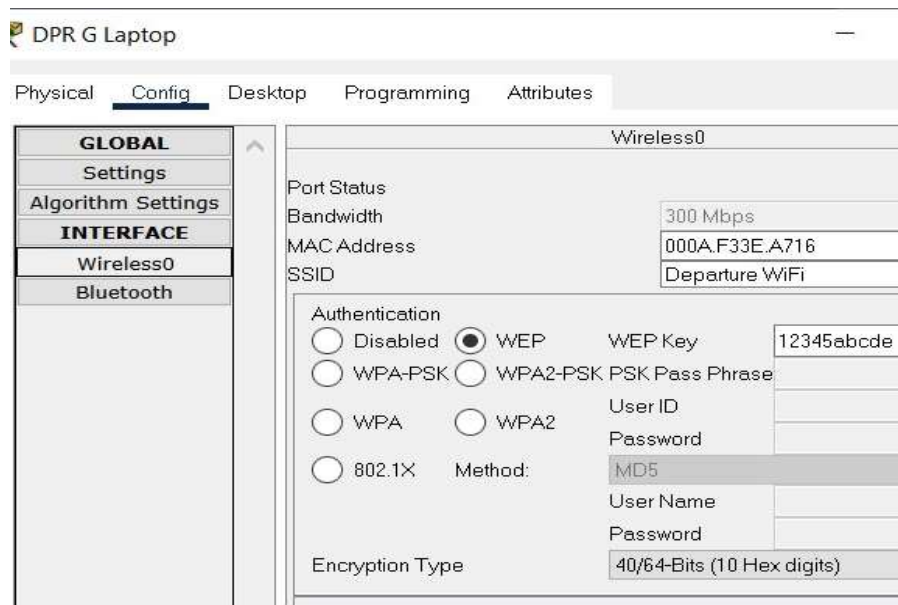
Fig. 16. End Devices Configuration

IP has been set for the Departure guest laptop and connected it to the Wi-Fi. The connection is shown in Figure 16.
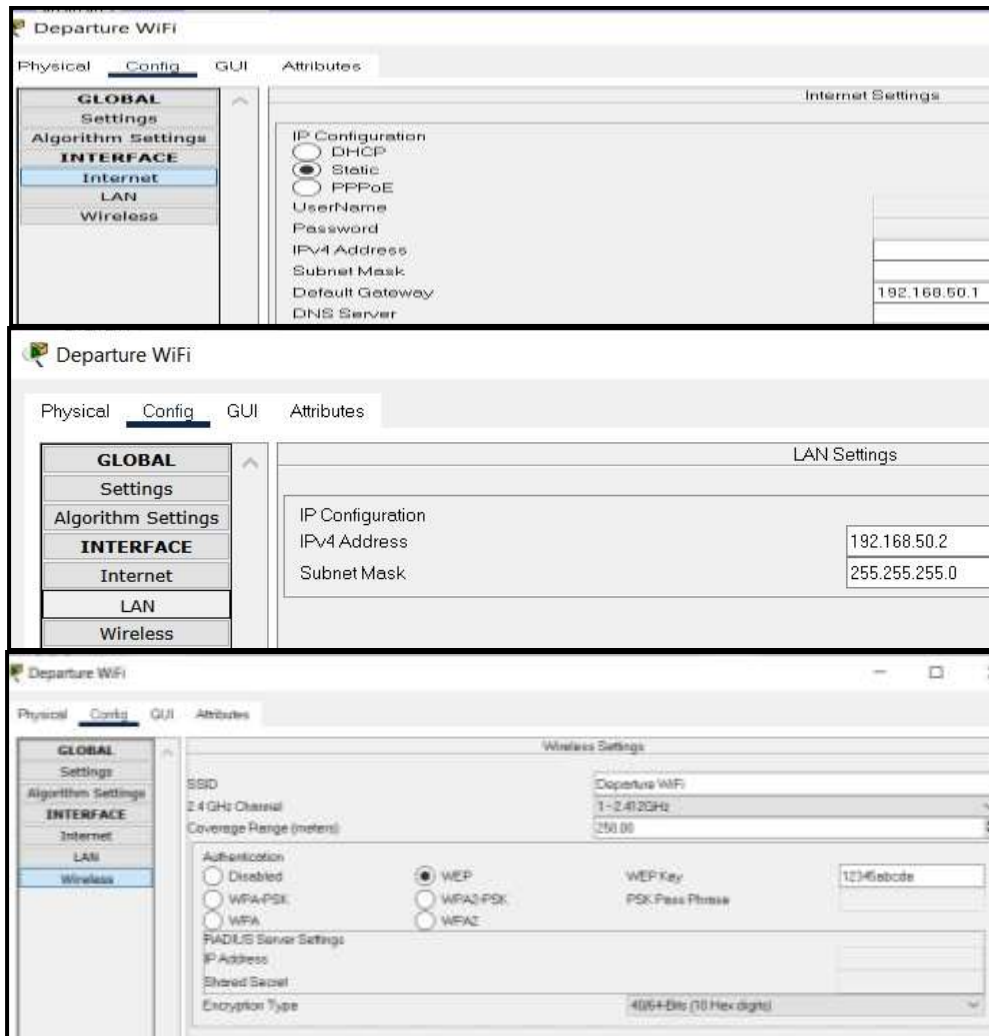
Fig. 17. Wi-Fi Router Configuration (Departure Room)

The Wi-Fi router will get internet from the guest router of the Arrival Room through the route '192.168.50.1'. The IP of the Wi-Fi router is set as '192.168.50.2' and the Subnet mask is set as '255.255.255.0'. The Wi-Fi router name is set as 'Departure Wi-Fi' and the password is set as '12345abcde'. This Wi-Fi router can transmit data in any range between 0-250 meters and it will use 2.4 GHz of wireless channel to avoid conflict (Figure 17).
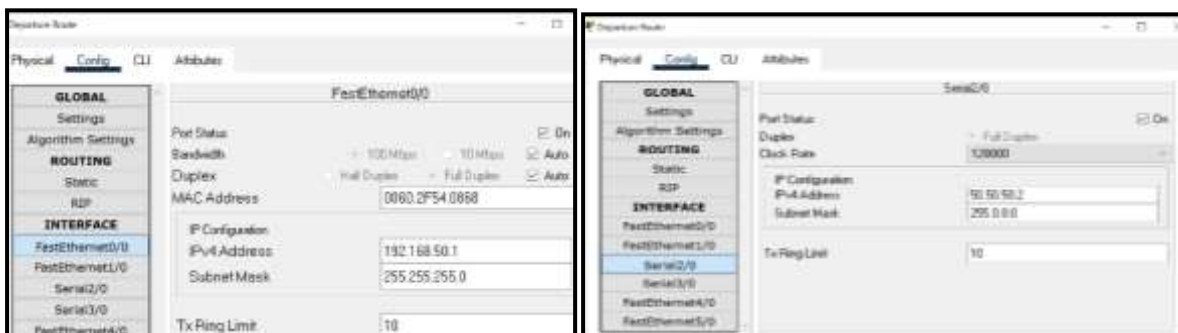
Fig. 18. Departure Room Guest Router Configuration

The Departure_Guest_Router is connected with two devices through two ports. The ethernet port is connected to the Wi-Fi router and supplies the internet to it. The serial port

is connecting the server through the departure router. The IP configuration is as shown in figure 18.

4.4 Security and Server Room
There are two servers in the Security Room (Figure 19). These servers are connecting two switches that are connected with motion detector security cameras.
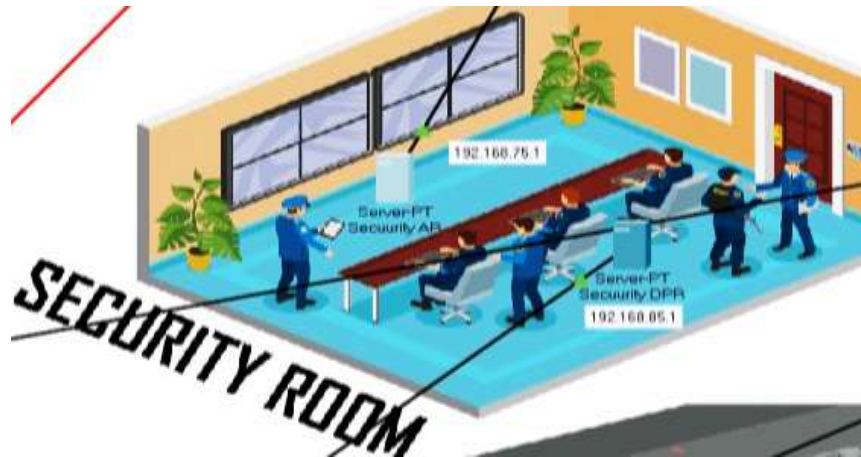
Fig. 19. Security Room

4.4.1 IoT Devices
There is an individual working motion detector operated security camera in both the arrival and the Departure Room. The working of the IoT device is shown in Figure 20.
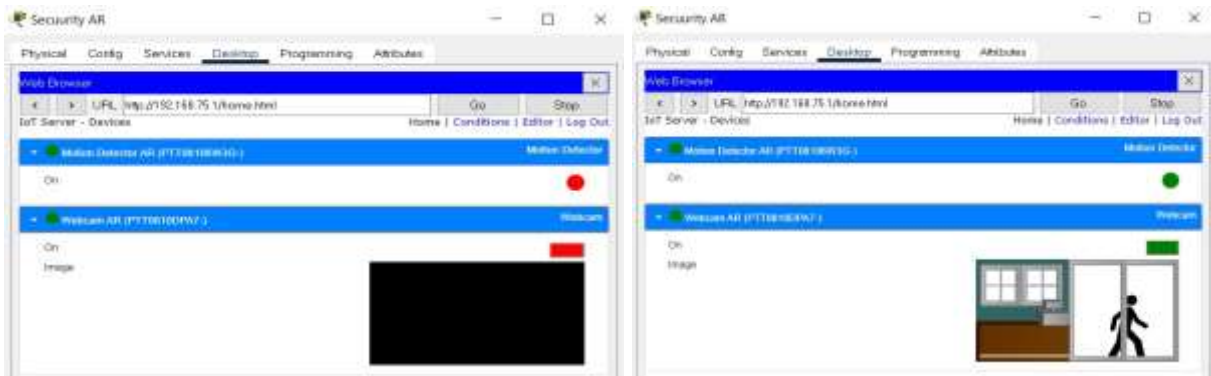
Fig. 20. IoT Devices

In Figure 20, it is shown that when the motion detector is off, the camera does not work and vice-versa. Basically, when someone walks near to the motion detector, it sends a signal to the camera to be turned on. It is basically a power efficient way to install security cameras. This model needs a registration server to work properly. Live feedback can be seen by logging into the registration server by entering the correct username and password.

It shows that this model of installing security cameras is pretty safe and secured. In addition, the data can be found on the servers in the Security Room as the servers are collecting and storing the data.

4.4.2 Server Room
In the Server Room (Figure 21), there are mainly three basic servers.
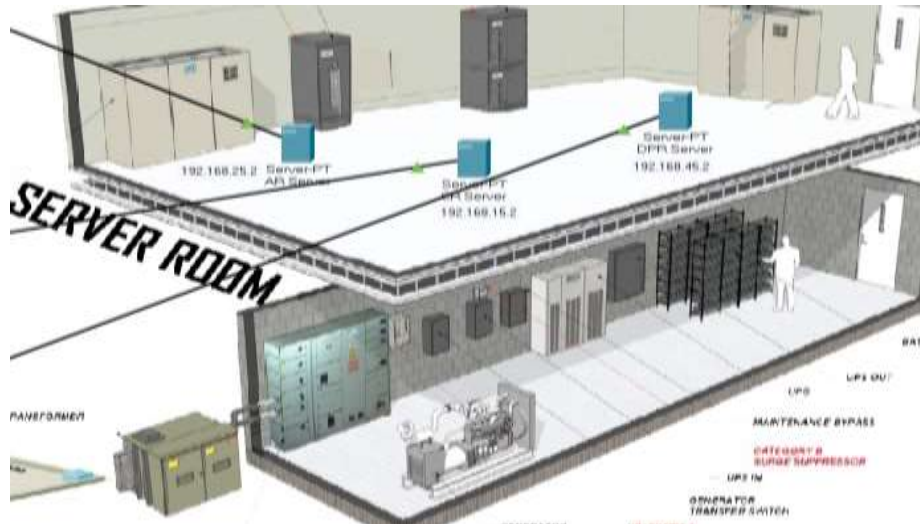
Fig. 21. Server Room

These servers collect and store data coming from the air control, the arrival and the Departure Room.

5 Conclusions
In this research, a prototype of network design for an airport has been successfully developed and tested in the real-time simulation mode available in Cisco Packet Tracer. This prototype has been developed in such a way that ensures faster data transmission and secured network connections. In addition, this network design makes sure that any unwanted data transmission cannot be happened. All these implementations help to develop smooth network connection as well as make the network design secured enough to operate. The researchers have ensured successful connectivity among all the devices in this network system.

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Sriman MITRA is a business graduate from United International University, Bangladesh, specialized in management information system. He is one of the founders and former president of UIU Management Information Systems Forum as well. During working in the forum, he has organized and attended many workshops and training session relating data and business analytics. He eagerly wants to apply abroad for higher studies in data science and business analytics field. Recently, he has worked on a Scopus indexed research paper about detecting facemask using python and AI tools. Therefore, he has further research interest in fields related with data analysis and visualization, machine learning, business analytics, AI.

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