

Smart University Network Module Implementation by Using Cisco CCNA with Packet Tracer

Ahmed Imran Kabir ¹, Shovon Basak ², Mojibul Haque Tanim ³, Aminul Islam ⁴

¹ Adjunct Lecturer, School of Business and Economics, United International University, Bangladesh.

^{2,3,4} Undergraduate School of Business and Economics, United International University, Bangladesh.

ahmedimran@bus.uui.ac.bd ¹, sbasak152213@bba.uui.ac.bd ², mtanim153119@bba.uui.ac.bd ³,
aislam142214@bba.uui.ac.bd ⁴

Abstract – In this paper, an integrated network design for university has been presented. This network design is composed of many sections. First, the paper started to explain the design constraints. Many universities are eager to design a network that meets standards but has always been faced with cost implementation barrier. Secondly, this design accounts for challenges that will be faced when designing network due to the lack of a rich economy like developed countries. Another challenge that we have limited equipment availability, requiring careful selection of components. Also, security is an important section in this network design. Strong security solutions are detailed including as firewall, backup, virtual switch and DNS server options. This configuration includes some software applications, such as antivirus, password, and encrypted passwords. This design allows for future expansion, as universities using this design can connect 3115 additional hosts, allowing for per host costs, like cabling. The additional hosts can be included without exhausting the available IP address. Also, if there are high budget, they can develop the network system to become more powerful, have a high level of security and many servers can be added to the network. Lastly, as cheap and effective as the methods of designing a network in this research are, it is not limited to only developing countries.

Index Terms – Cisco, Packet Tracer, CCNA, Network Module, Smart University, Computer Networks.

1. INTRODUCTION

Technology has become an important concept in our life. It assists in connecting communities together. Obviously, people have started to use technology in every field of life including education, health, the military, etc. A school's computer network performs so many functions, such as connecting students with the university, faculty, and the library. Most universities today use the network to provide online education by connecting widely dispersed students with their professors directly. For this reason, computer networks play a vital role in the education area by providing efficient communications for the university environment. However, the design of computer networks differs from one university to another. This is as a result of many factors which determine the differences. Such factors include; adaptability, integration, resilience, security, and cost. Installing networks in a university relies on the university's budget, which differs by institution and from

country to country. For instance, there are many countries whose universities do not have the financial capability for designing the 'perfect' or ideal network. Yet these universities from these third world countries still need to have good quality and more secure network equipment with less cost. This is because these schools aspire to deliver capability in line with the leading prestigious universities despite low budgets. Therefore, this design will be focusing on factors that will enhance computer network for universities to be able to compete favorably with another computer network in other universities.

2. OBJECTIVES

The main goal of this project is to present a Local Area Network design suitable for universities. Many universities in developing countries are searching for ways to integrate networks that have security, backup, and other features available in a university network in a developed country. The universities in developing countries are faced with challenges in designing a network that is equal in the standards used by developed countries. The main problem developing countries face deals with a profound budget deficit. This research will help these universities to design a network that employs low-cost solutions without unacceptable compromises in security or quality.

3. RELATED LITERATURE

Capacity is the ability of the network to withstand intense pressure from utilization [1]. According to [2], Most times, the networks are mainly crowded by many users that the network capacity could not handle. **It is very important to design a network in such a way to handle many users without failure. This network is designed for a user population of 5075. If more users access the network; it will be able to scale.**

Reliability refers to the ability of the computer network's hardware and software component to consistently perform according to its specifications [1]. **This research's network will be highly reliable in performance because its components will be chosen from Cisco Company, a major and well-regarded manufacturer. Reliability of the security in the network is in**

high level. This is because there are many powerful devices used to secure data like the firewall device that is used in filtering data entering into the network. If any issue happens to the data, there is a way of restoring the data from backup servers. Each computer in the network has anti-virus to protect users' data. Also, all router and switches are protected by passwords and encryptions.

According to [3], the first challenges this network design will face is economic and budget issue. The cost for designing of the network system has a limit that cannot be exceeded. This network design will be the solution for designing network at a cheaper cost. This is because this design can be made to be an integration network system, with good security, and quality of devices by low prices. The availability of equipment is needed to complete the installation of all parts of the network. They do not have the complete equipment required for the local area network, such as server device, backup device, and firewall device. The provision of devices will be another challenge that will be faced when designing this network.

4. THEORETICAL BACKGROUND OF DESIGNING THIS NETWORK

4.1 Create Background Image

First of all, the researchers created the background picture with other third-party software. Like

1. Sweet Home 3D



2. Adobe Photoshop



3. Adobe Illustrator

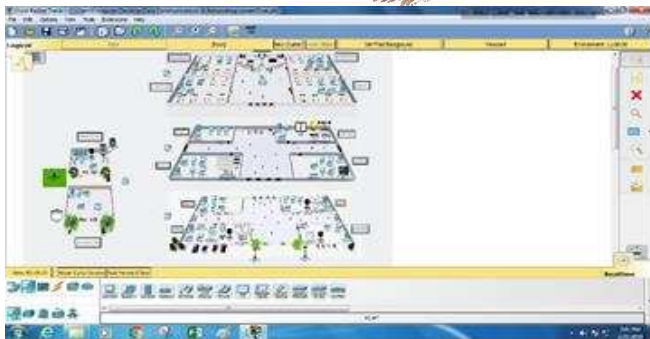


Figure 4.1.1: Putting background image on Cisco packet tracer

4.2 Choosing the Equipment

Each network must have a media for transferring information from one node to another, or from one device to other devices [4]. These media play a significant role in determining the

transmission speed of the network, maximum distance, shielding against interference, and the cost of the network [5]. There are two options for general use: One of them is a physical connection, and the other one is wireless. Here are some devices researchers use to design this network:

Router, Switches, Wireless Router, Cell Tower, PC, Laptop, Server, Printer, TV, Smart phone, AC, CO2 Detector, Fan, Fire sprinkler, Garage Door, Home Speaker, Lawn sprinkler, Motion Detector, Smoke Detector, Alarm, Solar Panel, Webcam, Window, cloud, SDC, Old Car etc.

4.3 Connection Setup

The obvious way, given the constraints, to connecting devices together, all computers must be connected to switches then switches must be connected to the routers [6]. After that, according to [7], all routers connect to the last switch in order to link with edge switch, in which various servers such as DHCP server and DNS server are connected. The last switch is also connected to a firewall device. The firewall device links to the NAT router, and then to the external networks or internet.

4 types of cables were used here:

- Copper Cable
- Coaxial Cable
- Serial DTE Cable
- IOE custom Cable

4.4 Choosing Network Topology

A network topology defines how hosts are connected to a computer network. It characterizes how the PCs and other hosts are organized, and linked to each other [8]. According to [9], there are many types of network topology such as Point-to-Point, Bus, Star, Ring, and Mesh topology. Each type has a different set of advantages and disadvantages [5].

The researchers used the Star topology in this design. Because the star topology is generally used for all networks whereby each device or computer is connected to a center hub by a direct line [10]. The center hub can be a switch, router, or server. Each computer connects directly to the center device such as the hub, router, and server. According to [11], a star topology is designed with each node connected directly to a central network hub, switch, or concentrator. It is easy to add and remove a computer from the network without affecting the network. It is easy to replace, install or remove hosts or other devices, the problem can be easily Detected-It is easier to modify or add a new computer without disturbing the rest of the network by simply running a new line from the computer to the central location and plugging it to the hub [12]. Also, the cost of this network topology is less. If a computer shut or breaks down, it will not affect other devices in the network. However, if the center device (hub) breaks down, it will affect

all the computers connected with it. This topology will be used for this design because each computer is independent of other computers in the network, and it is less expensive than mesh and ring topology and easy to install.

4.5 Choosing Network Architectures

The researchers used the client-server architectures. Because most applications written today use client-server architectures. [13] stated that, client-server architectures attempt to balance the processing between the client and the server by having both do some of the logic. In these networks, the client is responsible for the presentation logic, whereas the server is responsible for the data access logic and data storage. The application logic may either reside on the client, reside on the server, or be split between both.

5. IMPLEMENTATION & CONFIGURATIONS OF DEVICES

Implementation is the carrying out or completing of a network project. This paper will design a project involving a computer network that will be implemented this network.

5.1 Servers

The term server refers to a device or a computer program that supports other devices or programs which are called clients [14]. This is known as the client-server model; one server can support many clients and can give different functionalities or characteristics to different clients. The cost of purchasing many servers is very high, and institutions in developing countries cannot afford such high-priced systems. According to [15], "The server is usually the most expensive computer on the network. As a result, few servers will be used for this project's network design. The few servers that will be used in this project are DHCP server and DNS server.

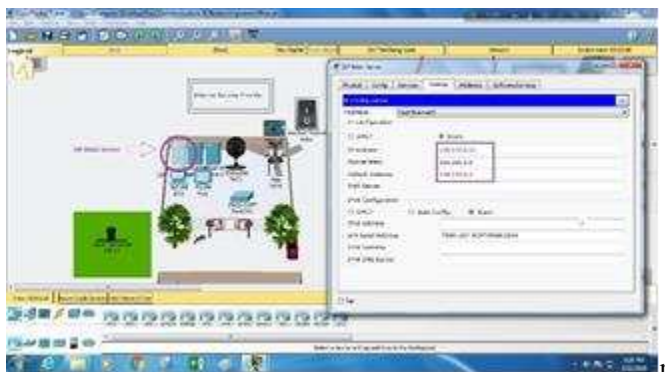


Figure 5.1.1: Assigning servers

5.2 DHCP Server

Dynamic Host Configuration Protocol (DHCP) server will be connected to the switch device in order to connect to many computers. Each computer that is connected to the network

needs an IP address. The DHCP will distribute the IP address to each computer. Cisco DHCP server is used because it is easy to configure the DHCP device using packet tracer simulation program [16]. After configuring DHCP server, all hosts on the local area must change the IP configuration option from static to DHCP to get the IP address automatically.

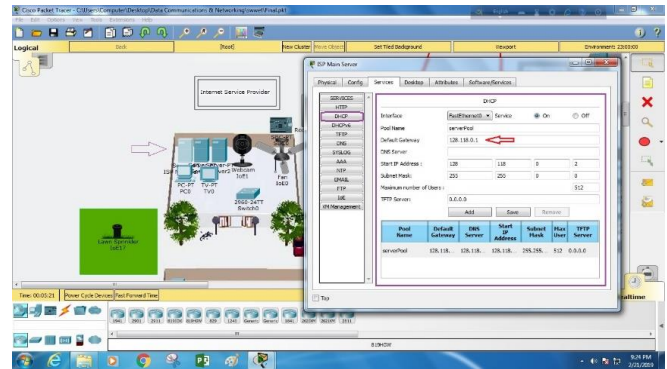


Figure 5.2.1: Assigning DHCP servers

5.3 DNS Server

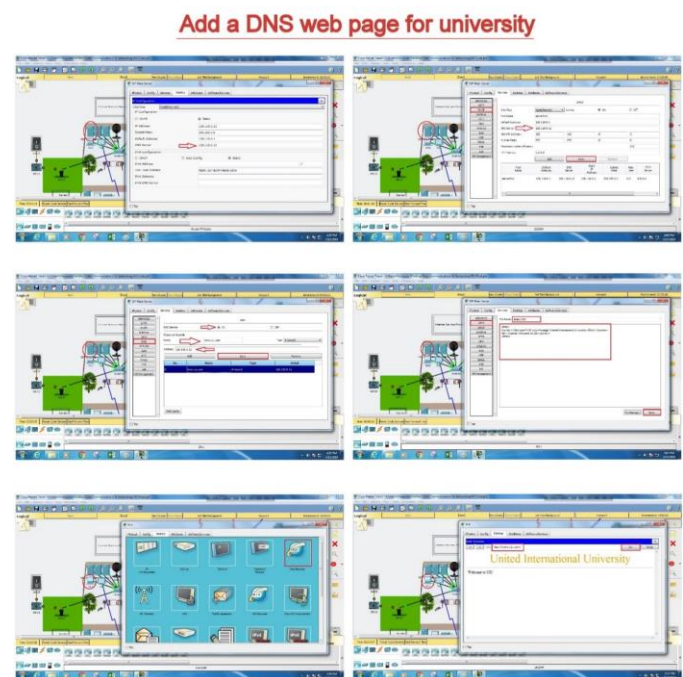
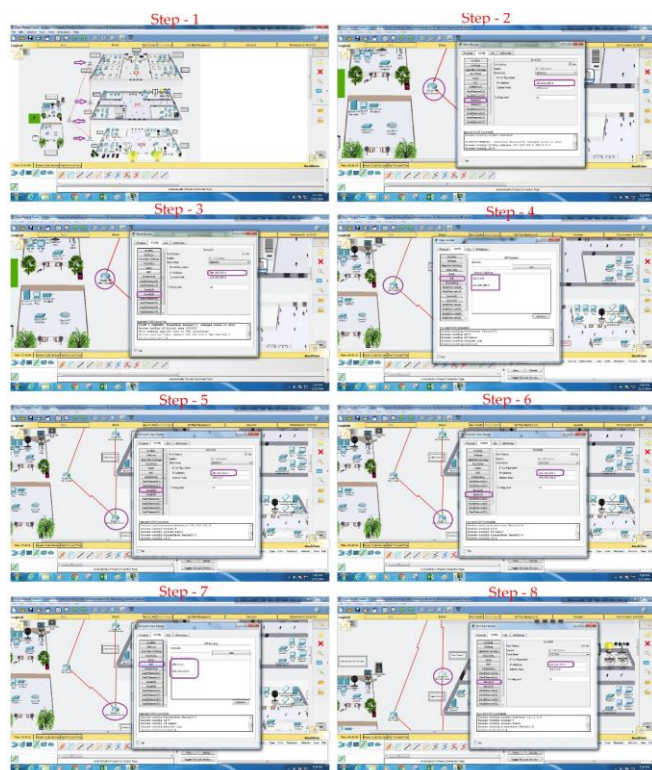


Figure 5.3.1: Assigning a DNS webpage for university

According to [17], the Domain Name System (DNS) is a server service that maps a domain name to IP addresses. DNS server translates a domain name to the IP address. IP address contains 32 bit [18]. Since people cannot easily memorize all numbers of IP addresses, it is easier for them to memorize domain names of IP addresses. For instance, it is easier to memorize "www.uiu.com" website, but difficult to memorize the IP

address “128.118.0.12” for requesting university site. It is easy for a computer to understand numbers, and in reverse to a human who prefers text to the numbers. For example, when a user requests “www.uiu.com” page, the computer host does not understand the request “www.uiu.com”. The Computer needs to know the IP address of “www.uiu.com” site. The Computer host will send a request to the DNS servers to request the IP address of the university site. The DNS server will then translate “www.uiu.com” to “128.118.0.12”. With this, the computer host can get information from the university site. If a network does not have DNS servers, making use of computers in surfing the internet will be complicated. Humans have to memorize all IP address, or must make a note for each IP address. Without DNS servers, the internet will be very much complex or nearly impossible to use. The DNS server will be connected to the switch then to the router. The IP address for the DNS server must be static, and IP address used is “128.118.0.12”.

5.4 Routers



A router is a networking device that forwards data packets between computer networks [19]. [19] also stated that, the router chooses the best path to transfer data packets to their destination in the most efficient manner. Think of a router as a traffic cop at a busy intersection. This traffic cop makes determinations on which vehicles get through, which vehicles are not permitted on the path and the destination that the vehicles may take. The best kind of router for this endeavor is

made by Cisco because of its high standards of reliability and technical support. Since the proposed network must connect many computers to many switches, the router is an important component of the network. The configuration of the Router starts with many steps. These steps are as follows:

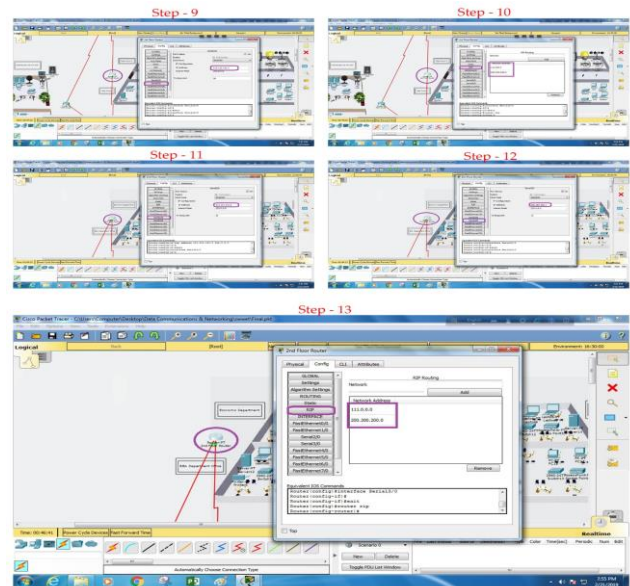


Figure 5.4.1: Assigning routers in the university network.

5.5 Personal Computers

The first step is to configure all the personal computers. Each personal computer must be connected to a switch. Each computer needs a unique Internet Protocol (IP) address.

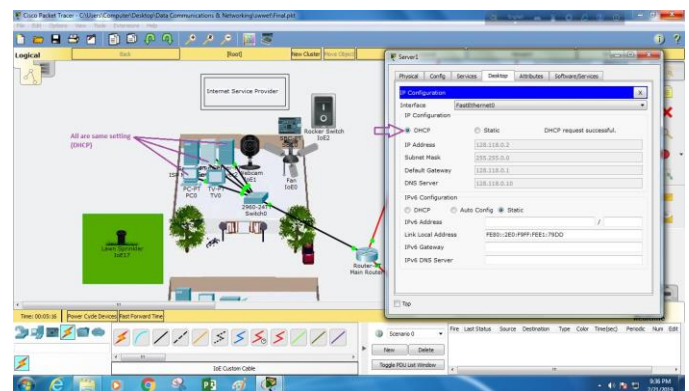


Figure 5.5.1: Assigning personal computers.

5.6 IOE Devices

Internet of Everything is a step ahead of Internet of Thing. If we go by the statistic predictions, then by 2020 then Cisco will lead the industry of Internet of Everything with around 50 Billion of devices connected to it [20]. The key upgradation in Cisco Internet of Everything is that the number of devices that

can be connected and managed via cloud are way more than Internet of Thing.

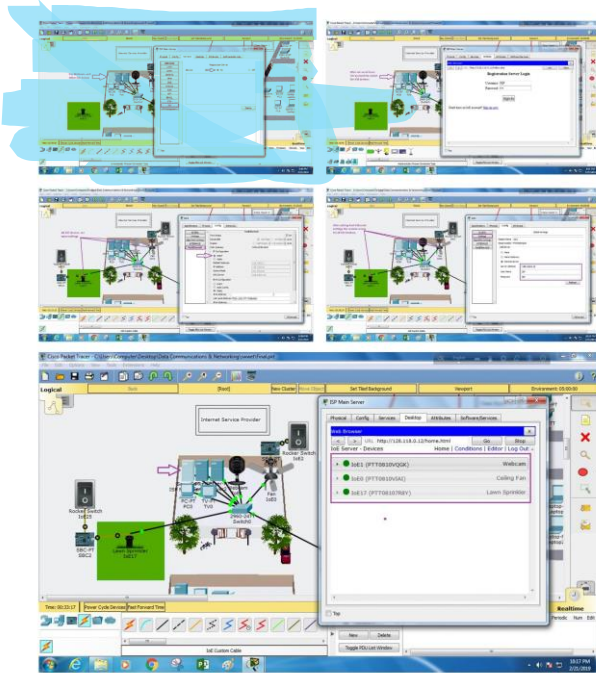


Figure 5.6.1: Assigning IOE devices in the network

Now the researchers also setup some condition for IOT devices. For example, when some detector detects the smoke in room at that time alarm and fire sprinkler will be open and alert the students to leave the place and go to a safe place.

Set up condition for IOE Devices



Figure 5.6.2: Putting conditions on IOE devices for the network

5.7 (SBC-PT) BOARD

Session border controller board is used to interconnect different smart object and provide programming environment with different language those are JavaScript, python and visual basic, to control the connected smart object represent the home architecture that connected each other using wireless and wired medium [21].

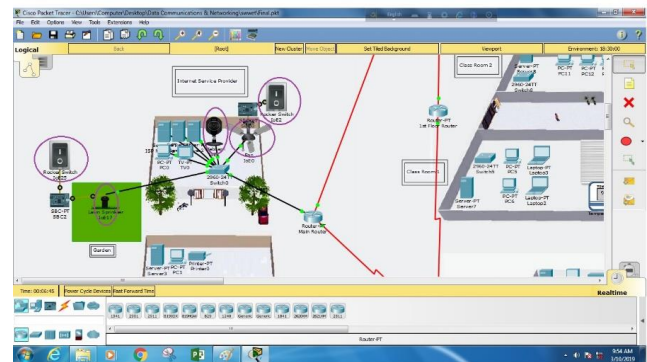
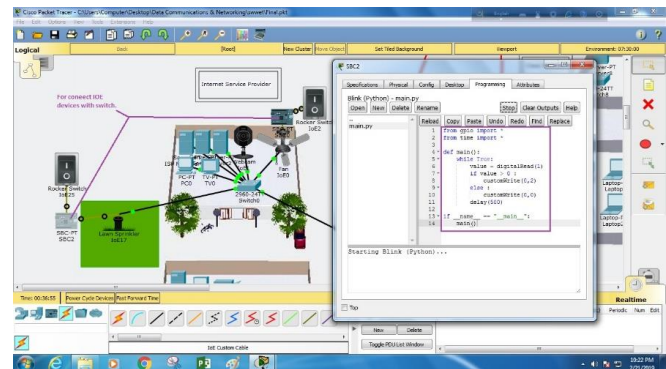


Figure 5.7.1: Configuring session border control board (SBC-PT) for the network.

5.8 Wi-Fi Router

According to [22], the Wi-Fi is one type of wireless communication device used for connecting to a network. It is imperative for daily life's communication. Wi-Fi signal must

be made available to connect inside all buildings at the University. This is because all students and faculties make good use of the Wi-Fi connection with their tablets, phones, and laptops, etc. The wireless local area network (WLANs) that will be used in this project network design is (WRT-300N). The WRT-300N is an advance group of details for WLANs developed by a group, working in the Institute of Electrical and Electronics Engineers (IEEE). The WRT-300N is an open design, and it is also less expensive. According to Leung, Kin K., and B-J. Kim, Frequency assignment for IEEE 802.11 wireless networks, "In addition, the cost of WRT-300N equipment is much lower than that for 3G equipment because of the simple and open design of the former networks, coupled with competition among WLAN vendors. All Wi-Fi devices must be secured by a password. The password prevents unauthorized user to connect to the Wi-Fi network. This is because the network could easily be hacked when it is open to all users, especially unauthorized users who can overcrowd the network, making it work very slowly. Also, a limited number of IP addresses that are reserved for the real users of the network can be taken by unauthorized users. To connect the wireless, access point is used, and at least one access point is installed in each floor. The numbers of access point Installation depend on the size of the building. A Bigger building can have more than one access point installed in it. The access point usually makes use of the star topology network connection.

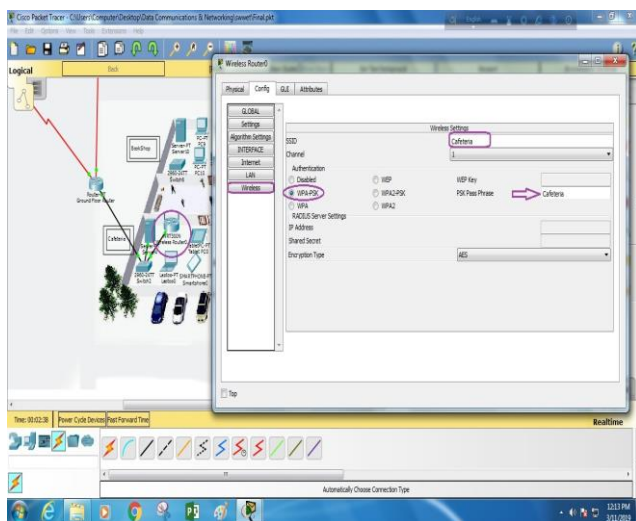


Figure 5.8.1: Configuring Wi-Fi routers.

5.9 TV

The TV Settings sub-panel allows you to manage TV images that would be displayed on a connected TV end device. To add a TV image, click the Browse button and select an image. It is recommended that you use .PNG graphics. Afterwards, click the Add button to add the image to the list of TV images. To remove a TV image, select the TV image from the list and click the Remove button.

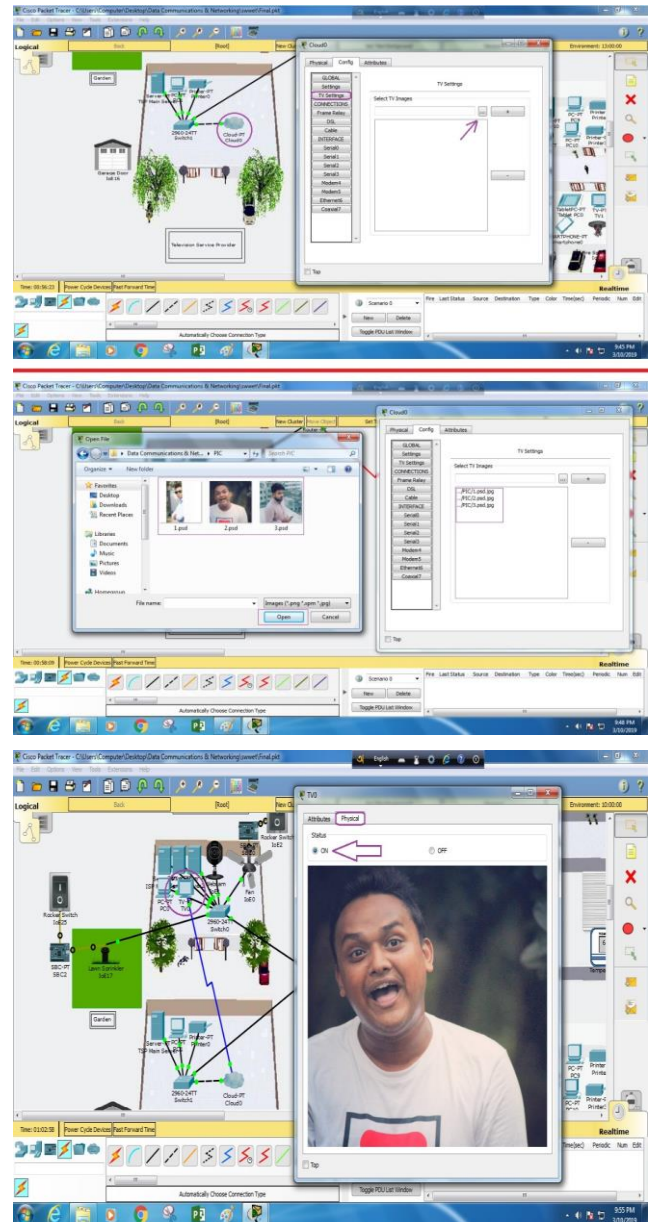


Figure 5.9.1: Configuring smart TV for the network.

5.10 Email Configuration

A mail server (sometimes also referred to an e-mail server) is a server that handles and delivers e-mail over a network, usually over the Internet. A mail server can receive e-mails from client computers and deliver them to other mail servers [23]. A mail server can also deliver e-mails to client computers.

To set up the email server, the researchers open up server0 and after clicking on services tab, select the email service and a window opens up with the type of configurations available for the mail server. And the configurations are:

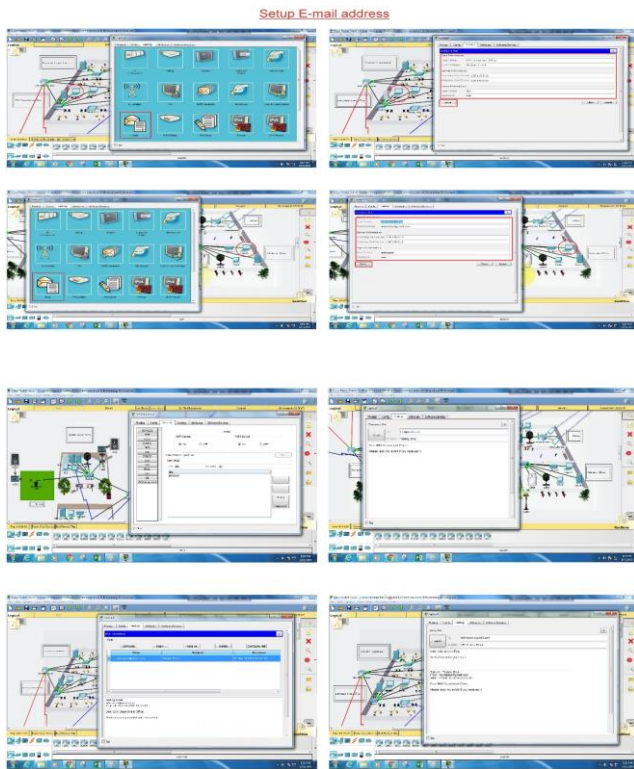


Figure 5.10.1: Configuring email addresses for the network

6. SIMULATION OF THIS NETWORK

In this study, the Packet Tracer which can perform network performance measurement and network laboratory operations by the simulation drawing and the cisco system is made through the net simulation program. It is drawn in details in Figure 5 as it will be seen as the basic network. There is three-part scheme, An ISP and routers, modem and computers are used. While the cables connected to the router are fiber optic, other twisted pairs are preferred. Serial ports and router IP-addresses are manually entered and all other are statically configured. Fast Ethernet is used for ingress and the IP addresses and MAC addresses are matched as given. In addition, in this study many scenarios have been simulated. The devices, which are used in the network, provide information about the cabling local area network topology, and Package follower environment software included in this simulation Data transfer methods are divided into 3: single point, multipoint, and multiple transfers. Multiple addresses must be sent to multiple addresses for a single destination address transfer the broadcast is transmitted to all nodes in the network's dataset. All these transmissions are sent in one package. As a result, and the data will always be transmitted over all the networks. In this design represents the network measurement which has 3 main parts: Server room, TV service provider, and University building. The cable from the modem is shared between the

wireless modem. Simulation experiments have proven that the network topology works and preforming is done correctly.

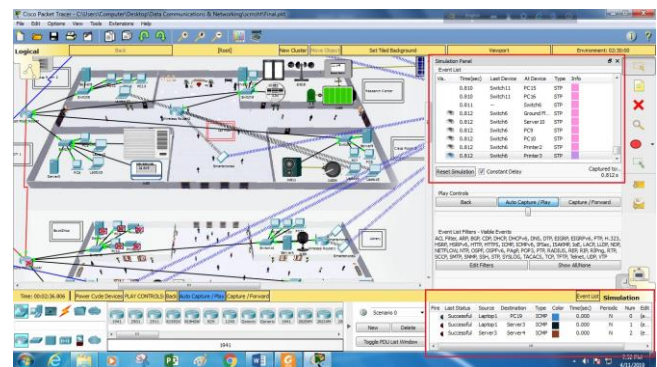


Figure 6.1: Final simulation for the network system to check all the connections.

7. CONCLUSION

In this paper, a University Network Design that uses both wired and wireless topology have been implemented with some important concepts like DHCP, DNS, Email, VLANs in a single network using Cisco Design and Simulation of Local Area Network Using Cisco Packet Tracer. Packet Tracer. VLANs have been used to logically group clients on the network, and with the aid of a router and switch configurations, data packets routed from one device to another. It is also noteworthy that, the configuration and specifications are for the initial prototype and can further be developed and additional functionality can be added to increase support and coverage. The procedures provide a veritable approach for the design of LANs for end-to-end IP network connectivity for next generation network (NGN) architecture implementations.

REFERENCES

- [1] J. D. McCabe, Network analysis, architecture, and design: Elsevier, 2010.
- [2] M. Pióro and D. Medhi, Routing, flow, and capacity design in communication and computer networks: Elsevier, 2004.
- [3] D. A. Patterson and J. L. Hennessy, Computer Organization and Design MIPS Edition: The Hardware/Software Interface: Newnes, 2013.
- [4] S. Hagen, IPv6 essentials: " O'Reilly Media, Inc.", 2006.
- [5] J. M. Kizza, Guide to computer network security: Springer, 2009.
- [6] T. McMillan, Cisco networking essentials: John Wiley & Sons, 2015.
- [7] D. Hucaby, CCNP Routing and Switching SWITCH 300-115 Official Cert Guide: Exam 38 Cert Guide: Cisco Press, 2014.
- [8] T. Lammle, CompTIA Network+ Study Guide Authorized Courseware: Exam N10-005: John Wiley & Sons, 2012.
- [9] D. Anfinson and K. Quamme, IT Essentials: PC Hardware and Software Companion Guide: Cisco Press, 2008.
- [10] M. Dye, R. McDonald, and A. Rufi, Network Fundamentals, CCNA Exploration Companion Guide: CCNA Exploration Companion Guide: Cisco press, 2007.
- [11] G. P. Agrawal, Fiber-optic communication systems vol. 222: John Wiley & Sons, 2012.
- [12] F. A. Nadeem and P. Sarkar, Implementing Cisco UCS Solutions: Packt Publishing Ltd, 2013.

- [13] T. Noergaard, Embedded systems architecture: a comprehensive guide for engineers and programmers: Newnes, 2012.
- [14] D. Mitchell and T. Keegan, VMware vSphere for dummies: John Wiley & Sons, 2011.
- [15] D. Lowe, Networking for dummies: John Wiley & Sons, 2003.
- [16] R. W. Smith, LPIC-1:(Exams 101 and 102): John Wiley & Sons, Inc, 2011.
- [17] Q. Docter, E. Dulaney, and T. Skandier, CompTIA A+ Complete Deluxe Study Guide Recommended Courseware: Exams 220-801 and 220-802: John Wiley & Sons, 2012.
- [18] N. B. Dale and J. Lewis, Computer science illuminated: Jones & Bartlett Learning, 2007.
- [19] L. C. Miller and P. H. Gregory, CISSP for Dummies: John Wiley & Sons, 2016.
- [20] A. Abraham, P. Dutta, J. K. Mandal, A. Bhattacharya, and S. Dutta, "Emerging Technologies in Data Mining and Information Security," Proceedings of IEMIS, vol. 2, 2018.
- [21] D. Minoli, Voice over IPv6: architectures for next generation VoIP networks: Elsevier, 2011.
- [22] D. Briere and E. Ferris, Wireless home networking for dummies: John Wiley & Sons, 2011.
- [23] E. Quigley and M. Gargenta, PHP and MySQL by Example: Prentice Hall Professional, 2006.

Authors



Ahmed Imran Kabir, an Adjunct Lecturer of the School of Business and Economics, United International University, Bangladesh. His prior study was Master of Science in Business Analytics, Texas A&M University- Commerce, United States.



Shovon Basak, an undergraduate student at the School of Business and Economics, United International University, Bangladesh. He is doing his major on Management Information System.



Mojibul Haque Tanim, an undergraduate student at the School of Business and Economics, United International University, Bangladesh. He is doing his major on Management Information System.



Aminul Islam, an undergraduate student at the School of Business and Economics, United International University, Bangladesh. He is doing his major on Management Information System.