Local Area Network Deployment for Gwagwalada Area Council, Abuja, Nigeria

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ABSTRACT

Networks are everywhere or so it seems. You can hardly do anything with data that does not involve a network. Like the human networks that we are all part of, computer networks let us share information and resources. In business, the reliance on networks is even more pervasive than in homes or schools. In Gwagwalada area council, the mode of documentation is usually a manual form, which is a vulnerability to the security of confidential data such as employee, citizens and political data. The method of printing and access to information is ambiguous; sometimes an employee will have to leave his/her office to another office just to have a printout which can be easily gotten by sharing resources through network. In this Research, a study of the existing system was carried out using Qualitative means of information gathering technique which involves in-depth interview and observation that prompted the release of a new network system. Local Area Network system is designed for Gwagwalada Area Council that is capable of providing network resources and services (as well as Internet connections if the need be by the organization) to local users and a limited access of network service to public users for Business activities. Through this networking system, the organization can effectively reduce daily running cost, the organization internal works can be more systematic and well organized, and the communication of the employees in the organization can become more efficient by the use of mail services. The network is used to share files, prints and data. Employees can communicate with one another through Mail. Besides, some expensive hardware such as color printer can be shared by a lot of employees. The researcher determined the functional requirements and best topology for the Network system deployed. The implementation of the Local area network was completed using Cisco packet Tracer to simulate the process.

Keywords: Local Area Network, Deployment, Communication, Gwagwalada Area Council, Abuja, Nigeria

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1. BACKGROUND OF STUDY

The proliferation of electronic and computer technologies in the 1970s made it feasible to place small personal computers at locations where users needed them. Before this, computational tasks had been performed by large computers in centralized locations. The widespread use of personal computers prompted the need for a communication method that could link this equipment. This led to the creation of local area networks (LANs). These networks facilitated the decentralization of computing tasks by allowing network-connected computers to exchange information among them, without having to go through a central location (ITVC, 2010) . According to Jean (2003) networks are everywhere or so it seems. You can hardly do anything with data that does not involve a network. Like the human networks that we are all part of, computer networks let us share information and resources.

In business, the reliance on networks is even more pervasive than in homes or schools. Networks help individuals and businesses alike save money, but they also help create income. Without a doubt, networking within the home will catch on over the next few years as it has in business. Soon, nearly all individuals in even moderately developed nations will have networked components throughout their homes. Those that don't will be net-logically disadvantaged because they will not be able to learn or to function at the same level as those who are networked. Though computers are capable of carrying out their intended function in a standalone mode, computers will be much stronger if they can exchange information with one another. In past, countless number of business companies had used computer in their daily run. For example, they used computer in accounting to record every transaction of the company made, in trading to record selling and buying information, in personnel management to record every employee's information and etc. However, nowadays the success of the Internet makes people to sense that network is a much more powerful tool for them to enhance their business and make their company running more efficient,

A Local Area Network (LAN) is the networking infrastructure that provides wired and wireless access to network communication services and resources for end users and devices spread over a single floor or building, (CISCO, 2010). According to Teodora (2010), a computer network consists of a collection of computers, printers and other equipment that is connected together so that they can communicate with each other. The globalization of the Internet has occurred faster than anyone could have imagined. The manner in which social, commercial, political, and personal interactions occur is rapidly changing to keep pace with the evolution of the Internet. This expansion has created a wider audience and a larger consumer base for whatever message, product, or service can be delivered. Today millions of individuals are connected to this global network, and the number is growing, (CCNA, 2008). In the present age of information Technology, use of Internet is becoming quite popular for accessing information on any topic of your interest. It also provides tremendous opportunities to students, researchers and professionals for getting information on matters related to academic and professional topics and lot more. In the present world, most of the people who have computers around themselves use Internet to access information from the World Wide Web, exchange messages & documents and e-services.

According to Brendan (2001), in recent years there has been a significant move towards using computers as entrances to the vast world of the Internet. A day hasn't gone by without some public discussion of the Internet and its user-friendly offshoot - the World Wide Web (WWW). Millions of computer users around the world now have access to and frequently use the applications provided by the Internet and the WWW. Terms such as WWW, E-Mail, Search Engine, Home Page, ISP, Intranet and URL have come into common usage. This was not always the case; the Internet originally was a collection of loosely coupled computer networks (a collection of connected computers) spread around the world that mainly used the UNIX operating system. This meant that users of the fledgling Internet needed to have some UNIX command knowledge to be able to use the Internet. The great majority of computer users who were familiar with MSDOS/Windows and Macintosh based PCs were therefore not able to easily access the Internet. The Internet for a while remained largely a domain of the "computer nerd".

The Internet is similar in some ways to the global telephone system: Each allows the establishment almost instantly of 2- way connections between sites anywhere in the world. However, unlike a telephone conversation, the Internet allows us to communicate in a variety of ways. Most importantly, we are not limited to verbal interactions with other people in many cases, it is possible to gain access to information stored in their computers. The basic facilities available over the Internet are described below and include e-mail, list servers, USNET/newsgroups, File Transfer Protocol, Internet Relay Chat, Gopher facility, and the WWW, (Richard C, 2013).According to Wikipedia online (2019), Gwagwalada is one of the six local government area councils of the Federal Capital Territory of Nigeria, together with Abaji, Kuje, Bwari, and Kwali; and the Abuja Municipal Area Council (AMAC). Gwagwalada is also the name of the main town in the Local Government Area, which has an area of 1,043 km^2 and a population of 157,770 at the 2006 census. Gwagwalada Area Council is administered by an Executive Chairman elected through adult

suffrage. The Council is composed of 10 elected councilors representing the ten wards of the council, namely: Zuba, Ibwa, Dobi Kutunku, Tunga Maje, Gwako, Paikon kore, Ikwa, Quarters and Central. The postal code of the area is 902101.

The researcher is keen to use Gwagwalada Area Council (GAC) as the case study because of the fast growth of the area. Having known all these about Gwagwalada, it will be sad to note that the organization does not have an efficient and effective network deployment to handle its day to day activities hereby incurring huge cost. The researcher found it wordy to conceptually deploy a network that can be used to share files and organizational program. Employees can communicate with one another through shared network. Besides, some expensive hardware such as color printer can be shared by a lot of employees. Finally, employees can use the network to search information.

1.2 Statement of the Problem

In GAC, the mode of documentation is usually a manual form, which is a vulnerability to the security of confidential data such as employee, citizens and political data. The method of printing and access to information is ambiguous; sometimes an employee will have to leave his/her office to another office just to have a printout which can be easily gotten by sharing resources through network. Citizens who come for a requirement or document will have to wait for days and weeks to pass before it could be completely process due to the manual way of retrieving documents which does not allow professionalism and encourages touting. These irregularities have made the assessing of important information such as ongoing projects, local government staff record and allocations to be difficult. In addition, to other problems are the issues of documentation, the retrieval of records for official use. The problem of having a lot of customers/Citizens and not been able to provide a satisfactory service is also troubling. Not forgetting the fact that the location of the organization in Abuja which is a fast rising settlement has made this organization not to be able to accommodate all of the demands from its customers and citizens as a result of the existing system that is manually operated. But by deployment of a networking system, the organization can effectively reduce daily running cost, the organization internal works can be more systematic and well organized, and the communication of the employees in the organization will become more efficient. The network will be used to share files and organizational program.

1.3 Research Motivation

Firstly, there is a dearth in the use of Local Area Network for sharing of peripherals and services in Gwagwalada Area council, secondly, there is ambivalence as to whether Local Area Network can be deployed in the organization and thirdly, there is a need to deploy a workable Network for Gwagwalada Area Council.

1.4 Aim and Objectives

Aim

The main aim of this research is to deploy a Local Area Network system for Gwagwalada Area Council.

Objectives

The objectives of this research work are listed below:

1. To review existing systems to find out what is needed for the network system, to determine the functional requirements for the Network system to be deployed and to determine the best topology to be used in framing the Local Area Network design.
2. To design the network system for Gwagwalada Area Council.
3. To implement the Local area network using Cisco packet Tracer.
4. To enable sharing of resources in the organization by creating a Domain, to secure confidential data of the organization by creating a firewall and to share and store files by deploying a File Transfer Protocol server.

1.5 Purpose of the Study

The purpose of this research is to study the vulnerability of an organization network system and build a Local Area Network that would be capable of providing network resources and services (as well as Internet connections if the need be by the organization) to local users and a limited access of network service to public users for Business activities. Through this networking system, the organization can effectively reduce daily running cost, the organization internal works can be more systematic and well organized, and the communication of the employees in the organization can become more efficiently. The network can be used to share files and organization program. Employees can communicate with one another through shared network. Besides, some expensive hardware such as color printer can be shared by a lot of employees. Finally, employees can use the network to search information.

1.6 Significance of the Study

The significance of the study is drawn from two stand points: Academic and practical view.
In the academic arena, this study will prove to be significant in the following ways:

i. The study will serve as a body of knowledge to be referred to by future and present researchers.
ii. It will contribute to the enrichment of the literature to identify and review related network assets, the security, challenges and ways of deployment.

In the Practical Arena, the significance of a research of this type can hardly be faulted. There is need to carry out the research on Local area network for information storage and retrieval for efficient and effective flow of work in Gwagwalada Area Council. This research will enable citizens and staff share resources over the network rather than the manual form based on pen and paper approach. There is need to provide domain to help executive management make decisions. This local area network will assist the organization in automating manual tasks. Automation can save time, money and resources and enhance organizational workflow. The Domain of this Network system cannot be compared with traditional networks; this system can be accessible anytime via any PC or mobile Device with wired or wireless connection.

2. REVIEW OF RELATED WORKS

Joysankar (2016) designed a secured private area network for computing in the University Campus which consists of various network components that includes cisco routers for routing and control of the network, layer 3 switches, Firewall and different nodes connected to the network. This researcher found out that Joysankar did not implement his design by deploying a Domain name system server to control the network environment and also the network has no file transfer protocol which would enable file storage and retrieval and file sharing services. The network has also not been implemented with a simple mail transfer protocol to effectively manage communication with the firm. However all the requirement above will be met in my design and also be deployed for Gwagwalada area council in other to have a well and reliable network system.

Mohammed, Lutfer and Syed (2013) in their research on network Architecture and security issues in campus network discussed about the vulnerabilities for end user computers to be virus, worms and Trojan horse attacks and important means of mitigating these attacks is by using antivirus system installed on all clients on the network. This is a very huge task because not all system/client on the network will have antivirus installed on it. The researchers did not deploy a domain name system server to control services on the network. Therefore this researcher has identified the need for the network to be deployed with a domain name system server which will have full patch of antivirus that will service all requests of services to clients on the network and to protect against these forms of attacks from virus, worms and Trojan horse through buffer overflow on the network.

Mardav (2006) designed a local area network for campus layout using two different cabling techniques. In the design, the researcher compared the cost of one to the other and found out that Unshielded twisted pair cable network is more expensive to implement than thin coaxial cable network. This research will make use of unshielded twisted pair cable for Gwagwalada area council irrespective of the cost because of the reliance on the network which has a dedicated connection with the hub. However in coaxial cable network, if a cable segment of any daisy chain connected host is damaged, then the entire department's network will be lost hereby stopping the flow of work in Gwagwalada Area Council. Further to the use of unshielded twisted pair in this research is that the user will also get more bandwidth and thus higher performance than the Coaxial cable.

2.1 Network Models

Callum (2015) description of Network models are itemized below

2.1.1 Open Systems Interconnection (OSI) Model

OSI stands for open systems interconnection model and is used by developers for discussing about how messages should be transmitted between certain points in any telecommunication network.

1. **Layer 1 -** Layer 1 is the physical layer. This layer involves movement of data through a network. This layer also allows hardware to send and receive data over a carrier network.
2. **Layer 2 –** Layer 2 is known as the data-link layer. The role of this layer is to create links across a network; this is done by gathering information and transferring data in the forms of frames.
3. **Layer 3 –** Layer 3 is known as the network layer and is used for creating the address and the route of the data, this therefore ensures that the information gets to the right place. An example of this layer in use would be IP addresses, which is the network layer for the internet.
4. **Layer 4** – Layer 4 is known as the transport layer and is used for managing the packages of data and the delivery of these packets to the correct location. This also includes the check for errors which could occur in the data once it has been delivered.
5. **Layer 5** – This layer is known as the session layer, the role of this layer is to handle conversations, and this involves the set and ending of conversations. This includes connecting and the reconnection once after an interruption.
6. **Layer 6 –** Layer 6 is known as the presentation layer and is normally part of the operating systems (Windows, Linux etc.). The role of this layer is to convert incoming and outgoing data on the network into a readable presentation format.
7. **Layer 7 –** This layer is known as the application layer and is the final layer in the model. The role of this layer is to identify partners and this therefore allows data send to be opened and therefore shown.

2.2.Transmission Control Protocol/Internet Protocol

TCP/IP stands for the transmission control protocol/internet protocols. They are a complete suite of protocols which are used on the internet to connect hosts on the World Wide Web. TCP/IP is built into the operating systems used today making it the standard for the transmission of data over networks. Network operating systems also have their own protocols; an example of this would be NetWare etc. however these also support TCP/IP. This model and other related and similar protocol models are maintained by the internet engineering task force. These models provides end to end connectivity which shows how data over a network should be packetized, addressed, transmitted and routed in order for the data to be received at its final destination. The top layer of this model is the application layer, this layer defines TCP/IP protocols and how programs are hosted within a network, and an example of this would be the domain naming system (DNS). The third layer of this model is the transport layer, the purpose of the layer is to allow devices to connect and host a conversation through the transportation of data. The second layer is the internet layer, the purpose of this is layer is the pack data into IP datagrams which allows them to forward between and across networks.

The next layer of the model is the network access layer, this is the first layer and defines the details of how data is sent through the network, an example of this would be how bits of data are sent etc. It also deals directly with hardware devices such as optical fiber wires etc.

2.3 Comparison of Models

Both of the models above have similarities and differences which make them unique and better for certain purposes. One of the similarities would be that they are similar in the way they are built, this is because both of the models are constructed with the use of layers, and both contain an application layer, this layer has the same task on each model, however each model uses different services depending on which model is used. Both models also have similar transport and network layers; this means that functions performed between these layers on each of the models will have a similar effect and outcome. A final similarity of the two models is that they both assume that the packets of data will be switched, meaning that individual packets of information which are sent over the network may take slightly different paths so they can reach the same destination.

One of the main differences between the two models is way in which both are built; the OSI model consists of 7 layers, whilst the TCP/IP only consists of 4 layers. This is because the TCP/IP model combines both the presentation and the session layers (which can be seen on the OSI model) into the application layer therefore making it shorter (this model also does the same for the data link and physical layers, which are both added into the network access layer.), because of this the TCP/IP model seems the less complex of the models due to the fact that it has three fewer layers. One of the major differences between the two models is that TCP/IP is the more credible of the two models, this is because this models and its protocols are the standard to which the World Wide Web was built, which therefore gives it creditability, this is a contrast to the OSI model, this is because this model only exists as a guidance tool to which models can be built around.

3. RESEARCH METHODOLOGY

In deployment of Local area network for Gwagwalada area council, a thorough study was made of the existing system. This study was carried out using various forms of information gathering techniques. In the analysis of the existing system the areas considered include how the present system operates, the information that goes in, how these information are processed and the expected output. Since the new network to be designed needs to be taken into consideration like every other Network, it is mandatory that the network protocol become more user-friendly so as to enable administrators and staff of GAC process their daily activities using the secured Local Area Network.

3.1 Activities of Gwagwalada Area Council

The activities of Gwagwalada area council includes works, constructions, administrative, community services, issuance of indigene and residential certificate, issuance of Burial warrants, health services, Agricultural services, educational services, financial services, environmental services and Audit services. Etc. The figure below shows the organizational chart of Gwagwalada Area Council.

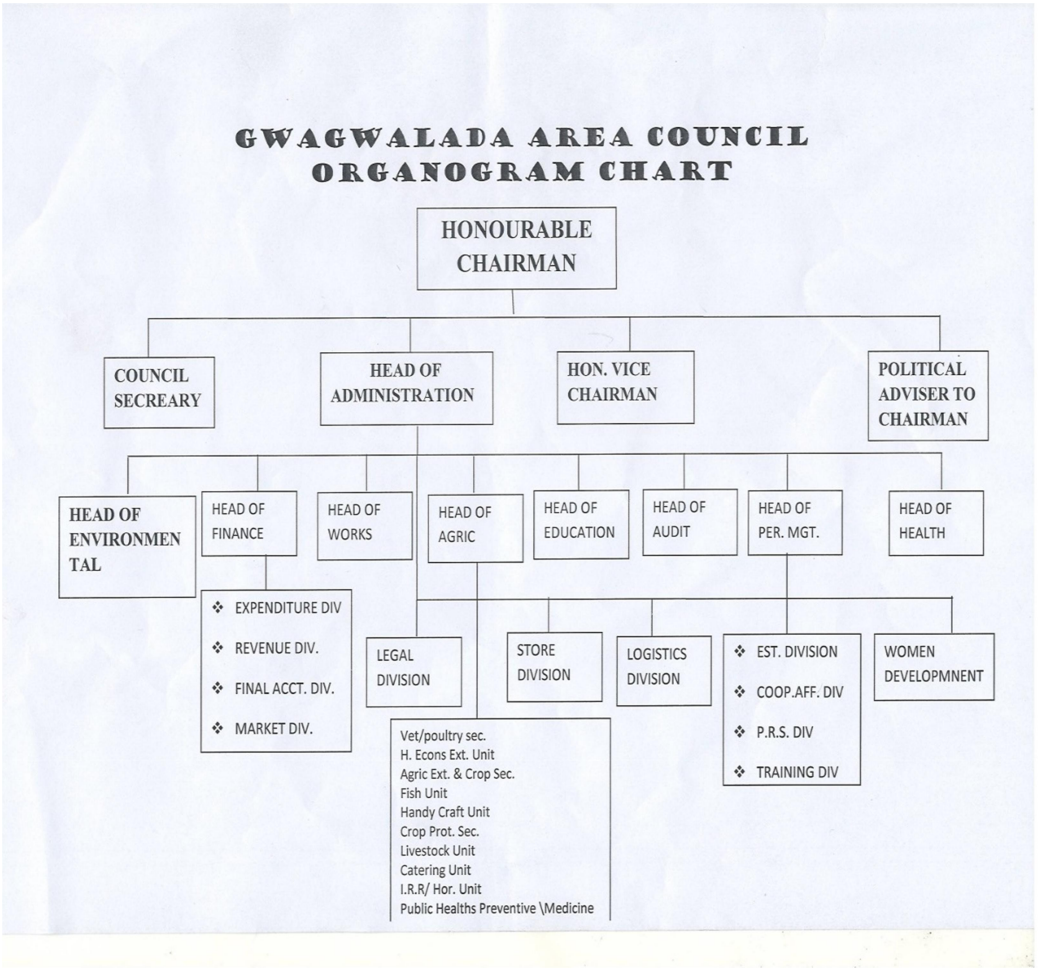
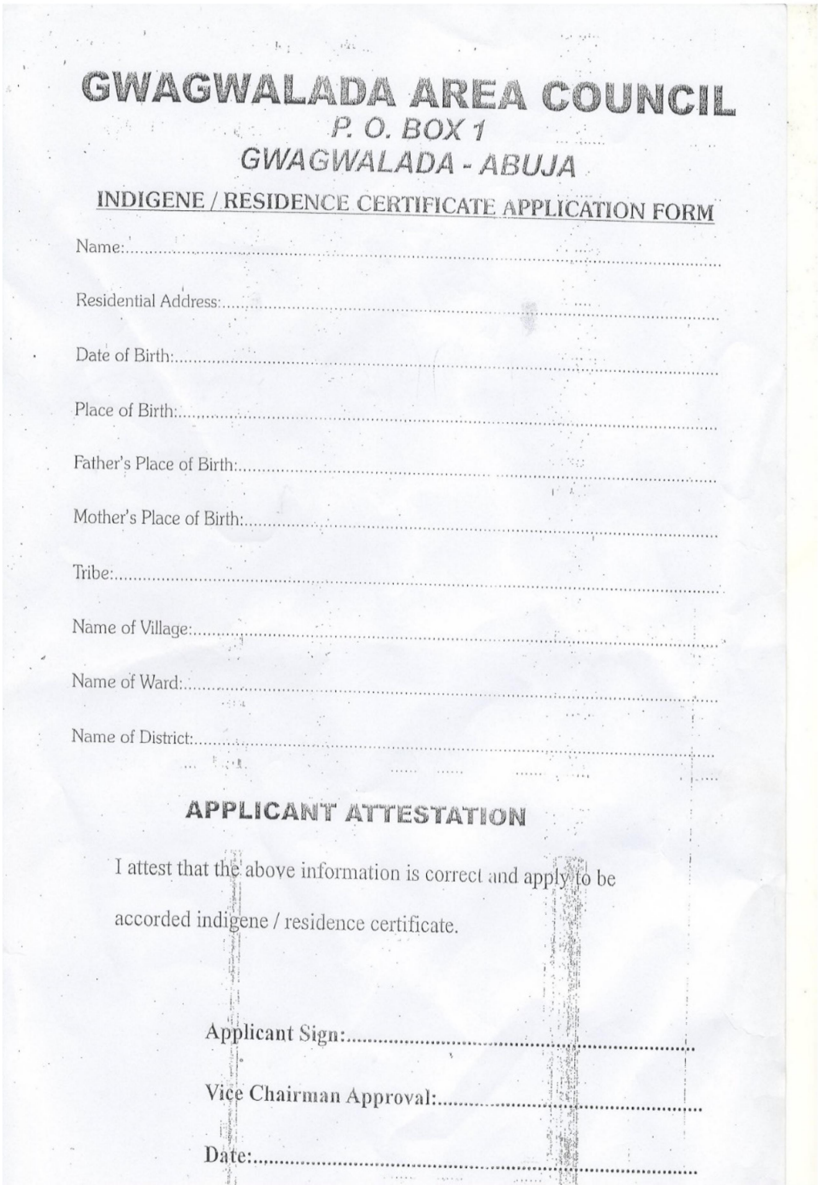


Figure 3.1: Organogram of Gwagwalada Area Council

Investopedia, 2019 "An organizational chart is a diagram that visually conveys a company's internal structure, by detailing the roles, responsibilities, and relationships between individuals within an entity. Organizational charts either broadly depict an enterprise company-wide or drill down to a specific department or unit.''The internal structure Gwagwalada Area council is depicted in the figure above. The Honourable Chairman is the head of the organization, directly followed by the council secretary, head of Administration, Honourable Vice Chairman and Political adviser to the Honourable chairman. The head of administration is fully in charge of the activities of the Area council which the various departmental heads and all the staff of Gwagwalada area council are under. The departmental heads includes; Head of Environment, head of works, Head of Agriculture, Head of Education, Head of Audit, head of personnel management and head of Health. These department have several division and units they control which includes expenditure division, revenue division, final account division, market division, legal division, store division, logistics division, establishment division, cooperate affairs division, planning research and statistics division, training division, women development division. These divisions have several units which includes vet/poultry unit, Head of economy extension unit, agriculture and crop unit, fish unit, handy craft unit, livestock unit, catering unit and public health preventive/ medicine unit.

3.2 Input Analysis of the Existing System

The input analysis shall show the activities that are concerned with collecting information in the organization; this manual process is done using a pen or paper which has affected the flow and documentation of community data. In this analysis, the samples of the forms used in collecting the data of citizens of the community shall be displayed. The forms shall help to elaborate the many activities that are carried out within the organization. More so, this form of qualitative method of research methodology is adopted due to it feasibility in making the research exercise an efficient one. Since, the manual process is associated with error; a detailed explanation shall be needed to explain the various stages. This is shown in Fig 3.2 below.



GWAGWALADA AREA COUNCIL
P. O. BOX 1
GWAGWALADA - ABUJA

INDIGENE / RESIDENCE CERTIFICATE APPLICATION FORM

Name:.....

Residential Address:.....

Date of Birth:.....

Place of Birth:.....

Father's Place of Birth:.....

Mother's Place of Birth:.....

Tribe:.....

Name of Village:.....

Name of Ward:.....

Name of District:.....

APPLICANT ATTESTATION

I attest that the above information is correct and apply to be accorded indigene / residence certificate.

Applicant Sign:.....

Vice Chairman Approval:.....

Date:.....

Figure 3.2. Indigene / Residence Certificate Form

This form sample is used to collect information from the user environment for the benefit of the organization to record the information of citizen seeking residence/ indigene certificate. Using this medium the residence/ indigene certificate is made available for the proposed citizen. In this input form, the Name and other personal details of the citizen is collected. The provision for the date of birth, place of birth, tribe, Name and residential address is always mandatory since the organization uses it to get certain information from the citizens that will enable the organization to keep stuck on citizen for documentation purpose. Meanwhile, it is optional that the citizen indicates the mother's place of birth because children inherit father's origin.

3.3 Process Analysis of the Existing System

The process analysis is that stage that initiates the output analysis; this is done after the input analysis has been carried out manually. This process analysis involves the exchange of files of completed forms from the citizens to the personnel in charge. Once, this is completed the input analysis is dimmed successful. This form of process has been hugely affected by the manual form of processing which is planned to be converted to a computerized networking process.

The forms collected can be scanned and forwarded to the various departments in charge for further processing using a shared local area network; with this the confidential document can only be accessed by only the authorized departments. This process will ensure the confidentiality of information to be processed into data before go issuing to citizens boycott the process of carrying files from now office to the other which will in turn bring about a fast organized way of processing.

3.4 Output Analysis of the Existing System

The output analysis is carried after the successful completion of both the input analysis and the process analysis. In this analysis, the research considers the time of completion of the forms, the convenience in filling the form, the series of irrelevant questions that are not rewarding, the effectiveness of the manual process, the efficiency of the paper form in attending to a large number of citizens at once, the process of taking completed forms and opening files for them. Now, the researcher finds this aspect to be very demanding and thus, concentrated on this features in order to provide an effective Local area network system to deal with the manual process on timely bases.

3.5 Design Consideration

Project design gives insight of the architecture to be implemented, it is elaborated in the follow categories;

3.5.1 Topology Design

The project topology shown in figure 3.3 below is designed by considering the characteristics and features of an Organization. The topology is assumed to have three departments with the possible future expansion and planned to offer flexible, reliable, secure and fast network services. It is designed to have one gateway two servers, one access point for wireless device to connect, one firewall, three Hubs, workstations and printers where employees are located. The topology adopted is a tree topology which allows users to create networks using Hubs. Message from any site can be received by all other sites, until it reaches an end point. End point controller absorbs a message if it reaches end point controller without being accepted by a host.

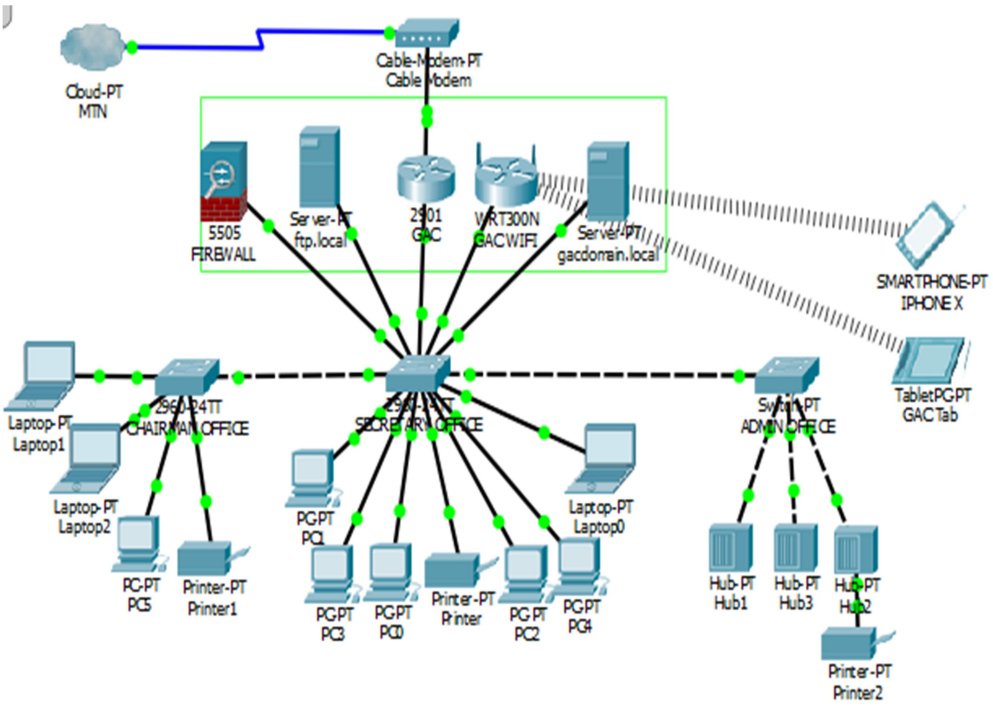


Figure 3.3 Network Design and Topology

3.5.2 Input Analysis of the New System

The input analysis shall show the activities that are concerned with collecting information in the new system for the organization; this process is done using a computer network through a computer and file server this will make the flow of work and documentation of community data easier and faster. In this analysis, the samples of the forms used in collecting the data of citizens of the community shall be uploaded to the file server by an account that has administrator privileges. This forms are saved with security features which makes the document confidential from unauthorized users. Only user with account that has privilege will be able to access the file from the server when uploaded. The inputted form is free from virus and unsolicited request by hackers and users.

3.5.3 Process Analysis of the New System

The process analysis is that stage that initiates the output analysis; this is done after the input analysis has been carried out by a computer system. This process analysis involves retrieving the file/form from the file server to the computer system of personnel in charge instead of exchange of files of completed forms manually from the citizens to the personnel in charge. Upon file requested from the server, the server prompt for username and password of the user. The user will have to enter the details as requested by the server for authorization purpose. The form/ file is listed in the directory list. The user selects the appropriate file needed. Once, the form is completed using computer system, the input analysis is dimmed successful. The forms collected can be scanned, uploaded and forwarded to the various departments in charge for further processing using a shared local area network; with this the confidential document can only be accessed by only the authorized departments. This process will ensure the confidentiality of information to be processed into data. This process will boycott the aspect of carrying files from now office to the other which will in turn bring about a fast and organized way of processing.

3.5.4 Output Analysis of the New System

The output analysis is carried after the successful completion of both the input analysis and the process analysis. In this analysis, the processed form which turned out to be a certificate on the server through processing will be printed, released or sent by mail to the personnel who will finally issue the certificate to the citizens and by this it has eradicated the wastage of time used in the completion of the forms, the convenience in filling the form, the series of irrelevant questions that are not rewarding, the effectiveness of the manual process, the efficiency of the paper form in attending to a large number of citizens at once and the process of taking completed forms and opening files for them. Now, the researcher finds this aspect to be very demanding and thus, concentrated on this features in order to provide an effective Local area network system.

3.5.5 Simulations

Simulation using Cisco packet tracer was adopted to carry out the implementation of the local area network for Gwagwalada area council. The Cisco packet tracer as the tool helps to show the behaviour of the network the same way it will work in real time. Furthermore to the methodology used in this research is a qualitative approach, which involves firstly;

Direct observation: the researcher studied staff and citizens as they go about their daily activities without participating or interfering. This type of research is often unknown to citizens and staff, and as such, was conducted in public settings where citizens and staff did not have a reasonable expectation of privacy. Secondly;

In-depth interviews: this was carried out by speaking with some staff of the organization in a one-on-one setting. Sometimes the researcher approaches the interview with a predetermined list of questions or topics for discussion but allows the conversation to evolve based on how the staff responds. Other times, the researcher has identified certain topics of interest but does not have a formal guide for the conversation, but allows the interviewee to guide it.

3.5.6 Method of data collection

The method of data collection technique that is employed in this academic research is a qualitative one. In this technique, the observation and the interview form of data collection was used to collect data from the environment. In this style, the researcher was able to talk to certain people within the working environs; these include the data entry staff, the admin and other related offices that aided the successful completion of this exercise. This form of data collection enables researchers to have a face to face interaction, thereby providing the opportunity for the researcher to evaluate the interviewee. More so, is the opportunity for observation; in this exercise the researcher have the opportunity to evaluate the circumstances surrounding the working environment.

4. IMPLEMENTATION AND EVALUATION

4.1 Network Requirements

Client PC Requirements (Desktop workstations on the LAN)

- Processor - 1.4GHz or higher processor recommended; 1GHz minimum required
- Intel i5™ family processor recommended.
- RAM - 2GB or more of RAM is recommended; 1GB minimum required.
- Hard Drive – 500 Megabytes of available space required.
- A normal client's hard drive size ranges from ~100 to 500 Gigabytes depending on the storage need of the user.
- Monitor and Video Card - Super VGA (1024 × 768) or higher-resolution capable.
- A secondary monitor is recommended for the primary scheduling workstation.

- Keyboard and mouse – Be sure to include these peripheral devices when ordering a new computer.
- NIC (Network Interface Card a.k.a. Ethernet Card) – Minimum data transmission speed of 100Mbps.
- Operating System – Advanced local area network works best on the newest computers running Windows 10 (64 bit)*, Windows 7 (64 bit), or Windows 8.1 Pro. Windows 8 Pro and Windows 7 (32 bit) work but are not recommended.
- Please contact your IT professional to ensure your Windows 10 machine has information sharing restricted to protect against unwanted upload.
- Windows 8 RT, Windows 'Home' and Windows 'Basic' type operating systems are not supported
- LAN Requires Microsoft .NET 4.5 or greater
- Document Scanner (for patient charting) – A TWAIN compliant scanner, connected directly to the client PC is required for most clerical workstations. Scanning over remote desktop is possible by sharing the workstation's "scans" folder or by purchasing Remote-Scan software. Network scanners are not supported are also Support and must be configured and maintained by your IT personnel.
- UPS (Uninterruptible power supply) – Provides continuous power to devices (computer) during brief power outages. This device replaces surge protectors.
- PC Peripheral Devices :–
- Camera - USB-based digital still shot camera recommended (patient charting)
- Video - USB-based digital video camera recommended (patient charting)
- Printer - Colour printer, Black and white Printer

Note: For businesses that only use a single computer, the LAN Server can adhere to the Client PC Requirements recommendations.

Server Requirements

- Processor – 2.0 GHz or higher processor minimum required
- Intel i7, Xeon Nehalem or newer family of processors are recommended
- RAM - 4GB or more of RAM is recommended; 2GB minimum required
- Servers using terminal services for remote desktop should increase RAM by 256MB per remote desktop user.
- Typical minimum server configuration contains two (2) hard drives of 250 GB each minimum.
- Monitor and Video Card (optional for console usage) - Super VGA (1024 × 768) or higher-resolution capable
- Keyboard and mouse or compatible pointing device
- Backup Device – An external hard drive is a common form of backup for some facilities due to its portability and security possibilities.
- Web based data backup solutions are available. Products such as Carbonite, Google Drive or Dell Data Safe Online work well and are significantly cheaper than re-entering your data!
- NIC (Network Interface Card) – 1BGb recommended. 100Mbps transmission speed minimum required.
- Database Server Operating System - Windows Server 2008 R2 or Windows Server 2012 R2.
- Also supported are the first Windows Server 2012 and Server 2008 (first release).
- Small Business Server, Foundation, and Essentials variants can be deemed sufficient upon discussion regarding Remote Desktop Services limitations
- Small office environments of 6 workstations or less can use Windows 7 PRO 64bit, Windows 8 PRO 64bit, or Windows 10 PRO 64bit for the server operating system if there are NO remote facilities requiring access.
- LAN Requires Microsoft .NET4.5 or greater

- Remote Access (Remote Desktop Services) – Remote desktop should be enabled and a port mapped from the router/modem to the server (may use non-default port number if needed). If Remote Desktop cannot be configured, alternate methods such as LogMeIn.com or TeamViewer are possible but not recommended for daily use.
- Remote Desktop Services CALs (Client Access Licenses) – If remote offices plan to use LAN, they will do so via Remote Desktop to the main office's server. Purchase additional Remote Desktop Services CALs as required.
- UPS (Uninterruptible power supply) – Provides continuous power to device (server) during brief power outages. This device replaces surge protectors.
- Workgroup/Domain **-** Windows domain elevated to at least 2003 is preferred; Workgroup environment minimum.
- Users require read/write/modify permissions.

4.2 Standard/Common LAN Requirements

- Network Devices - Gigabit Ethernet (wireless LAN capable if needed) Router (NAT/Firewall capability recommended) and Switch (depending on number of devices);
- IP Addressing - Static IP or Dynamic DNS Service (allows remote access support)
- Statically assign an IP address to the server using Private Addressing and map a port number from the router/modem to the server's IP address.
- Network Media (cabling) - CAT5e rated or higher Ethernet cable (enough for your office)
- UPS (Uninterruptible power supply) – Provides continuous power to device (router/modem/switch) in moments of power outages. This device replaces surge protectors. (see details about backup/power below)
- A list of domains can be provided to allow a bypass, if necessary.
- Remote Facilities
- Remote offices (if applicable) working outside of the main facility's LAN will require Windows Remote Desktop Connection application (available for PC and Mac) to connect to the main office's server.
- This scenario requires a Windows Server operating system listed above in server requirements.
- **Remote Access (Remote Desktop Services) -**Remote desktop should be enabled and a port mapped from the router/modem to the server (may use non-default port number if needed). If Remote Desktop cannot be configured, alternate methods such as LogMeIn.com or TeamViewer are possible but not recommended for daily use.
- **UPS (Uninterruptible power supply)** – Provides continuous power to device (server) during brief power outages. This device replaces surge protectors.
- Standard/Common ISP Requirements
- **Internet Connection** – High speed internet connection (DSL, Cable, or DS1) preferably 3 Mbps download ~300 Kbps Upload speed or higher (for single office environment)
- **IP Addressing** - Static IP or Dynamic DNS Service (allows remote access support).
- **Optional Networking Devices -** Wireless Access Point, Wireless Network Adapters (802.11n preferred; 802.11g minimum).

4.3 Implementation Analysis

Basically a research analysis includes planning, designing and controlling of a network project. This project focus is on building a local area network for Gwagwalada area council and to apply the security measures to ensure the safety of the network resources and services for GAC. The plan of this research is to build a simulation network for Gwagwalada area council using cisco packet tracer, which consists of one Cisco 2901 as a getaway router, one

cisco cloud-PT as Internet cloud, one Cisco cable modem-PT as Cable modem and internet service provider router for internet access, one Cisco 5505 device as firewall, two Cisco server-PT as file transfer protocol server, domain name server and mail server, one Cisco three Cisco 2960-24TT switch as a core switch, three Cisco Hub PT as point of connection for other devices, Printers and workstation (laptops and Desktops).

4.4 Implementation Procedure

The implementation procedure will show the different segment of the Network, the configuration of the router, the configuration of the access point, the configuration of the switches, the configuration of the firewall, the configuration of the file server, the configuration of the domain name server, how the server operates, how packets are transmitted over the network, how mails are configured, how mails are sent, how mails are processed, how mails are received, how cables are used for various devices.

4.4.1 Router Configuration

The figure 4.1a below shows the Cisco Router 2901 interface which consist of the Global, routing, switching and interface. The display name is changed to the name of the specified organization to ensure quick identification on the network.

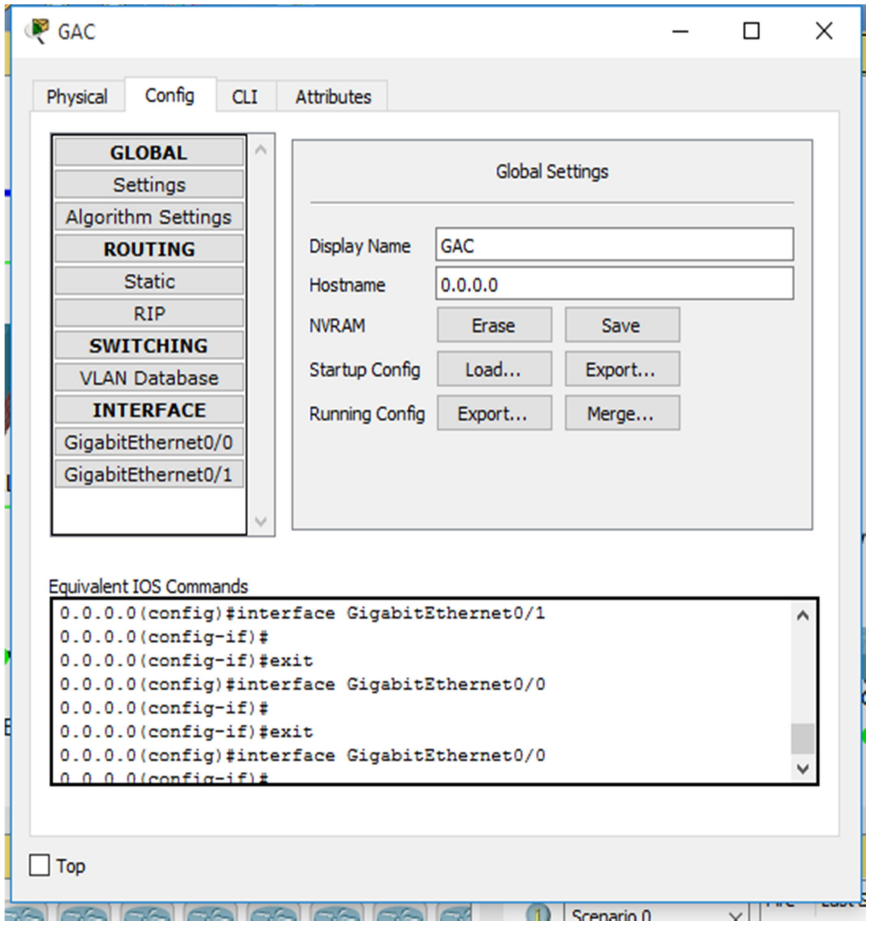


Figure 4.1a Cisco Router 2901 interface

The Gigabitethernet0/0 interface is turned on to allow connection to the device and it is configured to a bandwidth of 1000Mbps for fast Ethernet since it is the main local area network and the gateway for the network. The duplex is set to full duplex in other to allow communication in two ways continually without collision. The Internet Protocol is set to a single VLAN on the network which all other devices will use as the default gateway on the network. The subnet mask is configured to align with the subnet of the class of IP used. The IP must be a private IP since it is used for internal network to avoid IP clashes on the network when connected globally to internet. IP chosen as the default gateway is 192.168.2.1 and the corresponding subnet mast of 255.255.255.0. This can be seen in the figure below.

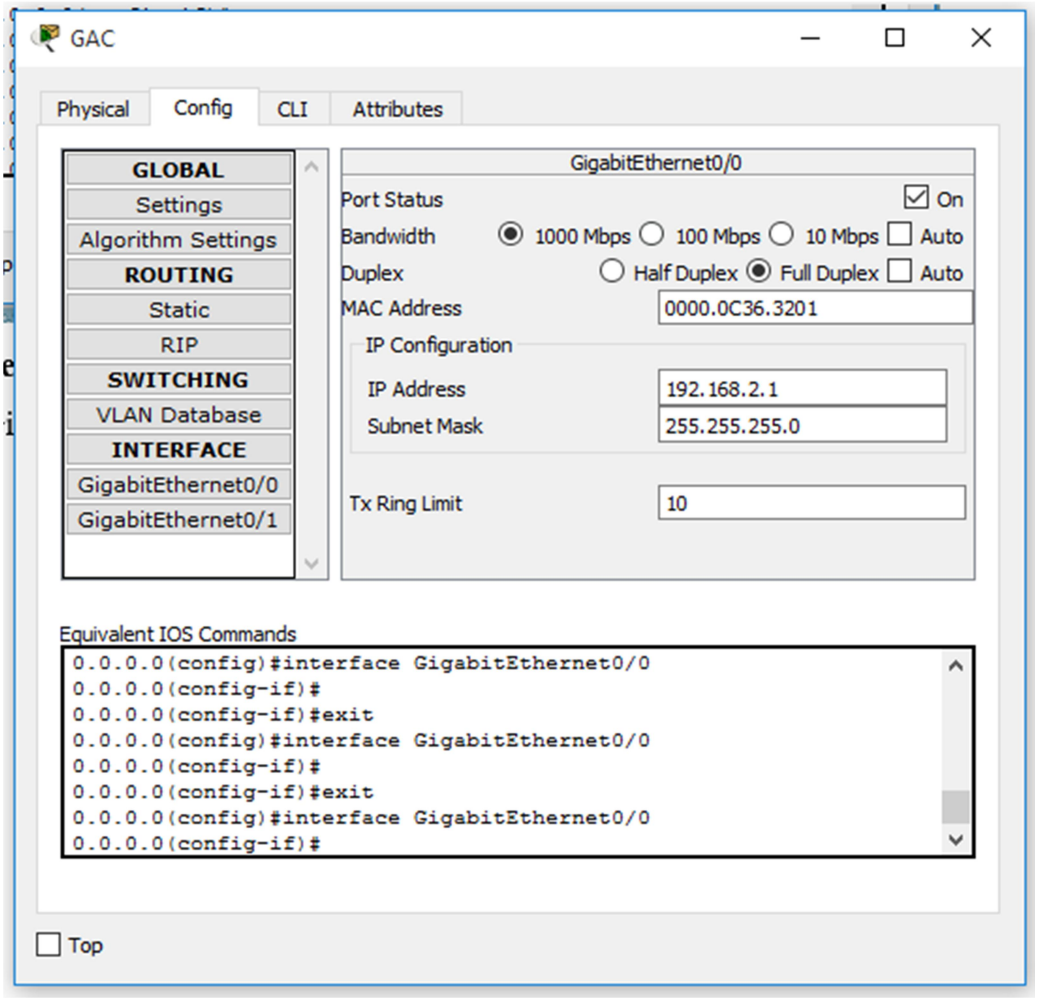


Figure 4.1b Cisco Router 2901 Configuration

4.4.2 Switch Configuration

The below figure shows the interface of Cisco 2960-24TT 24ports switch which serves as the Distribution layer for the network. It consist of Global, switching and interface. The Global settings display name is change to be more specific to the organization, the name has been changed to Secretary Office while the hostname has been assigned an Internet Protocol which correlates with the VLAN of the router. The IP of the switch has now been inputted to be 192.168.2.5. This can be see below in the figure 4.2a.

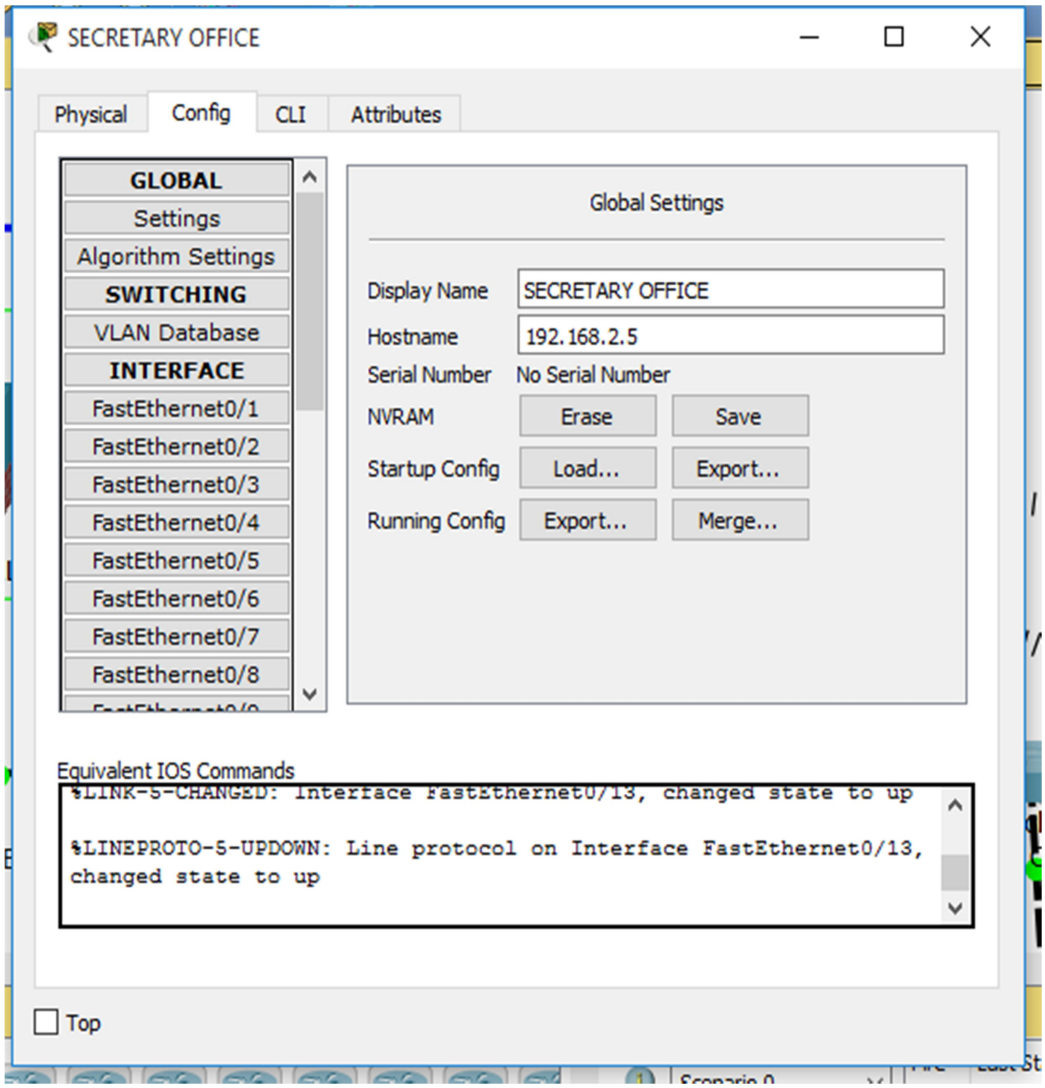


Figure 4.2a Cisco 2960-24TT Switch Interface

All 24 ports Fast Ethernet interface ports are turned on to allow connection from other devices. Bandwidth is set to 100Mbps and duplex set to Full duplex to allow two way communication of devices which will not delay packets transmitted over the network. This process is repeated for all ports on the switch. This can be seen in the figure 4.2b below.

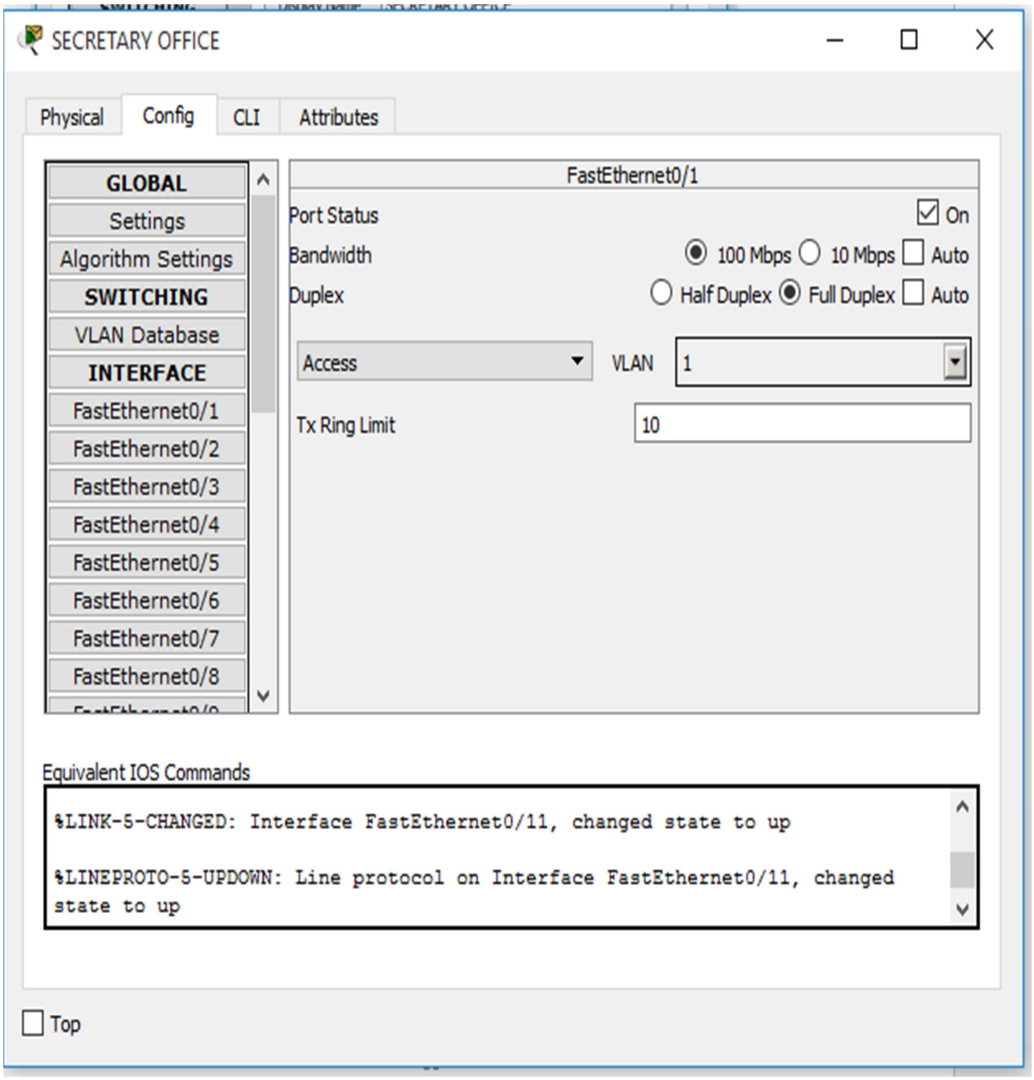


Figure 4.2b Cisco 2960-24TT Switch configuration

4.4.3 Domain Name System Server Configuration

Domain name system server provides numerous services for the Local area network. It manages a massive database that maps domain names to IP addresses on the network. A local Domain name system server that is configured makes Gwagwalada Area Council Network act like any other Domain Name system for example Gmail.com. This Domain helps to assign IP automatically to devices configured to use Dynamic host configuration protocol to access the network. The Domain is also configure to route traffic through the default gateway of the network which is the main router IP. It also serves as Mail server for Gwagwalada Area council. This server provides hypertext transfer protocol and hypertext transfer protocol secured for workstation to connect to the web pages available on the server. The Configuration tab consist of Global and interface for configuration. The display name is changed to ''gacdomain.local'' and the default gateway is set to the default gateway of the network which 192.168.2.1. The DNS server is the IP of this same device used as the server. IPv6 is not applicable to the network, it is therefore set to auto config. This illustration can be seen in the figure 4.3a below.

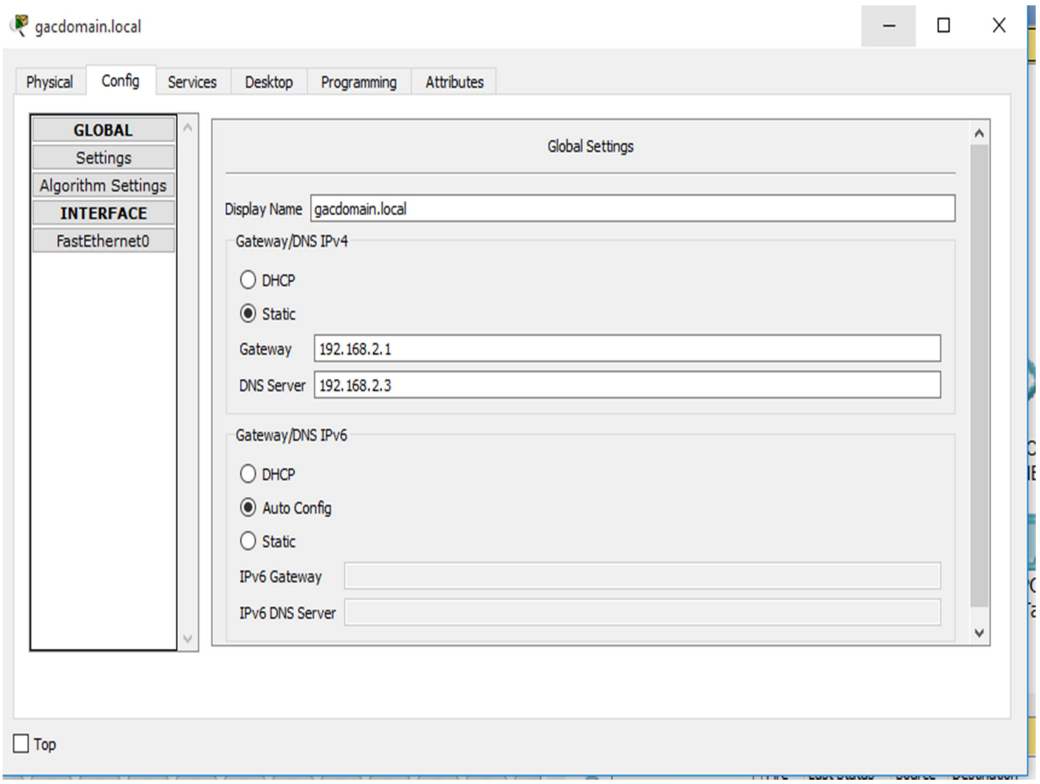


Figure 4.3a Domain Name System Server Interface

Fasthethernet0 port in the interface is turned on to enable connection from the network switch. Bandwidth is set to 100Mbps and Duplex is set to full duplex. A static Internet Protocol of 192.168.2.3 is assigned to the Domain Name System Server that will also be used by devices on the internet as the Domain name system internet Protocol when connecting to the network. The appropriate subnet mask of 255.255.255.0 is set for the server subnet Mask. This can be viewed in the below figure 4.3b

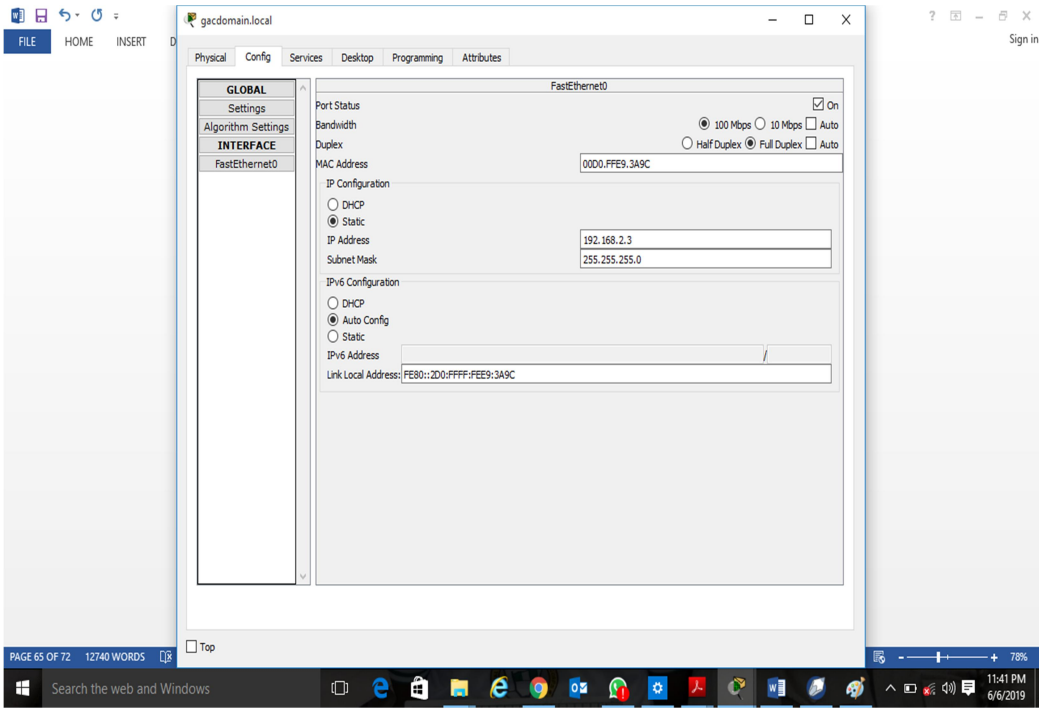


Figure 4.3b Domain Name System Protocol Configuration

Services are configured to keep the Domain Name System server running. These are hypertext transfer protocol and hypertext transfer protocol secured. These services are turned on to allow host connect and communicate with the server using web browser. Important files are uploaded to the server using the import button on the interface. Files uploaded can be edited and saved for the sake of correction and omission of important write-ups. New files can be created on the server with the new file button, after which it will be saved on the server. This illustration can be viewed in the figure 4.3c below.

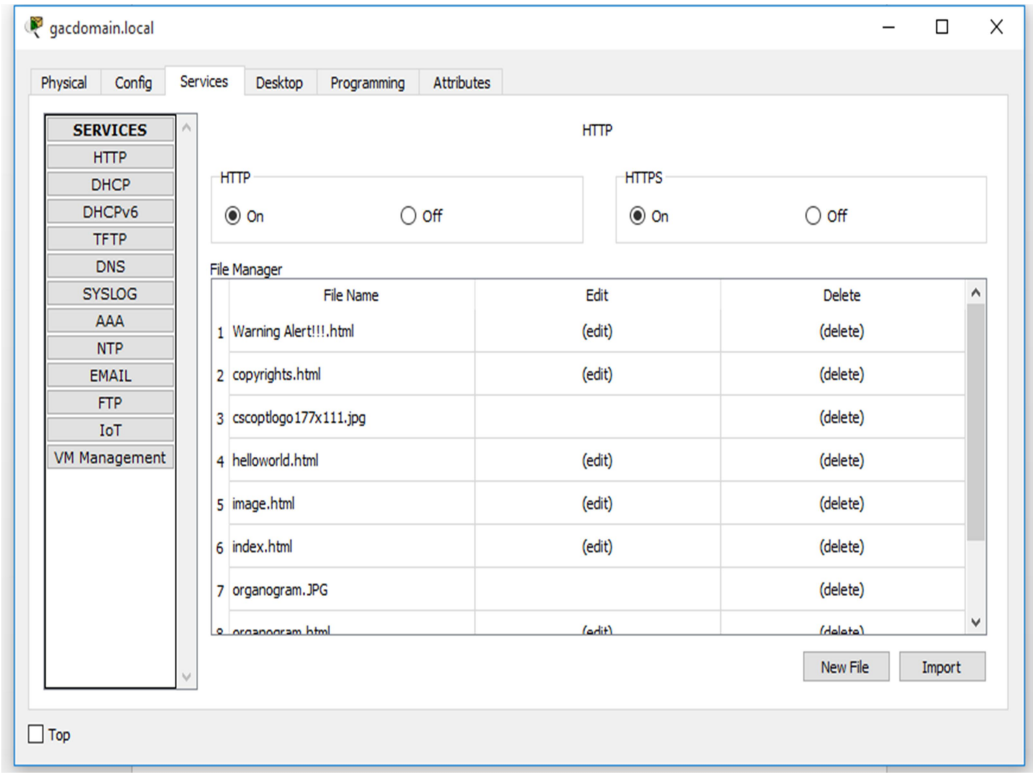


Figure 4.3c Domain Name System HTTP Services

Dynamic host configuration protocol services is configured to enable workstations and nodes with Dynamic host configuration protocol enabled to connect to the network. DHCP server dynamically assigns an IP address and other network configuration parameters to each device on the network so they can communicate with other IP networks. This protocol assigns IP to device automatically within the range it has been set to. The service is turned on and the pool name is set to serverpool. Default gateway of the network and DNS is set to 192.168.2.1 and 192.168.2.3 respectively. The start range is set to notify the server that devices which uses DHCP are to start from a range of 192.168.2.128, therefore the first device with DHCP will automatically get 192.168.2.128 and the server repeats this step for as many devices as possible. This explanation can be seen in the figure 4.3d below.

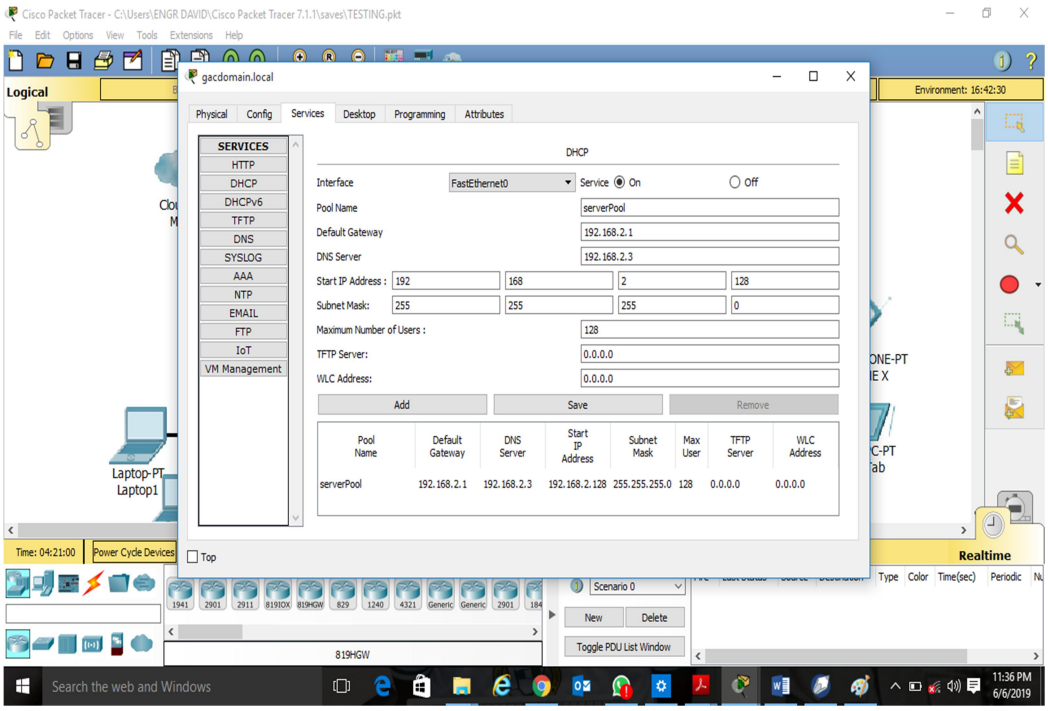


Figure 4.3d Domain Name System DHCP Services

Domain name system service is set to be on to allow the predefined server function for the purpose to which it has been created. The server name is entered which is gacdomain.local while the address is the internet protocol address of the predefined server, 192.168.2.3. In Gwagwalada area council, two servers which are File transfer protocol server and Gacdomain server have been deployed. Each of this servers are added to the domain name system to ensure it is entered in the registry of the domain name system. The second server, ftp is also added with the corresponding address of 192.168.2.2. The figure 4.3d below shows all the illustration above.

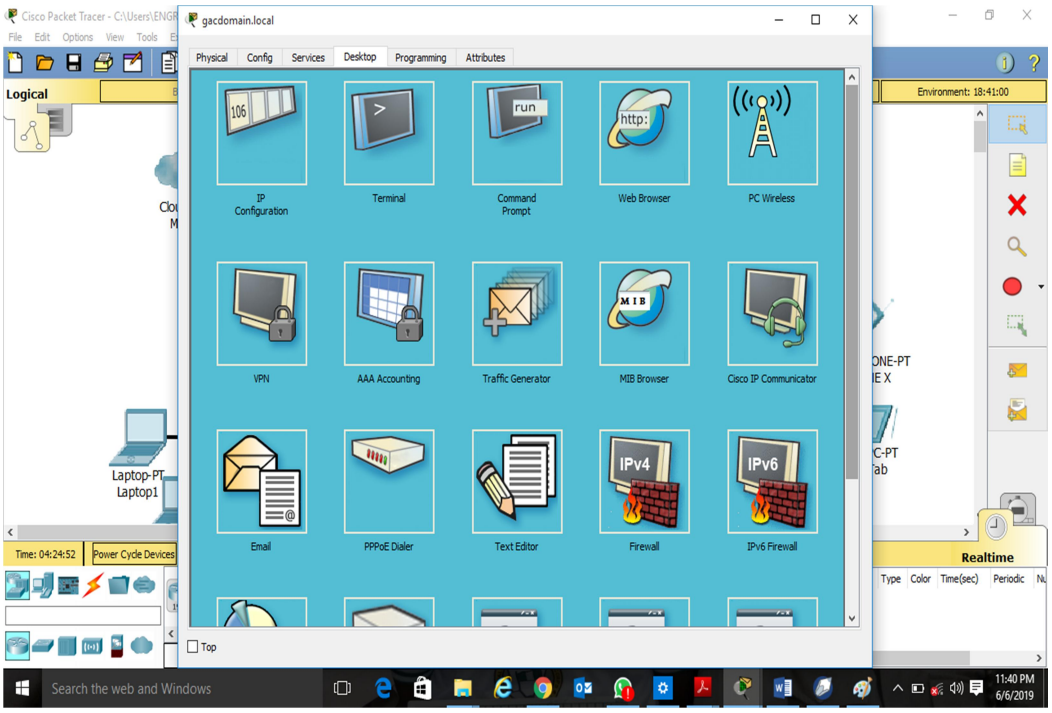


Figure 4.3e Domain Name System Server Desktop Tab

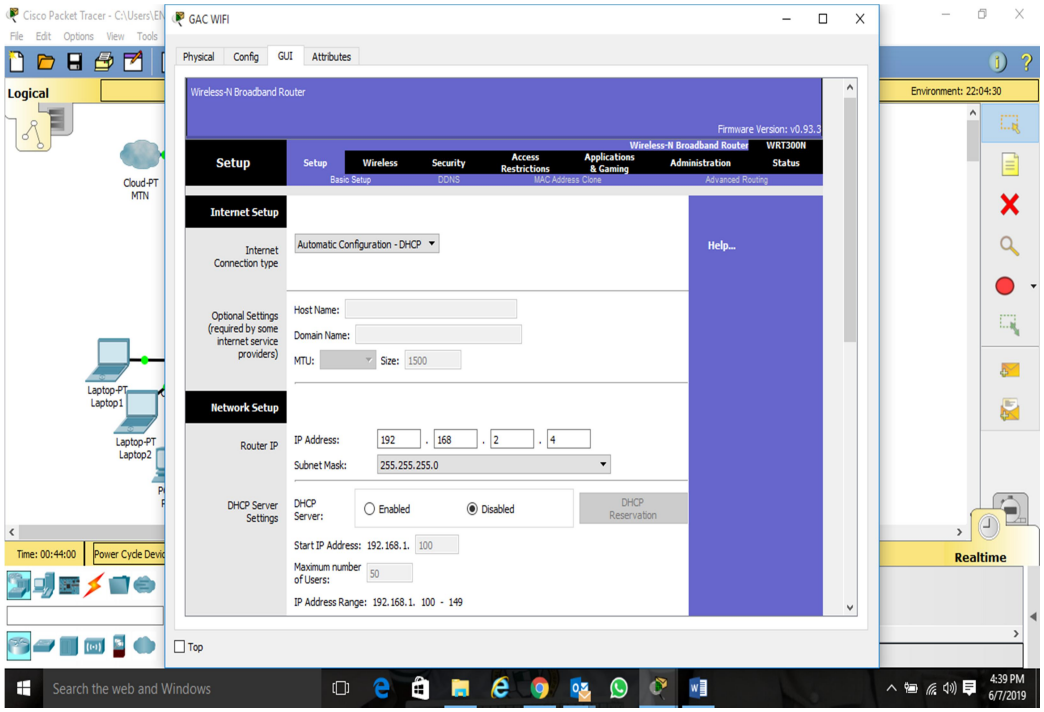


Figure 4.3f Access Point Interface

4.4 Firewall Configuration

Firewall is necessary for setting up rules on the network, which traffic will observe when accessing pages on the web. Firewall is a system that enforces an access control policy between two networks such as your private LAN and the unsafe, public Internet. The firewall determines which inside services can be accessed from the outside, and vice versa. It is thought of as a pair of mechanisms: one to block traffic, and one to permit traffic. A firewall is more than the locked front door to your network. It is the security guard as well of the network in Gwagwalada area council. Webpages not necessary can be blocked using the firewall just to disallow clients on the network from accessing unwanted site. The firewall rule is set by the administrator of the network. In the figure 4.6a below the firewall is configured to use Firewall as Display name and security as Host name.

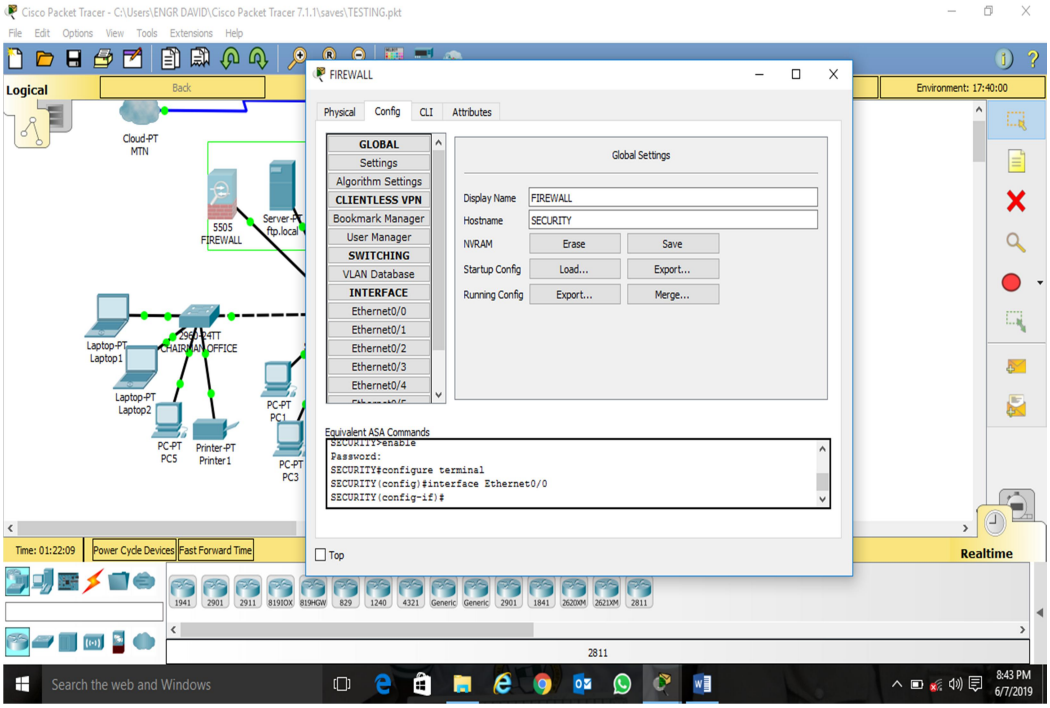


Figure 4.a: Firewall Interface

Hub Configuration

Hub is set to automatically connect to the switch using half duplex and 100Mbps for its bandwidth. Figure 4.5 below shows the interface of a hub. End devices also connect to the hub automatically.

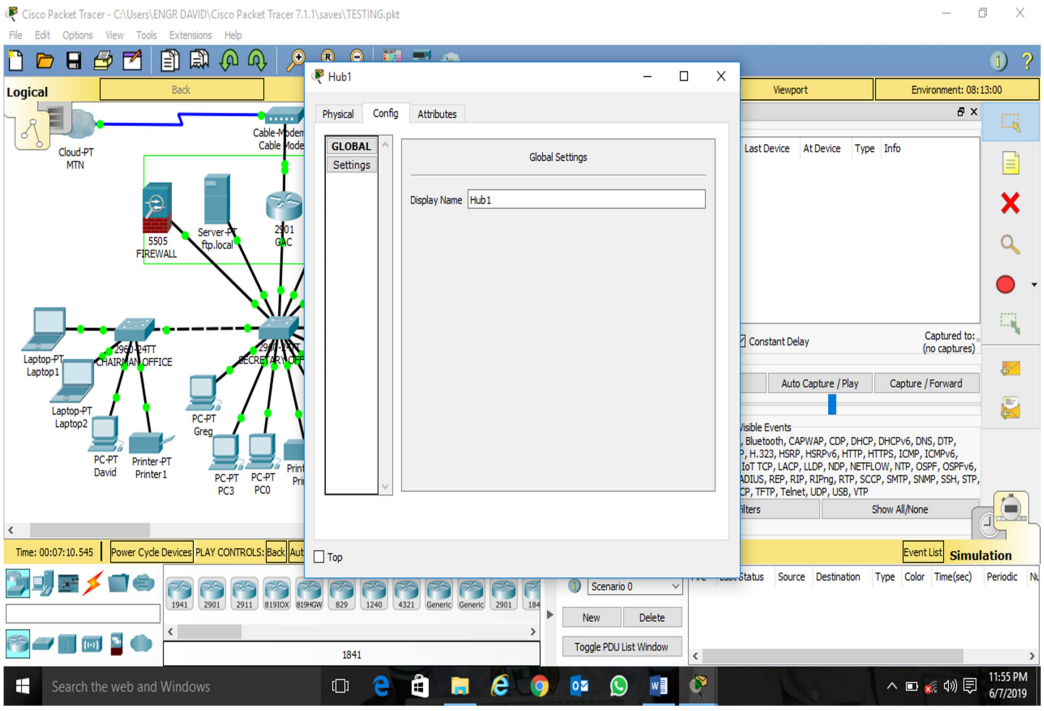


Figure 4.4b Hub configuration

Workstation (Laptops and Desktops) Configuration

Workstations are configured to have network access using Internet Protocol, subnet mask and default gateway. Administrator sets internet protocol as static for Desktop computer while laptops are allow to be assigned an Internet protocol by the Domain name system server. The IP assigned by the Domain name system server is picked from the range configured on the server which is 192.168.2.128 - 192.168.2.254. Devices on dynamic host configuration protocol will have IP in that range. Upon connecting to the internet, an IP is assigned. Laptops are generally and preferably set to use Dynamic host configuration protocol because it is mobile and will not connect to other network if an IP is assigned to it. Unlike Laptops, Desktops are not mobile, therefore their IPs shouldn't have to change and it should remain static at all times. The figure 4.8a below shows how to configure a Desktop to static Internet protocol.

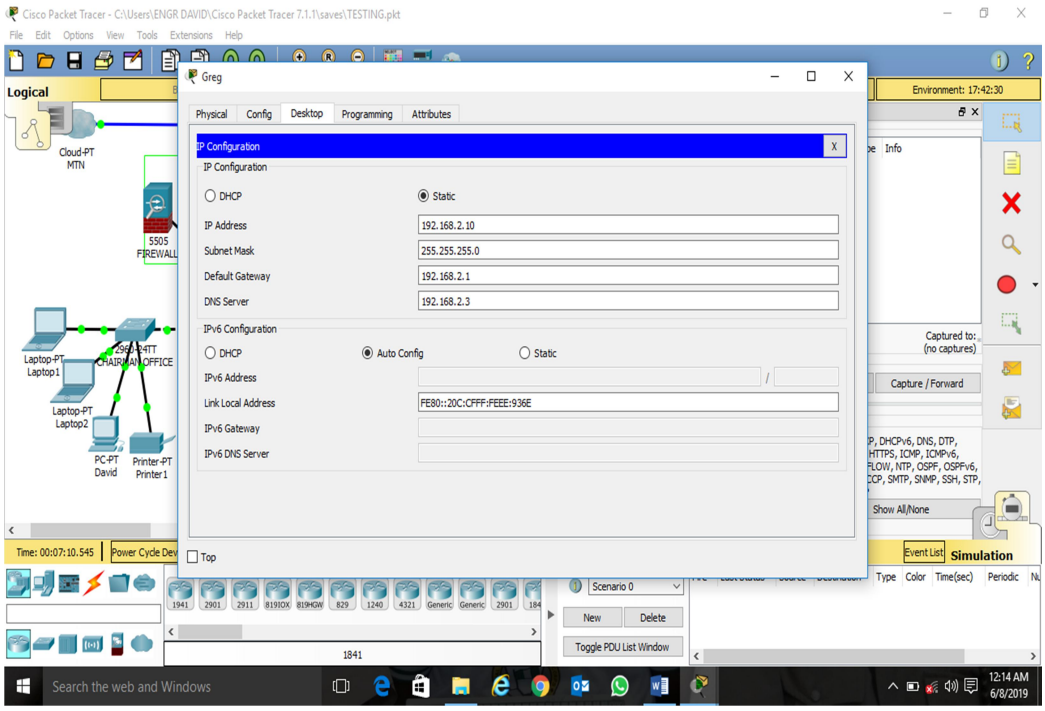


Figure 4.4c Desktop Internet Protocol Configuration

4.5 Network Cabling

To connect devices in Cisco Packet Tracer, first, you need to understand the various types of cables (connections) used to connect network devices. Some of the common types of cables are:

Straight-through: Used to connect different types of devices (devices that use different wiring standards), such as Router-to-Switch and Switch-to-PC.

Cross-over: Used to connect same types of devices, such as router-to-router, PC-to-PC, and switch-to-switch.

Serial DCE: Used to connect router-to-router in a WAN network.

Console: Used to take console (using hyper terminal) of a router on a PC.
To see the various types of connections, click the Connection icon. Spend some time to understand the connections. Once you are familiar with the types of connections, connect the devices to create the network topology.

4.6 Sending and Receiving Packets

Open the activity and click the **Simulation** mode icon in the bottom-right corner of the Packet Tracer window to open the Simulation panel. This is discussed in the subheading below.

4.6.1 Sending Packets

A simple PDU is sent from Laptop1 to GAC Tab, the following occurs;
Create a simple PDU that sends a ping from the Laptop1 to the GAC Tab.

Click the **Add Simple PDU** icon (looks like a closed envelope) in the right pane of the Packet Tracer window. The curser will change to an envelope with a plus sign. Click the Laptop1 first so it will become the source of the ping and then click the GAC Tab so that it will become the destination. This is described in the figure 4.10a below.

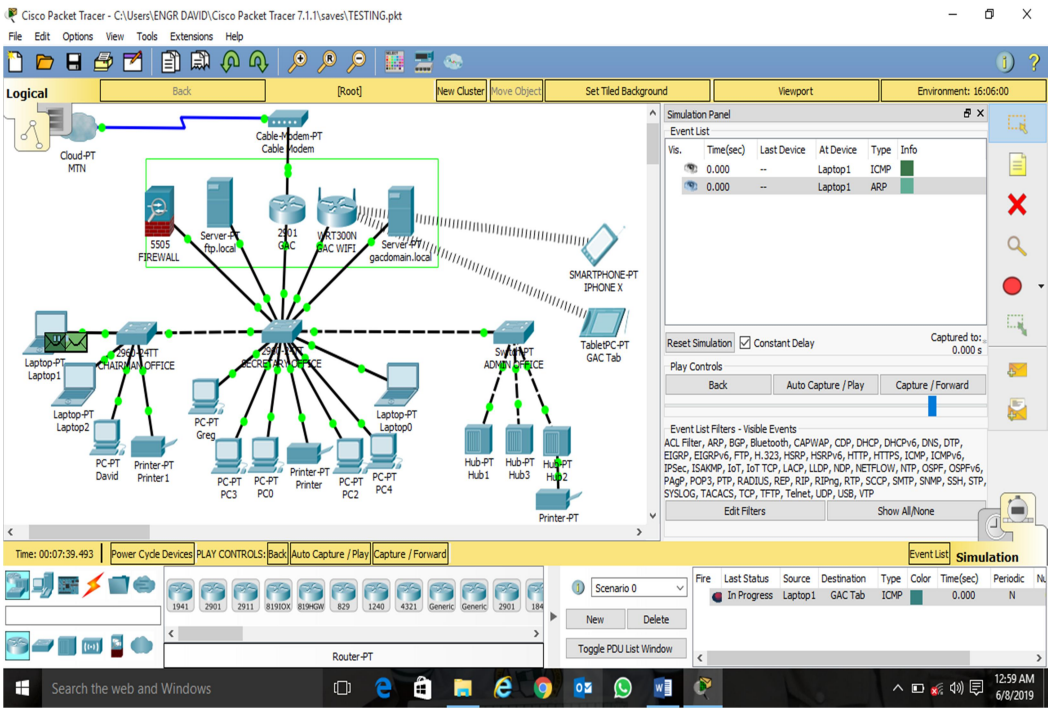


Figure 4.5a Sending Packets

4.7 Sending and Receiving Mails

Mail is sent by configuring the mail on the workstation,
Configure David PC-PT to use the email service.
Click David PC-PT and click the **Desktop** tab > **E Mail**.
Enter the following values into their respective fields:
Your Name: **Ogunlana David**
Email Address: **ogunlanadavid@gacdomain.com**
Incoming Mail Server: **192.168.2.3 or gacdomain.local**
Outgoing Mail Server: **192.168.2.3 or gacdomain.local**
User Name: **ogunlanadavid**
Password: **handle**
Click **Save**. The Mail Browser window displays.
The below figure 4.11a best describe the configuration.

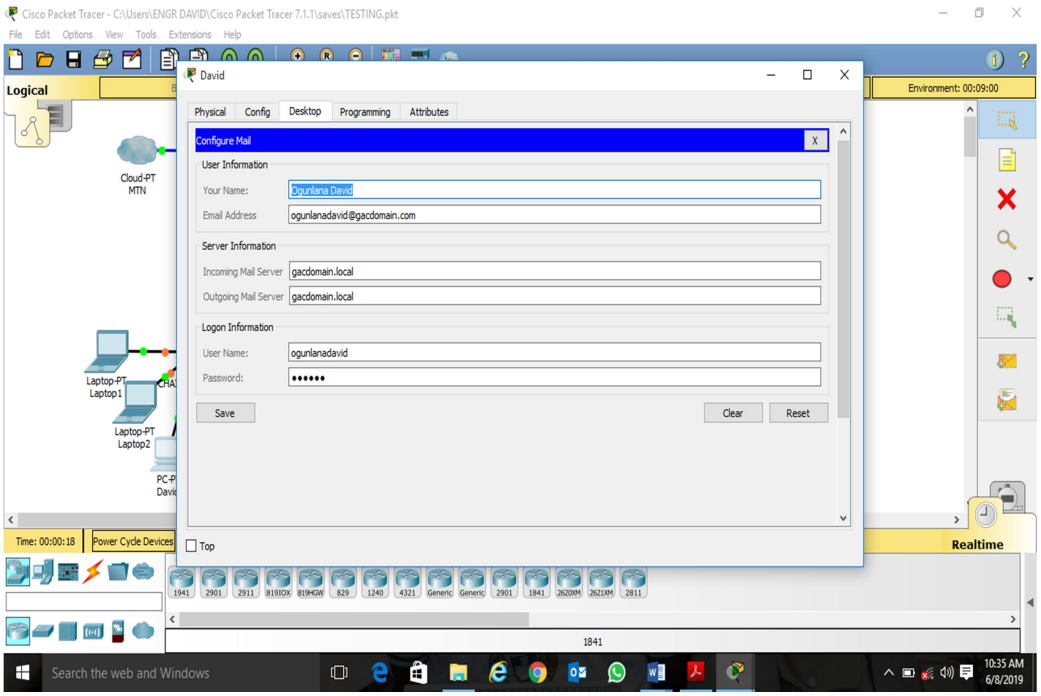


Figure 4.6a Configuring Mail

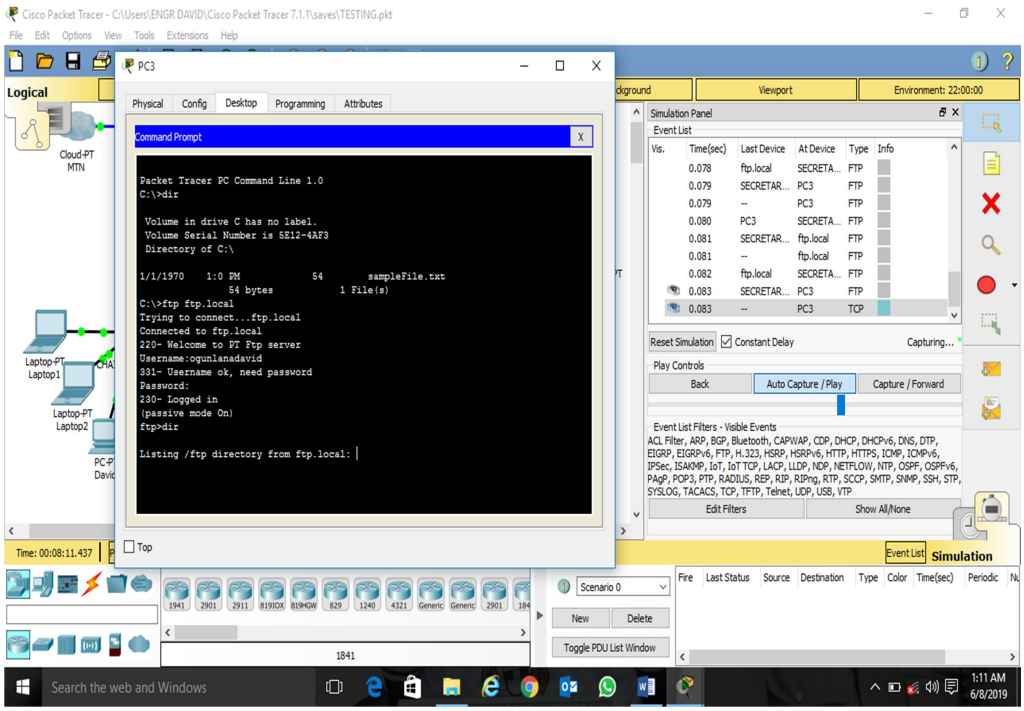


Figure 4.6b: Uploading File in Command prompt

4.7 Results

The following are the findings in this research;

1. File Transfer Protocol has been deployed for Gwagwalada area council to handle file storage and retrieval.
2. Domain name system server has been deployed to control the network and enable effective communication between resources and protocols.
3. Firewall has been configured to Secure and control inbound and outbound traffic on the network.
4. Simple mail transfer protocol has been deployed for Gwagwalada Area council for exchange of information.
5. Gwagwalada area council can carry out task using network and automation which has greatly reduced daily running cost.
6. Citizen satisfaction is keen with the Gwagwalada area council network.

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

Networks are everywhere or so it seems. You can hardly do anything with data that does not involve a network. Like the human networks that we are all part of, computer networks let us share information and resources. In business, the reliance on networks is even more pervasive than in homes or schools. In GAC, the mode of documentation is usually a manual form, which is a vulnerability to the security of confidential data such as employee, citizens and political data. The method of printing and access to information is ambiguous; sometimes an employee will have to leave his/her office to another office just to have a printout which can be easily gotten by sharing resources through network. In this Research, a Local Area Network system is designed for Gwagwalada Area Council that is capable of providing network resources and services (as well as Internet connections if the need be by the organization) to local users and a limited access of network service to public users for Business activities.

Through this networking system, the organization can effectively reduce daily running cost, the organization internal works can be more systematic and well organized, and the communication of the employees in the organization can become more efficient. The network is used to share files, prints and data. Employees can communicate with one another through Mail. Besides, some expensive hardware such as color printer can be shared by a lot of employees. The researcher determined the functional requirements and best topology for the Network system deployed. The implementation of the Local area network was completed using Cisco packet Tracer to simulate the process.

5.2 Conclusion

In this Research, a Local Area Network system has been designed for Gwagwalada Area Council. The design has eradicated the manual form of processing in Gwagwalada Area council. The research will effectively reduce daily running cost in Gwagwalada area council. The organization internal works will be more systematic and well organized, and the communication of the employees in the organization will become more efficient by using the mail server. The network is also used to share file and data through upload and download on the FTP server. Network is very vital in our day to day activities.

5.3 Recommendation

It is recommended that this Research is published to serve as a body of knowledge to be referred to by future and present researchers. It is recommended that this research is deployed in Gwagwalada Area Council for advancement in technology. The following recommendation are also necessary;

- The hardware and software requirement should be met.
- Staff of Gwagwalada area council should have basic knowledge of computer operation, the local Government should budget funds for adequate training of all personnel's and the staff of the Gwagwalada area council should be paid well in order for them to work effectively and yield maximum results.

- The Chairman should employ well educated personnel with right discipline and qualifications to occupy positions to function effectively and improve efforts to serve the nation and mankind better.

The following measures are to be taken to secure the network:

- A strong firewall and proxy to be used to keep unwanted people out.
- A strong Antivirus software package and Internet Security Software package should be installed.
- For authentication, use strong passwords and change it on a weekly/bi-weekly basis.
- When using a wireless connection, use a robust password.
- Employees should be cautious about physical security.
- Prepare a network analyser or network monitor and use it when needed.
- Implementation of physical security measures like closed circuit television for entry areas and restricted zones.
- Security barriers to restrict the organization's perimeter.
- Fire asphyxiators can be used for fire-sensitive areas like server rooms and security rooms.

It is the responsibility of administrators to ensure that data is backed up regularly, stored in a secure location, and that your server is protected with an Uninterruptible Power Supply (UPS) to protect against electrical surges and outages. The researcher can help the organization develop a backup strategy on request, but someone in Gwagwalada area council office should be responsible for ensuring proper implementation and for regularly confirming that your backup procedure is working correctly.

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